ASPECTE PRIVIND INCIDENŢA TRAUMATISMELOR MUSCULO-SCHELETALE LA SPORTIVII DE PERFORMANŢĂ. STUDIU COMPARATIV PE RAMURI SPORTIVE

ASPECTS ON MUSCULO-SKELETAL TRAUMAS IN COMPETITIVE SPORTSMEN. A COMPARATIVE STUDY BETWEEN SPORT BRANCHES

Elena Doina Mircioagă[15]

Key words: sport branches, musculo-skeletal traumas, competitive sportsmen, affected body segment.

Abstract

Aim. The aim of this study is to establish the incidence, frequency and location of musculo-skeletal trauma in the joints at competitive athletes, in a comparison between sport branches, age groups and time spent in training.

Material and method: The study was performed on a batch of 155 sportsmen who practiced athletics, basketball, handball, football and volleyball. The sportsmen were between 13 -42 years old and had been practicing sports for 4-20 years. We recorded and compared the percentage of traumas in the group of athletes, depending on the affected segment, the age groups and the time spent in training, in two periods of time.The study covered three years of competitions, the Z test was applied and considered a significance level $\alpha = 0.05$.

Results. Comparing the percentages between basketball and handball players traumas, we obtained significance for the following segments. Spine, leg, knee, shoulder - traumas in basketball are significantly less ($p=0.014$, $\alpha=0.05$) than in handball. Hand, palm, fist - traumas in basketball ocurring significantly often ($p<0.001$, $\alpha=0.001$) than in handball.

between basketball and volleyball players

Knee and shoulder – traumas in basketball are significantly less ($p<0.001$, $\alpha=0.001$) ($p= 0.003$, $\alpha =0.01$) than in volleyball.

between handball and volleyball players

Hand, palm, fist - traumas in handball are significantly less ($p<0.001$, $\alpha=0.001$) than in volleyball

Conclusions: The performance level and the number of training sessions influenced the high number of traumas that occurred. The extrinsic factors have a strong influence.

Cuvinte cheie: ramuri sportive, traumatisme, sportivi de performantă, segmente afectate.

Rezumat

Scop: Stabilirea incidenţei, frecvenţei şi localizării traumatismelor musculo-scheletale la nivelul articulaţiilor, la sportivii de performanţă, comparativ, între ramuri sporive, pe grupe de varstă şi vechime în sport.

Material si metodă: Studiul a cuprins un lot de 155 de sportivi de performanţă ce practică atletism, baschet, handbal, fotbal, volei. Sportivii au vârste cuprinse între 13-42 de ani, şi o vechime în sport cuprinsă în intervalul 4-20 ani. Am înregistrat şi comparat procentajul traumatismelor sportivilor între ramuri sportive, în funcţie de segmentul afectat, pe grupe de varstă şi vechime în sport pe doua perioade de timp. Studiul s-a derulat pe o perioada de 3 ani competiţionali. S-a aplicat testul Z şi s-a considerat un prag de semnificaţie $\alpha=0,05$.

Rezultate. Comparând procentele traumatismelor între baschetbalişti şi handbalişti, am obţinut semnificaţie pentru următoarele segmente. Coloană vertebrală, gambă, genunchi, umăr, traumatismele fiind semnificativ mai puţine la baschetbalişti ($p=0,014$, $\alpha=0,05$) decât la handbalişti. Mână palmă pumn, traumatismele fiind semnificativ mai multe la baschetbalişti ($p<0,001$, $\alpha=0,001$) decât la handbalişti

între baschetbalişti şi voleibalişti,

- Genunchi, şi umăr traumatismele fiind semnificativ mai puţine la baschetbalişti ($p<0,001$, $\alpha=0,001$) ($p=0,003$, $\alpha=0,01$) decât la voleibalişti.

între handbalişti şi voleibalişti

- Mână-palmă- pumn, traumatismele fiind semnificativ mai puţine la handbalişti ($p<0,001$, $\alpha=0,001$) decât la voleibalişti.

Concluzii: Nivelul de performanţă şi numărul de antrenamente efectuat a influenţat numărul mare de traumatisme înregistrat. Factorii extrinseci au o influenţă mai mare decat cei intrinseci

[15] assoc.prof,PhD,“ Victor Babes” Universit of Medicine and Pharmacy, Department of Physical Education and Sport.
Corresponding author: tel.: 0040723427876, mail address: doinamircioaga@yahoo.ro

Introduction

An injury, irrespective of its cause, may be of critical consequence in a sportsman's life. Hyperfunctional affections are repetitive lesions caused by overstress. They are located at the musculo-skeletal level and affect competitive sportsmen typically. Such lesions occur when a biological tissue (muscle, bone, tendon, ligament etc.) is stressed beyond its physical limits. [1]

The risk of accident is permanent in the competitive sportsman's life and has known ***causes***: too short warm-up periods, faulty training, improper equipment, sport-specific trauma (type of effort, its biomechanical characteristics), aggression on the court, bad courts/grounds, age, years of sports practising, sex, ability, the trainer's pedagogical knowledge and the training methods, the environment and the conditions of training or competitions etc. All this cause variations in trauma incidence percentage, location and type. [2]

Aim

To establish the incidence and location of musculo-skeletal traumas of joints in competitive sportsmen. The study compares different sports, **age groups and longevity in sports practising in two different periods of time, before and after** our intervention in training with specific means (exercise programmes) and injury prevention and rehabilitation methods.

Hypothesis

It's assumed that following the conducted study we can interfere in the training of sportsmen with exercise programmes and specific prevention and rehabilitation methods of sports traumas, according to the following criteria: sport branch, age and gender and sports longevity.

Methods and materials

The study starts from the premise that the high trauma incidence among the studied competitive sportsmen is caused by factors that can be controlled at least partially.

Subjects and Procedure

The study comprised 155 sportsmen (2 female and 103 male) who practiced **track and field (sprint and hurdles), basketball, handball, football and volleyball**. The sportsmen were between 13 and 42 years old and had been practising sports for 4-20 years. The study monitored specific trauma incidence and location, as well as the causes that led to traumas. It covered three competition years, during which the sportsmen were closely monitored.

The statistical processing included:

- the comparison of the average values: the "t" (Student) test was used for pairs of independent batches and a significance (risk) level of 0.005 (5%); the "F" test was used to compare more than two batches (the ANOVA model) [3]
- the regression and statistic correlation: linear regression and the Pearson coefficient;
- the Z test. [4]

- TRAUMA PREVENTION METHODS IN SPORTS THE TRAINING PROGRAMME INCLUDED:

Non-specific exercises for physical fitness
Warm-up exercises typical of every sport
Body strength exercises
Stretching
Post-effort recovery [5]

- METHODS OF RADIO-IMAGERY DIAGNOSIS OF TRAUMAS IN SPORTSMEN:

Radiological examination
CT scan, MRI
Musculo-skeletal ultrasound scans

Results

For a coherent research activity, the studied period of time was separated in two parts:

• The 5 sports were taken into consideration (155 sportsmen (52 female and 103 male). The sportsmen were between 13 and 42 years old and had been practising sports for 4-20 years.

First period

- We contacted the club managers, the coaches, sportsmen, the doctors and the kinetic therapy experts who accompany the sportsmen in competitions.
- The first measurements were taken (anthropometric parameters – height, weight (kg), body mass index (BMI).
- An evidence of trauma incidence, location and number and affected body parts was kept before the exercise programme. The possible method-related mistakes in various moments of training were also recorded.

Second period

- A coherent and complex exercise programme was introduced in the training. It focused on muscle groups and joints that are mostly used in the studied sport games and track and field events.
- The accident causes were determined by adding up the data from the pre-competition examination and tests and from the examination and questioning of the injured sportsmen.
- The sportsmen were monitored both while training and during competitions through different methods (conversation, observation, questionnaires etc). The injured sportsmen were examined imagistically and clinically.

We conducted a prospective-comparative statistical study with the following results:

The comparative (statistical) results of the two studied periods of time:

• The following 5 sports were taken into consideration: basketball, handball, volleyball, track and field and football.

• Traumas were recorded in 11 body parts: forearm, thigh, elbow, spine, face, calf, knee, ankle, hand – palm (PL) fist (FS), foot and shoulder.

• The percentage of trauma and injured sportsmen was compared by sport, sex, age and years of sports practising in the two studied periods.

• The obtained data were compared with the data given in the literature, in an attempt to identify the characteristic of each sport.

Percentage comparisons of traumas in all body parts among the studied sports

The results of the comparisons of trauma percentage by each body part, sport, age groups and years of practising sport in the two periods of time are the following (the Z test was applied and the threshold value $\alpha = 0.05$ was chosen):

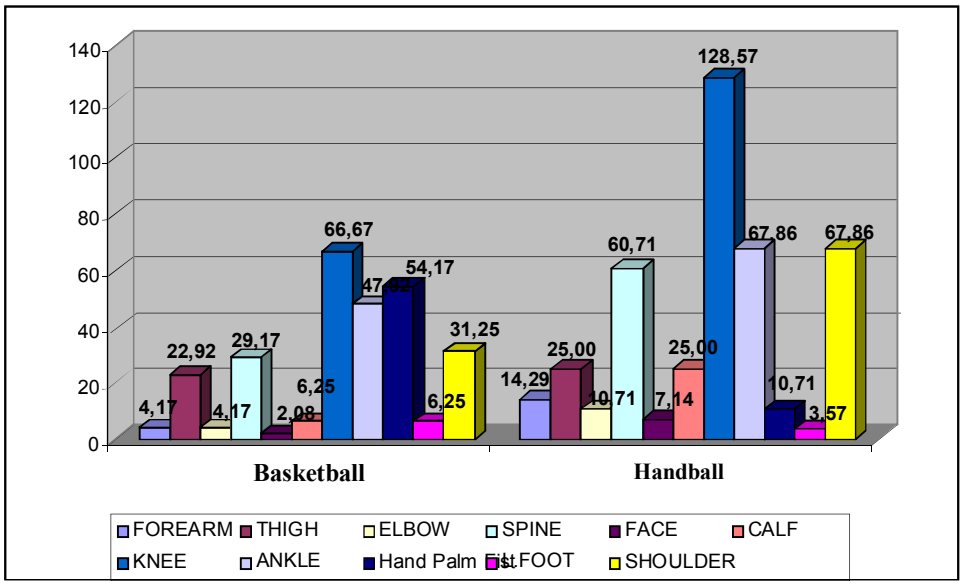


Chart 1 Comparative percentage distribution of traumas by the 11 body parts BASKETBALL–HANDBALL

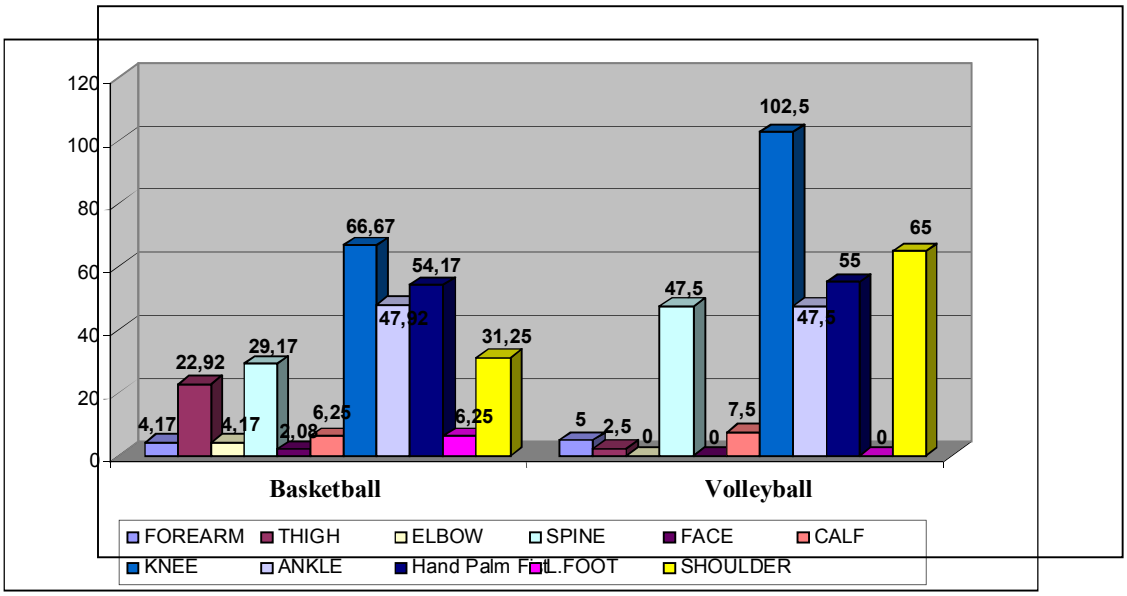
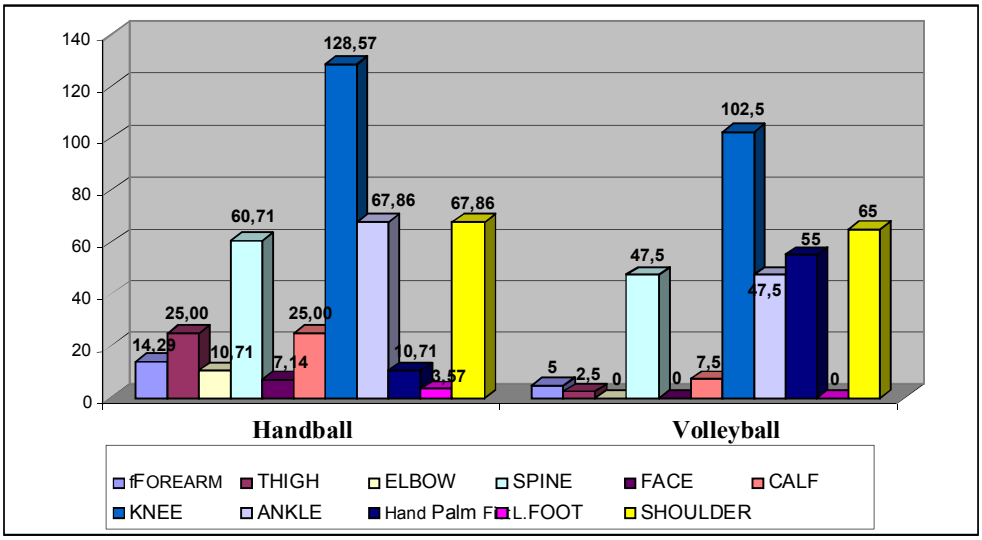


Chart 2 Comparative percentage distribution of traumas by the 11 body parts BASKETBALL – VOLLEYBALL



Graph 3 Chart Comparative percentage distribution of traumas by the 11 body parts HANDBALL – VOLLEYBALL

Table 1. The values given in the table below are the total number of traumas in one body part in relation to the number of portsmen

BODY PARTS	BASKETBALL 48 sportsmen	HANDBALL 28 sportsmen	VOLLEYBALL 40 sportsmen
FOREARM	4.17%	14.29%	5%
THIGH	22.92	25.00	2.5
ELBOW	4.17	10.71	0
SPINE	29.17	60.71	47.5
FACE	2.08	7.14	0
CALF	6.25	25.00	7.5
KNEE	66.67	128.57	102.5
ANKLE	47.92	67.86	47.5
HAND	54.17	10.71	55
FOOT	6.25	3.57	0
SHOULDER	31.25	67.86	65

Table 2. The Z test was used to compare these figures

BODY PARTS	BASKETBALL vs HANDBALL	BASKETBALL vs VOLLEYBALL	HANDBALL vs VOLLEYBALL
FOREARM	0.256^{ns}	0.743 ^{ns}	0.37 ^{ns}
THIGH	0.99 ^{ns}	0.014 ^{s}	0.014 ^{s}
ELBOW	0.529 ^{ns}	0.56 ^{ns}	0.129 ^{ns}
SPINE	0.014^{s}	0.122 ^{ns}	0.408 ^{ns}
FACE	0.63 ^{ns}	0.926 ^{ns}	0.324 ^{ns}
CALF	0.047 ^{s}	0.847 ^{ns}	0.097 ^{ns}
KNEE	0.002 ^{s}	<0.001 ^{s}	0.28 ^{ns}
ANKLE	0.148 ^{ns}	0.861 ^{ns}	0.157 ^{ns}
HAND	<0.001 ^{s}	0.89 ^{ns}	<0.001 ^{s}
FOOT	0.978 ^{ns}	0.308 ^{ns}	0.857 ^{ns}
SHOULDER	0.004 ^{s}	0.003 ^{s}	0.99 ^{ns}

*On comparing the trauma percentage between the **basketball players** and the **handball players**, the following body parts were significant:*

- **Spine – Calf- Knee – Shoulder, significantly less** traumas in basketball players ($p = 0.014$, $\alpha = 0.05$)
- **Hand palm fist, *significantly more*** traumas in basketball players ($p < 0.001$, $\alpha = 0.001$)

*On comparing the trauma percentage between the **basketball players** and the **volleyball players**, the following body parts were significant:*

- **Thigh – *significantly more*** traumas in basketball players ($p = 0.014$, $\alpha = 0.05$)
- **Knee – Shoulder significantly less** traumas in basketball players ($p < 0.001$, $\alpha = 0.001$)

*On comparing the trauma percentage between the **handball players and the volleyball players,** the following body parts were significant:*

- **Thigh – *significantly more*** traumas in handball players ($p=0,014$, $\alpha=0,05$)
- **Hand palm fist – significantly less** traumas in handball players ($p < 0.001$, $\alpha = 0.001$)

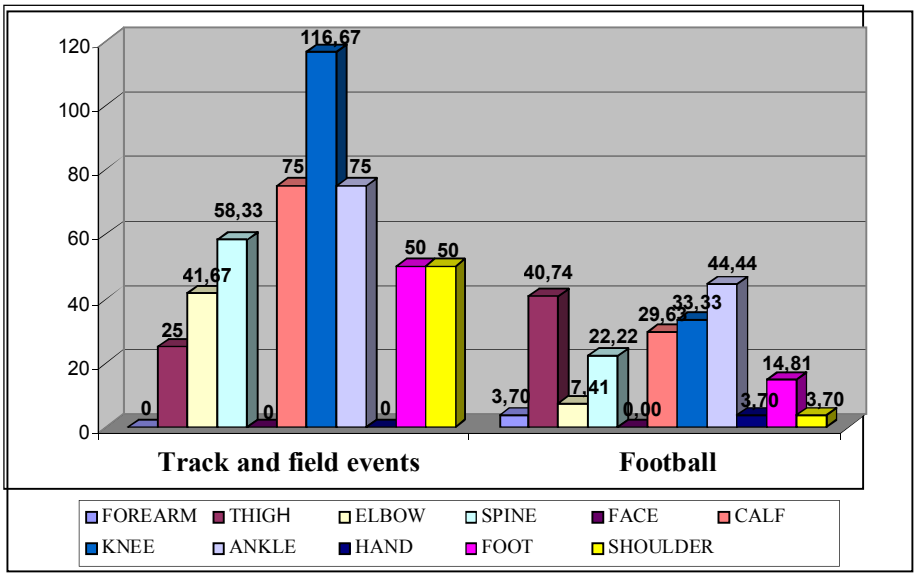


Chart 4. Comparison of trauma distribution in athletes and football players

Table 3. The Z test was used to compare the percentages and the results (p values and significance) are shown in **table 3**.

The comparison between trauma percentages in **athletes** and **football players** had the following significant results:

- elbow – spine -calf – knee- foot – shoulder – significantly less traumas in football players

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- ***The results of the comparison between trauma percentages by body parts and sport in the two periods are given in the following table (the Z test was applied and the significance threshold was α = 0.05):***

Table 4. Comparisons of the trauma percentages in the two periods p value and significance

BODY SEGMENTS	Athletes vs. football players
FOREARM	0.336 ns
THIGH	0.279 ns
ELBOW	0.016 s
SPINE	0.032 s
FACE	0.99 ns
CALF	0.011 s
KNEE	< 0.001 s
ANKLE	0.078 ns
HAND	0.336 ns
FOOR	0.027 s
SHOULDER	0.002 s

INJURED PARTS	Comparisons of the trauma percentages in the two periods p value and significance				
	ATHLETICS	BASKETBALL	FOOTBALL	HANDBALL	VOLLEYBALL
FOREARM	0.99 ns	0.304 ns	0.5 ns	0.702 ns	0.608 ns
THIGH	0.5 ns	0.085 ns	0.034 s	0.147 ns	0.5 ns
ELBOW	0.079 ns	0.237 ns	0.235 ns	0.665 ns	0.99 ns
SPINE	0.206 ns	0.24 ns	0.233 ns	0.296 ns	0.822 ns
FACE	0.99 ns	0.5 ns	0.99 ns	0.5 ns	0.99 ns
CALF	0.332 ns	0.304 ns	0.262 ns	0.028 s	0.608 ns
KNEE	0.001 s	0.02 s	0.007 s	<0.001 s	<0.001 s
ANKLE	0.107 ns	0.106 ns	0.49 ns	0.016 s	<0.001 s
HAND, PALM, FIST	0.99 ns	0.05 ns	0.5 ns	0.134 ns	0.089 ns
FOOT	0.34 ns	0.304 ns	0.034 s	0.471 ns	0.99 ns
SHOULDER	0.2 ns	0.075 ns	0.49 ns	0.206 ns	0.5 ns

The **red** cases indicate major differences, i.e. the number of traumas decreased significantly in the second period compared to the first, with the **exception** of **foot traumas in football**, whose number **increased significantly (p=0,034 α=0,05).**

In athletics, **knee** traumas decreased significantly (p=0,001 α=0,01).

In basketball, **knee** traumas decreased significantly (p = 0.02, α = 0.05).

In football **thigh** (p = 0.034 α = 0,05) and **knee** (p = 0.007, α = 0.01) traumas decreased significantly; however, foot traumas increased **(p = 0,034, α = 0.05).**

In handball, **calf** (p = 0.028, α = 0.05), **knee** (p < 0.001, α = 0.001) and **ankle** (p = 0.016, α = 0.05) traumas decreased significantly.

In volleyball, **knee** and **ankle** (p < 0.001, α = 0,001) traumas decreased significantly in the second period.

Following the inclusion of prevention exercises and the decrease in the number of trauma-causing factors, trauma incidence was reduced significantly in eight body parts and less significantly in three body parts. [6]

COMPARISONS AMONG SPORTS BY AGE GROUPS

Subjects distribution on age groups, in relation to the practised sport and the total number of traumas in that sport

Table 5. To compare the values, the Z test was used. The results are given in the following table:

Age group	BASKETBALL - HANDBALL	BASKETBALL-VOLLEYBALL	HANDBALL - VOLLEYBALL	ATHLETES - FOOTBALL
13-18	< 0,001 s	0,499 ns	< 0,001 s	< 0,001 s
19-22	0,816 ns	< 0,001 s	0,003 s	0,058 ns
23-26	0,012 s	0,208 ns	0,206 ns	< 0,001 s
27-30	0,29 ns	< 0,001 s	< 0,001 s	-
Over 30	0,583 ns	0,309 ns	0,08 ns	-

- ***The differences between the trauma percentage in the two periods, by sport and age groups, are not* significantly.**

COMPARISONS AMONG SPORTS BY YEARS OF SPORT PRACTISING

*Table 6 ** 1st Period*

Years of sport practicing	BASKETBALL - HANDBALL	BASKETBALL-VOLLEYBALL	HANDBALL - VOLLEYBALL	ATHLETES - FOOTBALL
4-6	0.03 s	0.436 ns	0.002 s	0.139 ns
7-10	0.983 ns	0.157 ns	0.14 ns	0.014 s
11-15	0.176 ns	0.294 ns	0.013 s	0.009 s
16-20	0.887 ns	0.99 ns	0.855 ns	0.029 s
> 20	-	0.022 s	0.032 s	-

The most affected groups are the following:

- 7-10 years (43.87%) and 11-15 years (40%), in all sports

*Table 7 ** 2nd Period*

Years of sport practising	BASKETBALL-HANDBALL	BASKETBALL-VOLLEYBALL	HANDBALL - VOLLEYBALL	ATHLETES - FOOTBALL
4-6	0.748 ns	0.228 ns	0.068 ns	0.037 s
7-10	0.427 ns	0.958 ns	0.366 ns	0.158 ns
11-15	0.462 ns	0.988 ns	0.538 ns	0.015 s
16-20	0.647 ns	0.942 ns	0.948 ns	0.316 ns
> 20	-	0.043 s	0.08 ns	-

The most affected groups are the following:

- 7-10 years (43.87%) and 11-15 years (40%) in all sports.

The comparison of the trauma number by groups of years of sport practising was based on the Z test. The values given in the table below show **significantly differences** between trauma percentages among certain groups. *The comparisons were made within the same period and between the two periods*, to identify the groups with the largest number of injured sportsmen and the largest number of traumas.

- *The differences between the trauma percentage in the two periods, by sport and groups of years of sport practising are irrelevant.*

Comparisons by sport of trauma incidence in the studied batch with data from literature

The Z test was applied to compare trauma incidence in the studied batch with trauma incidence in literature. The results are shown in the following table:

Table 8. Comparisons by sport of trauma incidence in the studied batch with data from literature

Sport	% of injured sportsmen Studied batch	% Literature	p value and significance
Track and field (N_1=12) (N_2=16)	**100**	**73%**	**0.083^{ns}**
Basketball (N_1=48) N_2=123)	**87.5**	**61.3%**	**0.002^{s}**
Football (N_1=27) N_2=29)	**88.89**	**85%**	**0.79 ^{ns}**
Handball (N_1=28)N_2=117)	**88.29**	**67%**	**0.037^{s}**
Volleyball (N_1=40)N_2=111)	**97.5**	**63%**	**<0.001^{s}**

- **N1 – no. of sportsmen in the studied batch**
- **N_2 - no. of sportsmen in literature** [6,7,8]
- The differences between the percentage of injured athletes and football players are insignificant.
- Significantly more traumas occurred in the basketball, handball and volleyball players of our batch than in literature.

Discussions

The joint trauma distribution in the studied batch is the following:
• In the handball and volleyball batch, knee joint lesions are much more frequent than in the basketball batch.
• The repeated overstress of the extensor mechanism as a result of repeated jumping affected 67.5% volleyball players, and 43% of the basketball players. [8]
• Studies have shown that in volleyball the highest rate of traumas is associated with blocking and attacking, as both involve jumping.
• A study performed on 116 trauma-suffering sportsmen from 1997 (in the sportive medicine centre) concluded that over 60% of the injuries were caused by jumps.
• The factors favouring accidents are intrinsic and extrinsic. The latter have a higher influence, (the number of training sessions per week, the volume, not the type of training (plyometrics versus overstress). [8].
• Another factor is the type of court. Tough surfaces like concrete increase trauma risk, while polished hardwood floors reduce the ground reaction force.
• In basketball and handball, the most common injuries are knee and ankle sprains which may also lead to meniscal and muscle lesions.
• As far as pathology is concerned, according to this study, the most frequently affected joints in sportive games are the knee, ankle, shoulder, spine, hand (palm-fist), and the knee, shoulder, thigh and calf in track and field. [6]

• Accidents are less frequent in track and fieldthan in football, as both this study and the data in specialised literature show. According to the latter, most lesions occur in athletes (especially hurdlers).
• Every major or moderate trauma was preceded by a minor injury.

Conclusions

The results of our study have revealed a larger number of traumas in the players than the literature of the field. The high trauma incidence is caused by an association of controllable factors:
- insufficient effort capacity
- hypocalcemia
- kyphosis, lordosis
- improperly treated previous traumas
- errors in the training methods

In competitions, sportsmen are subjected to factors that cause accidents and musculo-skeletal traumas. Such external factors lead to unpredictable accidents. The usefulness, necessity and beneficial effects of the prevention programme included in the sportsmen's training were proved.

The performance level and the number of trainings influenced the large number of recorded traumas.

Traumas caused by overstress had a higher incidence than accidental traumas. They accounted for about 73% of the total number of traumas. [8]

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