PALESTRICA OF THE THIRD MILLENNIUM
CIVILIZATION AND SPORT

PALESTRICA MILENIULUI III
CIVILIZAŢIE ŞI SPORT

A quarterly of multidisciplinary study and research

© Published by The "Iuliu Haţieganu" University of Medicine and Pharmacy of Cluj-Napoca
and
The Romanian Medical Society of Physical Education and Sports
in collaboration with
The Cluj County School Inspectorate

A journal rated B+ by CNCS (Romanian National Research Council) since 2007,
certified by CMR (Romanian College of Physicians) since 2003
and CFR (College of Pharmacists of Romania) since 2015

A journal with a multidisciplinary approach in the fields of biomedical science, health, physical exercise, social sciences applied to physical education and sports activities

A journal indexed in international databases:
EBSCO, Academic Search Complete, USA;
Index Copernicus, Journals Master List, Poland;
DOAJ (Directory of Open Access Journals), Sweden

4

Vol. 16, No. 4, October-December 2015

Palestrica of the third millennium – Civilization and sport
Palestrica Mileniului III – Civilizație și Sport
Vol. 16, no. 4, October-December 2015

Editorial Board
Comitetul editorial

Editorial Office of the Journal of
„Palestrica of the Third Millennium”
Civilization and Sport
Street: Clinicilor no. 1
400006, Cluj-Napoca
Telephone: 0264-598575
E-mail: palestrica@gmail.com

pISSN 1582-1943
eISSN 2247-7322
ISSN-L 1582-1943
www.pm3.ro

Contents

Cuprins

Palestrica of the third millennium – Civilization and Sport
Vol. 16, no. 4, October-December 2015, 299–301

EDITORIAL

The Special Olympics-Paralympic Games relationship
Relația Special Olympics-Jocurile Paralimpice

Traian Bocu
"Iuliu Haţieganu" University of Medicine and Pharmacy Cluj-Napoca
Editor-in-Chief of the Palestrica Mileniului III journal
Vice-President of the Romanian Medical Society of Physical Education and Sport
traian_bocu@yahoo.com

Disabilities can be classified into six main categories: *motor disabilities*; *sensory disabilities*; *intellectual disabilities*; *mental disabilities*; *cognitive disabilities*; *associated disabilities* (several associated severe disabilities). This classification is subject to changes.

The problem of improving social inclusion for people affected by such disabilities through physical activities and sports competitions has been posed. Thus, the Special Olympics World Games on the one hand, which deal with intellectual disabilities, and the Paralympic Games on the other hand are the highest level competitions that currently exist.

The Special Olympics World Games are an international competition for persons with intellectual disabilities, organized by the Special Olympics Organization (1). Intellectual disabilities refer to significant limitations in learning, thinking, problem solving and in the development of activities of daily living skills. All people with intellectual disabilities are capable of learning and having a normal daily life which includes the ability to communicate effectively, to interact with others and the capacity of self-care (2).

Special Olympics is the world's largest sports organization for children and adults with intellectual disabilities, which provides competitions throughout the year with the participation of over 4.5 million athletes from 170 countries. Special Olympics competitions take place every day at local, regional, national and international level, amounting to more than 94,000 events a year. The Special Olympics Organization (like the International Paralympic Committee) is recognized by the International Olympic Committee. However, unlike the Paralympic Games, the Special Olympics World Games are not held in conjunction with the Olympic Games, and regional Special Olympics Committees are not modeled on the structure of national Olympic Committees.

The Special Olympics World Games alternate between Summer and Winter Games. They take place every two years, halfway between two Olympic Games (3).

The Special Olympics Foundation in Romania was created in November 2003, as an integrated part of the worldwide Special Olympics sports movement, initiated in 1968 by Eunice Kennedy Shriver, sister of the American president John F. Kennedy. This organization contributes to the social inclusion of people with intellectual disabilities, offering them the chance to discover and develop their sports potential and skills by means of training programs and competition events, organized throughout the year. The most recent Special Olympics Summer event in which Romania also participated was the Special Olympics World Summer Games 2015 for children with intellectual disabilities, which took place in Los Angeles, between 25 July and 2 August. The Romanian team included 29 athletes who participated in swimming, artistic gymnastics, bocce, table tennis, unified football and athletics (4). The next Special Olympics World Summer Games, the 15th edition, will be held in 2019, in a location that has not yet been established. Australia, Germany and South Africa have offered to host the Games.

The most recent Special Olympics World Winter Games took place in Pyeongchang, South Korea, in the period 29 January - 5 February 2013, and the next Special Olympics World Winter Games, the 11th edition, will be held in Graz and Schladming, Austria, between 14-25 March 2017.

In addition to the Special Olympics World Games and the Paralympic Games, there are also World Games for people with hearing loss - Deaflympics.

On the other hand, the Paralympic Games are a major international multi-sport event, which involves athletes with a range of physical disabilities requiring the assignment of athletes to different adapted sports and subcategories of impairments. Given the wide variety of impairments of Paralympic Games athletes, there are several categories in which the athletes compete. Disabilities are divided into ten categories. These categories are further divided into classifications that differ from one sport to another (5). Visually impaired people are included in Paralympic Games.

There are Winter and Summer Paralympic Games, which since the 1988 Summer Olympic Games in Seul, South Korea, have been held right after the Olympic Games. All Paralympic Games are regulated by the International Paralympic Committee (IPC). The next Paralympic Games will take place in 2016, in Rio de Janeiro, after the OG.

Historically, the Paralympic Games developed from a small competition for British veterans after the Second World War, in 1948, which turned into one of the greatest international sports events at the beginning of the 21st century. The first paralympic sports competitions in 1948 were intended for athletes in wheelchairs, in parallel to the Olympic Games. After 1960, Paralympic Games were organized on a regular basis; since 1992, these have been held three weeks after the Summer Olympic Games, in the same location. The first Winter Paralympic Games were organized in Sweden in 1976 (6).

Romania's first participation in the Paralympic Games dates back to the summer edition, in 1972, which was held in Heidelberg (Federal Republic of Germany). Romanian representatives participated in this competition only 24 years later, in 1996, in Atlanta (USA). Romania won three medals in the history of the Paralympic Games, all of which were won by Carol-Eduard Novak, in cycling. The athlete won the gold medal in the Men's Individual C4 Pursuit at the Paralympic Games in London (2012) and other two silver medals.

The first competition organized for disabled athletes, which coincided with the Olympic Games, took place on the opening day of the 1948 Summer Olympic Games in London (7). Paralympic bodies make efforts to obtain the recognition of equal treatment to that of Olympic athletes without disabilities; however, there is currently a great difference between the financing of Olympic and Paralympic athletes.

The social attention paid to Special Olympics and Paralympic athletes and the efforts made for their inclusion through organized sports activities are highlighted by many scientific studies published in specialized international and Romanian journals (Stănescu, 2009; Croitoru, 2010; Bota et al., 2014; Teodorescu et al., 2007).

The extension of the Special Olympics and Paralympic areas and the need for social inclusion of the members of these disabled categories through sports activities raise the problem of training specialists responsible for the education and training of persons with disabilities, as well as for the organization of specific competitions.

We suggest an intensification of efforts to introduce courses focused on disability issues for students of physical education faculties.

***

Dizabilităţile pot fi clasificate în şase mari categorii: *dizabilitatăţi motorii*; *dizabilităţi senzoriale*; *dizabilităţi intelectuale*; *dizabilităţi psihice*; *dizabilităţi cognitive*; *dizabilităţi asociate* (mai multe dizabilităţi grave asociate). Clasificarea nu este fixă.

Se pune problema ameliorării integrării sociale, a unui procent cât mai mare dintre persoanele afectate de unele din aceste dizabilităţi, prin intermediul activităţilor fizice şi sportive competiţionale organizate. Astfel, la cel mai înalt nivel, există Jocurile Mondiale Special Olympics (Special Olympics World Games), pe de o parte, care se ocupă de dizabilităţile intelectuale şi Jocurile Paralimpice (Paralympic Games), pe de altă parte.

Jocurile Mondiale Special Olympics sunt un concurs internațional sportiv adresat persoanelor cu dizabilități intelectuale, organizat de Organizaţia Special Olympics (1). Dizabilităţile intelectuale se referă la limitări semnificative în procesul de învățare, gândire, rezolvare a problemelor şi de dezvoltare a abilităților de viață de zi cu zi. Toate persoanele cu dizabilități intelectuale sunt capabile de învățare şi pot desfăşura o viață normală de zi cu zi, cum ar fi posibilitatea de a comunica eficient, de a interacţiona cu ceilalţi şi de a avea capacitatea de autoingrijire (2).

Special Olympics este cea mai mare organizaţie din lume de sport pentru copii şi adulţi cu dizabilităţi intelectuale, care asigură formarea pe tot parcursul anului concursuri care cuprind mai mult de 4,5 milioane de sportivi din 170 de țări. Competiții Special Olympics au loc în fiecare zi, toate în jurul valorii de concursuri locale, naționale și regionale, inclusiv mondiale, totalizând mai mult de 94000 de evenimente pe an. Organizația Special Olympics (ca și Comitetul Internațional Paralimpic) este recunoscută de către Comitetul Internațional Olimpic. Cu toate acestea, spre deosebire de Jocurile Paralimpice, Jocurile Mondiale Special Olympics nu sunt în directă legătură cu Jocurile Olimpice, iar Comitetele regionale Special Olympics nu sunt modelate pe structura Comitetelor olimpice naționale.

Jocurile Mondiale Special Olympics alternează: de vară și de iarnă. Jocurile Mondiale Special Olympics au loc o dată la doi ani, având în vedere alternanţa vară-iarnă, la jumătatea intervalului dintre Jocurile Olimpice (3).

Fundaţia Special Olympics din România a fost înființată în noiembrie 2003, ca parte integrantă a mişcării sportive internaţionale Special Olympics, iniţiată în 1968 de Eunice Kennedy Shriver, sora preşedintelui american John F. Kennedy. Această organizaţie contribuie la integrarea socială a persoanelor cu dizabilităţi intelectuale, oferindu-le şansa de a-şi descoperi şi dezvolta potenţialul şi calităţile sportive prin intermediul programelor de pregătire şi a evenimentelor competiţionale, organizate pe tot parcursul anului. Cel mai recent eveniment Special Olympics de vară la care a luat parte şi România au fost Jocurile Mondiale de vară Special Olympics 2015 (Special Olympics World Summer Games 2015), pentru copiii cu dizabilități intelectuale din lume; evenimentul a avut loc în perioada 25 iulie - 2 august în Los Angeles. Echipa României a participat cu un număr de 29 sportivi, care au concurat la înot, gimnastică artistică, bocce, tenis de masă, fotbal unificat şi atletism (4). Următoarele Jocurile Mondiale de vară Special Olympics, ediţia a XV-a, vor avea loc în anul 2019, locaţia nu a fost încă stabilită. Au depus oferte Australia, Germania, Africa de Sud.

Cele mai recente Jocuri Mondiale de Iarnă Special Olympics (Special Olympics World Winter Games) au avut loc în Pyeongchang, Coreea de Sud în perioada 29 ianuarie - 5 februarie 2013, iar următoarea ediţie de iarnă, a XI-a, va avea loc la Graz și Schladming, Austria în perioada 14-25 martie 2017.

În afară Jocurile Mondiale Special Olympics şi Jocurile Paralimpice, există separat Jocuri Mondiale pentru persoanele cu deficiențe de auz (Deaflympics).

Jocurile Paralimpice, pe de altă parte constituie un eveniment internațional major polisportiv, care implică sportivi cu o gamă de dizabilități fizice, care impun desfăşurarea competiţiilor pe ramuri de sport adaptate şi

pe subcategorii de handicapuri. Având în vedere marea varietate de handicapuri pe care sportivii Jocurilor Paralimpice le au, există mai multe categorii în care sportivii concurează. Dizabilitățile admisibile sunt defalcate în zece categorii. Aceste categorii sunt defalcate în continuare în clasificări, care diferă de la sport la sport (5). Persoanele cu deficienţele de vedere se includ Jocurilor Paralimpice.

Există Jocuri Paralimpice de iarnă și de vară, care începând din 1988, de la Jocurile Olimpice de vară de la Seul, Coreea de Sud, se desfășoară imediat după Jocurile Olimpice. Toate Jocurile Paralimpice sunt reglementate de către Comitetul Paralimpic Internațional (IPC). Următoarele Jocuri Paralimpice vor avea loc anul viitor 2016, la Rio de Janeiro, în continuarea JO. În istoria lor, Jocurile Paralimpice s-au dezvoltat pornind de la o mică adunare de veterani britanici după al doilea război mondial, în 1948, pentru ca pe parcurs să devină una dintre cele mai mari evenimente sportive internaționale de la începutul secolului 21. Primele competiții sportive paralimpice au avut loc pentru sportivi în fotolii rulante în anul 1948, paralel cu Jocurile Olimpice. După 1960, au fost organizate in mod regulat Jocuri Paralimpice, iar începând din anul 1992 ele se desfășoară la trei săptămâni după Jocurile Olimpice de vară, în aceiași locaţie cu acestea. Primele Jocuri Paralimpice de iarnă s-au organizat în Suedia, în anul 1976 (6).

Prima participare a României la Jocurile Paralimpice a fost la ediția de vară, în 1972, la Heidelberg (Republica Federală Germania). Reprezentanții României au participat în competiție abia 24 de ani mai târziu, în 1996, la Atlanta (SUA). România a câștigat trei medalii în istoria Jocurilor Paralimpice, toate fiind câștigate de Carol-Eduard Novak, la ciclism. Sportivul a câștigat medalia de aur la proba urmărire C4 pe pistă, la Jocurile Paralimpice de la Londra (2012) și încă două medalii de argint.

Prima competiție organizată pentru sportivii cu dizabilități, care a coincis cu Jocurile Olimpice, a avut loc în ziua de deschidere a Jocurilor Olimpice de Vară de la Londra, din 1948 (7). Organismele Paralimpice depun eforturi pentru a obţine recunoaşterea unui tratament egal cu sportivii olimpici fără handicap, dar cu toate acestea, în momentul de faţă există un decalaj mare între finanțarea sportivilor Olimpici și sportivilor Paralimpici.

Atenţia acordată din partea societăţii pentru categoriilor de sportivi Special Olympics şi Paralympics şi eforturile de incluziune a acestora prin activităţi sportive organizate, este oglindită în numeroase cercetări ştiinţifice publicate în reviste străine şi româneşti de specialitate (Stănescu, 2009; Croitoru, 2010; Bota et al., 2014; Teodorescu et al., 2007).

Având în vedere amplitudinea domeniilor Special Olimpycs şi Paralimpic şi nevoia de incluziune socială a membrilor acestor categorii cu dizabilităţi prin activităţi sportive, ridică problema formării specialiştilor care să se ocupe de educarea şi pregătirea cetăţenilor cu dizabilităţi, precum şi organizarea competiţiilor cu profil specific.

Sugerăm intensificarea eforturilor în direcţia introducerii unor cursuri pentru studenţii de la facultăţile de educaţie fizică, axate pe problematica dizabilităţilor.

References

Bota A, Teodorescu S, Şerbănoiu S. Unified Sports - A Social Inclusion Factor in School Communities for Young People with Intellectual Disabilities. Procedia-Social and Behavioral Sciences. 2014;17:21-27.

Croitoru D. Volei - sport adaptat persoanelor cu nevoi speciale. Sesiunea internaţională de comunicări ştiinţifice „Promovarea sportului şi educaţiei fizice ca parte integrantă în formarea tinerilor". ASE Bucureşti, 23.04.2010:303-308.

Stănescu M. Curriculum design in adapted and inclusive physical education. Palestrica of the Third Millennium - Civilization and Sport. 2009;3(37):324-330

Teodorescu S, Bota A, Stănescu M. Activităţi fizice adaptate pentru persoanele cu deficienţe senzoriale, mintale şi defavorizate social. Ed. Printech, Bucureşti, 2007.

Websites

(1) (https://en.wikipedia.org/wiki/Special_Olympics_World_Games). Accessed in September 2015.
(2) (https://www.lds.org/topics/disability/list/intellectual-disability?lang=eng). Accessed in September 2015.
(3) https://en.wikipedia.org/wiki/Special_Olympics. Accessed in September 2015.
(4) http://www.stiriong.ro/ong/sport-si-recreere/delegatia-de-sportivi-special-olympics-r. Accessed in September 2015.
(5) https://en.wikipedia.org/wiki/Paralympic_Games. Accessed in September 2015.
(6) https://ro.wikipedia.org/wiki/Jocuri_Paralimpice. Accessed in September 2015.
(7) http://www.agerpres.ro/flux-documentare/2014/03/18/istorii-ale-competitiilor-participarea-romaniei-la-jocurile-paralimpice-17-24-06. Accessed in September 2015.

Palestrica of the third millennium – Civilization and Sport
Vol. 16, no. 4, October-December 2015, 302–307

ORIGINAL STUDIES
ARTICOLE ORIGINALE

Characteristics of somatosensory evoked potentials in athletes

Caracteristicile potenţialelor evocate somestezice la sportivii de performanţă

Denisa Enescu Bieru [1], Germina Cosma [2], Mihai Dragomir [1], Mihnea Marin [3], Mirela Lucia Calina [1], Ligia Rusu [1]

[1] Faculty of Physical Education and Sport, Kinesiotherapy and Sports Medicine Department, University of Craiova, Romania
[2] Faculty of Physical Education and Sport, Theory and Methods of Motor Activities Department, University of Craiova, Romania
[3] Faculty of Mechanics, Applied Mechanics Department, University of Craiova, Romania

Abstract

Background. In the literature, the descriptions of the somatosensory system's physiological characteristics in athletes, using somatosensory evoked potentials, are very few.

Aims. The aim of our study was to discover possible characteristics of somatosensory evoked potentials (SEP) in athletes, appertaining to different sport categories: fencing, volleyball, and handball. By measuring some SEP wave parameters (latencies and intervals) and comparing the obtained results, we wanted to emphasize the cortical functional plastic changes induced by specific training and to draw a characteristic neurophysiologic pattern for each studied sport.

Methods. The studied group was formed by 15 professional sportsmen, males, aged between 15 and 23 years, who had practiced professional sport for at least 5 years. By using the Nihon-Kohden MEP 150 device, SEP obtained by stimulating (electric stimuli of an intensity superior by 3-4 mA to the motor threshold, a duration of 0.2 ms and a frequency of 3 Hz) the median nerve at the radiocarpal joint were recorded bilaterally, successively.

Results. SEP waves' (P14, N20, P22-25, N25-30, P35, N40, P45) latencies and the intervals P14-N20 and N20-P25 were measured. Analysis of obtained results did not show statistical significant differences for latencies and interval values of SEP waves. Pearson test revealed a similar neurophysiologic pattern for P35 and N40 waves, when stimulating the right and also, left hand.

Conclusions. Although for the majority of SEP parameters there were no statistically significant differences, some correlations for P14, P35, N40, waves generated by the association cortex, were considerably changed by the functional plastic processes induced by performance sports.

Keywords: somatosensory evoked potentials, fencing, volleyball, handball.

Rezumat

Premize. În literatura de specialitate, descrierile caracteristicilor fiziologice ale sistemului somatosenzitiv la sportivii de performanţă, cu ajutorul PES, sunt foarte puţine.

Obiective. Obiectivul studiului nostru a constat în evidenţierea posibilelor caracteristici ale potenţialelor evocate somestezice la sportivii de performanţă, aparţinând diferitelor ramuri sportive: scrimă, volei, handbal, prin măsurarea unor parametri (latenţe şi intervale) ale acestora şi compararea rezultatelor obţinute, pentru a sublinia modificările plastice funcţionale corticale, induse de antrenamentul specific şi a contura un profil neurofiziologic caracteristic fiecărui sport studiat.

Metode. Grupul de studiu a fost format din 15 sportivi de performanţă, băieţi, cu vârste între 15 şi 23 ani şi experienţă în ramura sportivă practicată, de cel puţin 5 ani. Cu ajutorul dispozitivului Nihon-Kohden MEP 150 s-au înregistrat PES, obţinute prin stimularea (stimuli electrici cu o intensitate superioară cu 3-4 mA pragului motor, o durată de 0,2 ms şi o frecvenţă de 3 Hz) nervului median la nivelul articulaţiei radiocarpiene, bilateral, succesiv.

Rezultate. Au fost măsurate latenţele undelor PES (P14, N20, P22-25, N25-30, P35, N40, P45) şi intervalele P14-N20 şi N20-P25. Analiza rezultatelor obţinute nu a evidenţiat diferenţe semnificativ statistice ale valorilor latenţelor şi intervalelor

Received: 2015, October 20; *Accepted for publication:* 2015, November 10;
Address for correspondence: Faculty of Physical Education and Sport, Craiova, Brestei Str. No. 156, 200207, Romania, Phone 0040-251-422743
E-mail: ligiarusu@hotmail.com
Corresponding author: Ligia Rusu; ligiarusu@hotmail.com

undelor PES. Testul Pearson a relevat, un pattern neurofiziologic similar, pentru undele P35 şi P40, atât în cazul stimulării mâinii drepte, cât şi celei stângi.

Concluzii. Deşi majoritatea parametrilor PES nu au diferit semnificativ statistic, totuşi, câteva corelaţii au fost remarcate pentru undele P14, P35, N40, unde generate de cortexul de asociaţie, semnificativ modificate de procesele plastice funcţionale, induse de sportul de performanţă.

Cuvinte cheie: potenţiale evocate somestezice, scrimă, volei, handbal.

Introduction

Somatosensory evoked potentials (SEP) represent the bio-electrical response generated by the stimulation of a peripheral nerve, thus being a common investigation of the nervous system, with applicability in physical effort physiology, a method for exploring the somatosensory system influx conduction, characterised by a large participation of proprioceptive receptors, which are significantly involved in professional effort.

Paraclinical investigations through evoked potentials have earned a well deserved place in human pathology, both by participating in establishing a diagnosis and by objectively tracking the evolution of the disease and the efficiency of therapy in neurological, ophthalmologic, endocrinological, internal and recovery medicine, otorhinolaryngology and plastic surgery (Christopher et al., 2012; Cruccu et al., 2008; Houlden et al., 2010; Hu et al., 2011; Makarov et al., 2012; Tremblay et al., 2011; Yiming et al., 2013).

In the literature, the descriptions of the somatosensory system's physiological characteristics in athletes, using somatosensory evoked potentials, are very few (Babiloni et al., 2010; Chen et al., 2008; Cruccu et al., 2008; Kido & Stein, 2004; Koya et al., 2013; Matsumoto et al., 2006; Murakami et al., 2008; Sehm et al., 2012).

This is why the aim of our study was to discover possible characteristics of somatosensory evoked potentials (SEP) in athletes, appertaining to different sport categories: fencing, volleyball and handball.

We compared the results obtained by the three groups of sportsmen, without including a group of sedentary subjects, as the somatosensory cortex undergoes specific plastic modifications induced by physical training (Murakami et al., 2008; Zwierko, 2008).

Literature data gathered from this area of interest shows the absence of significant differences between SEP parameters determined in high performance sportsmen (gymnasts, athletes) when compared with tested athletes and with sedentary people (Bulut et al., 2003; Iwadate et al., 2005).

For the present study, the mentioned sports were selected, according to the different use of the upper limbs during training: volleyball players use the most part of their upper limbs, fencers use one upper limb predominantly, and handball players use both upper and lower limbs intensely.

Hypothesis

Long periods of sports activity induce plastic cortical changes, characteristic of each athlete, through the repetitive character of the specific set of movements of each sport, as demonstrated in long-term experimental exercises. So, it is possible to create a characteristic electrophysiological pattern, in concordance with the type of the practiced physical activity, in which case this can be discovered through clinical neurophysiologic tests.

Material and methods

The research was carried out in compliance with the principles of ethics covered by the Declaration of Helsinki and Law No. 206/2004. The research was approved by the Ethics Committee of the University of Craiova – Research Centre for Human Body Motricity (REB-875-15). All subjects included in the study gave their written informed consent to participate in the research.

Research protocol

a) Period and place of the research

The research was performed during 2009-2013, at the Research Centre for Human Body Motricity of the Faculty of Physical Education and Sport Craiova.

b) Subjects and groups

The studied subjects were represented by 15 professional sportsmen, males, aged between 15 and 23 years, who had practiced professional sport for at least 5 years, divided into three groups: 5 fencers, 5 volleyball players and 5 handball players.

c) Tests applied

SEP responses were recorded, obtained by successive and bilateral stimulation of the median nerve (Balzamo et al., 2004; Montain & Tharion, 2010) at the radiocarpal joint (Fig. 1).

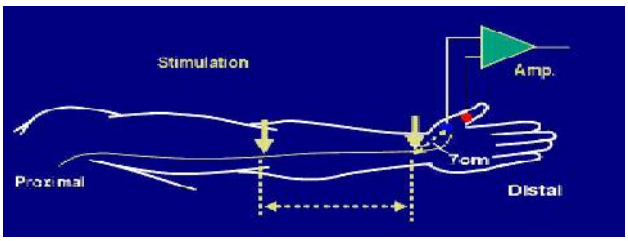


Fig. 1 – Median nerve electric stimulation.

The evoked potentials were obtained by using a Nihon-Kohden MEP 150 device, which can be used both for electromyography and for determining evoked potentials (Van't Ent et al., 2010). Stimulation was made by using electric stimuli, with an intensity superior by 3-4 mA to the motor threshold, a duration of the stimulus of 0.2 ms and a stimulation frequency of 3 Hz (Sehm et al., 2012). The response was recorded with low frequency filters of 10 Hz and a high frequency of 5000 Hz (Gobbele et al., 2007; Lin et al., 2009; Murakami et al., 2008).

The evoked potential was obtained with the help of surface electrodes placed on the head, according to the 10-20 system of electroencephalography (Fig. 2).

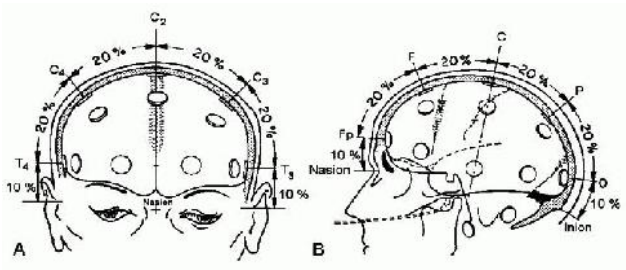


Fig.2 – 10-20 system of EEG electrodes placed on the head.

The reference electrode was the Fz electrode and the recording electrodes were placed contralateral to the stimulation area, at 2 cm posterior of C3 (C3') and C4 (C4'), respectively (Lupescu et al., 2006).

For extracting the evoked potential from the electroencephalographic source line, the averaging method was used, by summing 250-300 evoked responses.

Lines showed wave components from P14 to P45 (P14-15, N20, P22-25, N25-30, P35, N40, and P45), for which latencies, amplitudes and different intervals between maximum points were computed.

Due to the multitude of results obtained, of all these possibilities we retained for subsequent statistical processing only the latencies of the mentioned waves and intervals P14-N20 and N20-P25, which represent intracranial conduction.

d) Statistical processing

The Pearson test and Student test were used for statistical processing.

Results

SEP waves' (P14, N20, P22-25, N25-30, P35, N40, P45) latencies and the intervals P14-N20 and N20-P25 were measured. By processing the values obtained by measuring the characteristic SEP component parameters, we recorded the results presented in Table I.

The analysis of these values shows the fact that the waves' average latency obtained by stimulating the right hand was higher than that obtained for the left hand, although all subjects were right handed. Also, it is noteworthy that the differences between the parameters obtained by stimulating both limbs were statistically insignificant and by analysing statistical correlation, a positive relationship of the latencies from both limbs was shown only for P14 (cervicobulbar conduction), for wave latencies obtained by extralemniscal conduction and in other cortical areas than the specific one, as shown in Table II.

Characterising the parameters recorded for the group of sportsmen belonging to the same sports category was one of the goals of this study, which is why a separate analysis of these subgroups of subjects was made.

When analysing the group of handball players, we obtained the average values of the SEP component waves' latencies presented in Table III.

Like the values of the entire studied group, the waves' latencies obtained by stimulating the right hand were slightly higher compared with those for the left hand, though the differences were statistically insignificant, and the same correlation pattern was obtained for the group of handball players (H); there was one exception, a negative correlation for the P23-25 wave, unidentifiable for the entire studied group (Table IV).

For the group of fencers (F), latencies belonged to the same interval, with the mention that for right-left differences only P14 and P45 had higher values for the stimulation of the right hand. The other SEP components presented lower values for the stimulation of the right hand, compared to those obtained by stimulating the left hand, which was only

Table I

Values of SEP component parameters for the entire group.

SEP - hand		P14-15	N20	P22-25	N25-30	P35	N40	P45
Right hand	Average	17.12	20.13	22.85	25.57	30.78	34.39	38.97
	Std. deviation	1.39	0.74	0.90	1.13	2.42	3.57	3.08
Left hand	Average	16.92	20.05	22.63	25.35	30.40	34.16	38.34
	Std. deviation	0.84	0.92	1.03	1.33	2.69	2.94	2.62

Table II

Differences between SEP parameters and Pearson correlation coefficient values for the entire group.

Right-left differences	P14-15	N20	P22-25	N25-30	P35	N40	P45
P value	**0.65**	0.80	0.55	0.63	**0.69**	**0.86**	**0.56**
Pearson correlation coefficient	**0.79**	**0.07**	**-0.13**	**-0.02**	**0.95**	**0.94**	**0.93**

Table III

Mean and standard deviation values of SEP parameters for the group of handball players

SDV-SEP		P14-15	N20	P22-25	N25-30	P35	N40	P45
Right hand	Average	17.08	19.92	22.43	24.83	31.27	34.98	39.90
	Std. Dev	0.81	0.59	0.85	1.48	3.59	4.12	2.90
Left hand	Average	17.55	20.43	23.20	25.87	31.75	35.00	40.02
	Std. Dev	1.21	0.58	0.90	0.73	3.00	4.79	3.12

Table IV

Differences between SEP parameters and Pearson correlation coefficient values for the group of handball players.

Right-left differences	P14-15	N20	P22-25	N25-30	P35	N40	P45
P value	**0.65**	0.80	**0.55**	0.63	**0.69**	**0.86**	**0.56**
Pearson correlation coefficient	**0.53**	-0.41	**-0.67**	-0.46	**0.93**	**0.97**	**0.96**

found in this sports category (Table V).

During our testing, however, all right-left differences were statistically insignificant, and the same correlation pattern was evidenced for this group, with the exception of the P45 wave (Table VI).

Statistical analysis made for the group of volleyball players (V) revealed values showing no statistical difference for the right-left correlation, and there was a positive correlation of all identified wave latencies, with the mention that this aspect was only found in this tested group (Table VII).

By comparing the values of latencies obtained for SEP components from the subgroups representing the tested sports, a positive correlation was evidenced only in the case of latencies for the N40 wave.

A negative correlation was found for the P35 wave by statistical comparison of H-V and V-F. The same latency of P35 for the H-S correlation showed a positive value, differentiating the two sports.

These aspects were present both for latencies obtained by stimulating the left hand and for those recorded after stimulating the right hand.

Correlations can also be observed for latencies of waves generated by the specific area, without a characteristic pattern, as shown in Table VIII.

As previously mentioned, the values of intracranial conduction intervals P14-N20 and N20-P25 were also processed. These intervals were submitted to the same statistical processing as the latencies of SEP components, with the results displayed in Table VIII.

There was a discordant modification of values for the two intervals for right-left differences: P14-N20 had higher values for right compared to left, the same aspect being revealed for the subgroup of handball players. For the F and the V group, concordant modifications for the right-left differences were recorded. For both intervals, the mathematical sign of the modification differs: for F, the different right-left values were negative, while for V those differences were positive.

So, there were no noticeable correlations of these intervals for the entire studied group. However, subgroup H showed a negative correlation of both intervals, while the F and V correlation was positive, but only for central conduction, interval N20-P25.

By analysing the intersport correlations, we noticed positive correlations between H-V, V-F for the conduction interval, between the brain stem and cortex (P14-N20), following the stimulation of the left hand. Following the stimulation of the right hand, a positive correlation existed only between V and F, while for the same hand when comparing H-F for the same interval, a negative correlation appeared. Also, following the stimulation of the left hand, for the interval P25-N20, a positive correlation was observed when comparing values of the subgroups H-F, and a negative correlation was found when comparing H-V. Following the stimulation of the right hand, the obtained values were positively correlated only for the V-F correlation and at the limit, for the H-V comparison (Table VIII).

Table V

Mean and standard deviation values of SEP parameters for the group of fencers.

SDV-SEP		P14-15	N20	P22-25	N25-30	P35	N40	P45
Right hand	Average	17.10	20.36	23.12	25.72	28.58	32.57	36.55
	Std.Dev	0.93	1.54	1.51	1.58	2.32	2.22	0.58
Left hand	Average	17.35	19.92	22.72	25.04	29.08	33.20	37.48
	Std.Dev	1.26	0.96	1.13	1.61	2.10	2.95	0.50

Table VI

Differences between SEP parameters and Pearson correlation coefficient values for the group of fencers.

Right-left differences	P14-15	N20	P22-25	N25-30	P35	N40	P45
P value	0.76	0.61	0.65	0.52	0.76	0.78	0.056
Pearson correlation coefficient	**0.88**	0.12	0.13	0.20	**0.99**	**0.94**	-0.1

Table VII

Values of SEP component parameters and statistical results for the volleyball group.

SEP		P14-15	N20	P22-25	N25-30	P35	N40	P45
Right hand	Average	16.55	19.90	22.33	25.65	30.82	34.30	38.20
	Std.Dev	0.89	0.45	0.25	0.65	0.74	1.93	2.71
Left hand	Average	16.25	19.96	22.48	25.78	31.03	34.38	38.90
	Std.Dev	1.70	0.68	0.50	0.97	0.49	2.21	4.12
Right-left	P value	0.77	0.87	0.62	0.84	0.63	0.96	0.76
	Pearson correlation coefficient	**0.89**	**0.94**	**0.70**	**0.96**	**0.71**	**0.97**	**0.98**

Table VIII

Statistical results for the intersport analysis.

Correlation	Left hand							Right hand						
	P14-15	N20	P22-25	N25-30	P35	N40	P45	P14-15	N20	P22-25	N25-30	P35	N40	P45
H-F correlation	**-0.71**	0.05	0.30	0.73	0.95	1.00	**-0.76**	**-0.78**	**-0.52**	-0.42	-0.14	0.83	0.87	**-0.53**
H-V correlation	0.75	0.55	**-0.58**	0.35	**-0.91**	0.50	0.49	0.22	0.57	**-0.65**	0.22	**-0.89**	0.73	0.25
V-F correlation	0.72	**-0.75**	0.59	0.98	**-1.00**	1.00	0.66	0.75	**-0.69**	**-0.93**	0.27	**-0.82**	1.00	-0.30
p H-F	0.97	0.57	0.40	0.37	0.19	0.32	0.06	0.81	0.33	0.47	0.33	0.14	0.51	0.10
p H-V	0.39	0.96	0.78	0.27	0.78	0.75	0.37	0.24	0.26	0.14	0.88	0.58	0.79	0.63
p S-V	0.42	0.55	0.31	0.93	0.15	0.33	0.25	0.34	0.94	0.68	0.43	0.16	0.60	0.48

Discussions

The analysis of SEP wave parameters showed that the latencies of these waves obtained by stimulating the right hand were higher than those obtained by stimulating the left hand, for the entire group of sportsmen, while for the three studied sport groups, the same aspect was identified only for handball and volleyball (statistically insignificant differences).

For fencers, waves obtained from the specific cortical area had a lower latency when the right hand was stimulated, compared to those recorded by stimulating the left hand. One explanation for these results may be that handball and volleyball require both arms during the sports effort, without producing a specific differentiated plastic modification of the corresponding cortical area. For fencers, where the dominant arm was almost exclusively used, the process of a specific differentiated plastic modification due to sports training was dominant, leading to a decrease of wave latencies generated by the cortical areas specific to the used limb.

SEP testing proved to be efficient in gauging the sports effort, due to the highlighting of a P14-15 positive correlation (left-right) from records of sportsmen, belonging to each tested sport. Cortical SEP characteristics and aspects recorded for the three mentioned sports revealed lower values, highlighted for the first waves' latencies (P14, N20, P25) in volleyball players, compared to other sportsmen, an aspect which was obtained through successive stimulation of both hands.

The latest waves (P35, N40, P45), originating in the association cortex, had the lowest latencies for fencers, thus mirroring a large extent of plastic modifications, necessary for these localisations to sustain commands from specific areas (Nielsen & Cohen, 2008; Sadowski, 2008; Thomas & Mitchell, 1996). Fencing, being a sport that requires reactions of the lowest latency, stimulates the well defined association areas for specific responses, thus determining the stereotypic movements in this sport. Regarding the P15-N20 interval, which expresses conduction of information between the brain stem and specific cortical areas, its values were more reduced when stimulating the right hand compared to those obtained for the left hand for all three studied sportsmen subgroups, although the differences were statistically insignificant.

The mentioned interval was the expression of path conduction, where the transmission of information was not overly influenced by sports training, an aspect which differs from the N20-P22-25 interval, which reflects the components of the cortical response.

Conclusions

1. Neurophysiologic investigation through somatosensory evoked potentials for professional sportsmen represents a means of highlighting a possible pattern, characteristic of each practiced sport.

2. By analysing the recorded results, differences between the SEP component latencies obtained by successively stimulating both upper limbs could be evidenced. However, these differences were not statistically significant, an aspect which was constant when comparing differences between the groups of sportsmen.

3. By computing the P14-N20 and N20-P25 intervals, an electroneurophysiologic difference of stimuli conduction and a difference in activating somesthetic cortical areas could be evidenced, none of which was sustained from a statistical point of view.

4. The Pearson test showed that, when comparing results obtained by each group of sportsmen, a correlation pattern was present, similar for waves P35 and N40, both for stimulating the right and the left hand.

5. Although for the majority of SEP parameters, no statistically significant differences were found, some correlations for P14, P35, N40, waves generated by the association cortex, were considerably changed by the functional plastic processes induced by performance sports, which is an important reason to continue the study.

Conflict of interest

The authors confirm that this article content has no conflict of interest.

Author contribution

All authors have equally contributed to this article.

References

Babiloni C, Capotosto P, Del Percio C, Babiloni F, Petrini L, Buttiglione M, Cibelli G, Marusiak J,Romani GL, Arendt-Nielsen L, Rossini PM. Sensorimotor interaction between somatosensorypainful stimuli and motor sequences affects both anticipatory alpha rhythms and behavior as afunction of the event side. Brain Res Bull, 2010;81(4-5):398-405.

Balzamo E, Marquis P, Chauvel P, Regis J. Short-latency components of evoked potentials to median nerve stimulation recorded by intracerebral electrodes in the human pre- and postcentral areas. Clin Neurophysiol, 2004;115:1616-1623.

Bulut S, Ozmerdivenli R, Bayer H. Effects of exercise on somatosensory-evoked potentials. Int J Neurosci, 2003; 113(3):315-322.

Chen TL, Babiloni C, Ferretti A, Perrucci MG, Romani GL, Rossini PM, Tartaro A, Del Gratta C. Humansecondary somatosensory cortex is involved in the processing of somatosensory rare stimuli: anfMRI study. Neuroimage, 2008;40(4):1765-1771.

Cruccu G, Aminoff MJ, Curio G, Guerit JM, Kakigi R, Mauguiere F, Rossini PM, Treede RD, Garcia-Larrea L. Recommendations for the clinical use of somatosensory-evoked potentials. Clin Neurophysiol, 2008; 119(8):1705-1719.

Gobbele R, Waberski T, ThyerleiD,Thissen M, Fimm B, Klostermann F, Curio G, Bruchner H. Human highfrequency somatosensory evoked potentialcomponents are refractory to circadianmodulations of tonic alertness. J Clin Neurophysiol, 2007;24(1):27-30.

Houlden DA, Taylor AB, Feinstein A, Midha R, Bethune AJ, Stewart CP, Schwartz ML. Early somatosensory evoked potential grades in comatose traumatic brain injury patients predict cognitive and functional outcome. Crit Care Med, 2010; 38(1):167-174.

Hu L, Zhang ZG, Hung YS, Luk KD, Iannetti GD, Hu Y. Single-trial detection of somatosensory evoked potentials by probabilistic independent component analysis and wavelet filtering. Clin Neurophysiol, 2011;122(7):1429-1439.

Iwadate M, Mori A, Ashizuka T, Takayose M, Ozawa T. Long-

term physical exercise and somatosensory event-related potentials. Exp Brain Res, 2005;160(4):528-532.

Ji Y, Meng B, Yuan C, Yang H, Zou J. Monitoring somatosensory evoked potentials in spinal cord ischemia-reperfusion injury. Neural Regen Res, 2013;8(33):3087-3094.

Kido A, Stein R. Short-term effects of functional electrical stimulation on motor-evoked potentials in ankle flexor and extensor muscles. Experim Brain Res, 2004;159(4):491-500.

Lin CY, Yeh YC, Lai KL, Chen JT, Wang SJ, Lin YY, Liao KK.High-frequency somatosensory evoked potentials of normal subjects.Acta Neurol Taiwan. 2009 Sep;18(3):180-186.

Lupescu TD, Sirbu CA, Constantin D. Potențiale evocate somatosenzitive. In: Electromiografiepotențiale evocate. Ed. Univ. Carol Davila, Bucuresti, 2006;74-88.

Makarov MR, Samchukov ML, Birch JG et al. Somatosensory evoked potential monitoring of peripheral nerves during external fixation for limb lengthening and correction of deformity in children. J Bone Joint Surg, 2012;94(10):1421-1426.

Matsumoto R, Dileep R, Nair Eric LaPresto, William Bingaman, Hiroshi Shibasaki, Hans O. Lüders. Functional connectivity in human cortical motor system: a cortico-cortical evoked potential study, Brain, 2006;130(1):181-197.

Montain SJ, Tharion WJ. Hypohydration and muscular fatigue of the thumb alter median nerve somatosensory evoked potentials. Appl Physiol Nut Met, 2010;35:456-463.

Murakami T, Sakuma K, Nakashima K. Somatosensory evoked potentials and high-frequency oscillations in athletes. Clin Neurophysiol, 2008;119(12):2862-2869.

Nielsen JB, Cohen LG. The Olympic brain.Does corticospinal plasticity play a role inacquisition of skills required for high-performancesports ?, J Physiol, 2008;586(1):65-70.

Ring C, Wu DM, Xiong W, Thakor NV. Short- and Long-latency Somatosensory Neuronal Responses Reveal Selective Brain Injury and Effect of Hypothermia in Global Hypoxic-Ischemia. J Neurophysiol, 2012;107(4):1164-1171.

Sadowski B. Plasticity of the Cortical Motor System. J Hum Kin, 2008;20(1):5-21.

Sehm B, Schaefer A, Kipping J, Margulies D, Conde V, Taubert M, Villringer A, Ragert P. Dynamic modulation of intrinsic functional connectivity by transcranial direct current stimulation. J Neurophysiol. 2012;108(12):3253-3263.

Thomas NG, Mitchell D. Somatosensory-evoked potentials in athletes. Med Sci Sports Exerc, 1996; 28(4):473-481.

Tremblay S, de Beaumont L, Lassonde M, Théoret H. Evidence for the specificity of intracortical inhibitory dysfunction in asymptomatic concussed athletes. J Neurotrauma, 2011;28(4):493-502.

Van't Ent D, Van Soelen IL, Stam KJ, De Geus EJ, Boomsma DI. Genetic influence demonstrated for MEG-recorded somatosensory evoked responses. Psychophysiology, 2010;47:1040-1046.

Yamashiro K, Sato D, Onishi H, Yoshida T, Horiuchi Y, Nakazawa S, Maruyama A. Skill-specific changes in somatosensory-evoked potentials and reaction times in baseball players. Exper Brain Res, 2013;225(2):197-203.

Zwierko T. Differences in peripheral perception between athletes and nonathletes. J Hum Kin, 2008;19:53-62.

Palestrica of the third millennium – Civilization and Sport
Vol. 16, no. 4, October-December 2015, 308–314

Physical exercise in the rehabilitation of elderly patients with knee osteoarthritis

Exercițiul fizic în reabilitarea pacientului vârstnic cu gonartroză

Rodica Trăistaru [1], Diana Kamal [1], Viorela Enăchescu [1], Taina Avramescu [2], Constantin Kamal [1]
[1] *University of Medicine and Pharmacy of Craiova, Romania*
[2] *Faculty of Sport and Kinetotherapy, University of Craiova, Romania*

Abstract

Background. The risk for disability attributable to knee osteoarthritis (KOA) is as great as that attributable to cardiovascular disease and greater than that due to other medical conditions in the elderly.

Aims. We aim to highlight the role of physical exercise in the recovery of the clinical and functional status of elderly patients with KOA.

Methods. We performed a randomized controlled trial between two groups of elderly patients, each consisting of 35 patients. Healthcare was complex. The kinetic program was applied only to the study group. Evaluation of patients was carried out in three stages - initial (T1), after 2 weeks (T2) and after a further 10 weeks (T3) in an outpatient setting. Between T2-T3, patients in group 1 followed a home-training program (components learned during hospitalization).

Results. Regarding the quadriceps muscle, improvement of muscle strength was significant for each of the two groups, with no statistical difference between groups when comparing values. The mean scores of VAS and WOMAC scales improved, at times T2 and T3. The only values that were statistically significantly correlated were the averages of the pain parameter (VAS scale score) and the WOMAC functionality scale score, in the study group, at times T3 and T2.

Conclusions. Osteoarthritis of the knee, one common and crippling site of osteoarthritis, requires complex and individualized medical care. Regular aerobic exercise, with judiciously chosen parameters is one of the most recommended non-pharmacological, non-surgical measures in healthcare for elderly patients with osteoarthritis.

Keywords: elderly patient, knee osteoarthritis, physical exercise.

Rezumat

Premize. La pacientul vârstnic, boala artrozică cu localizare la nivelul genunchiului generează dizabilitate semnificativă, comparabilă cu cea determinată de suferința cardiovasculară și chiar mai importantă decât cele datorate altor afecțiuni.

Obiective. Demonstrarea rolului important al exercițiului fizic în refacerea statusului clinic și funcțional la pacientul vârstnic cu gonartroză.

Metode. Am derulat un studiu randomizat controlat între două loturi de câte 35 pacienți vârstnici, complet evaluați. Programul kinetic a fost performat doar de către pacienții din lotul de studiu. Subiecții au fost evaluați în trei timpi: inițial (T1), după 2 săptămâni (T2) și după alte 10 săptămâni (T3). Între momentele T2 și T3, pacienții din lotul de studiu au derulat un program de home-training.

Rezultate. Forța mușchiului cvadriceps s-a ameliorat la toți pacienții, fără o diferență semnificativă între cele două loturi. Valorile medii ale scorurilor scalelor VAS și WOMAC s-au îmbunătățit în momentele T2 și T3 de evaluare. Singurele corelații semnificative statistic au fost stabilite între valorile medii ale scalelor VAS și WOMAC pentru lotul de studiu, în momentele T2 și T3.

Concluzii. Gonartroza, una dintre cele mai frecvente localizări ale bolii artrozice, necesită asistență medicală complexă și individualizată. Exercițiul fizic regulat, aerobic, cu parametri judicios aleși, reprezintă cea mai recomandată și eficientă metodă non-farmacologică și non-chirurgicală în asistența medicală a pacientului vârstnic cu gonartroză.

Cuvinte cheie: pacient vârstnic, gonartroză, exercițiu fizic.

Received: 2015, September 10; *Accepted for publication:* 2015, October 1;
Address for correspondence: University of Medicine and Pharmacy of Craiova, No 2-4, Petru Rareş Str, Craiova, 200349, Romania
E-mail: rodicatraistru@hotmail.com
Corresponding author: Rodica Trăistaru, rodicatraistru@hotmail.com

Introduction

Osteoarthritis is the most common musculoskeletal affliction, representing a significant health problem worldwide (Murphy et al., 2008). Statistical data worldwide mention that over 100 million people are diagnosed with OA, which is one of the most common causes of disability (Hinman et al., 2010; Heiden et al., 2009). The global incidence of this disorder is high, more than 50% of the world's population (>65 years, 9% of men and 18% of women) have X-ray evidence of OA in one of the joints (Bathia et al., 2013).

Osteoarthritis, a chronic disease with debilitating potential, is a progressive disorder affecting the joint cartilage, subchondral bone, joint capsule and synovia (Weiss & Jurmain, 2007). It has a multifactorial etiology and is characterized by a disrupted state of physical and mental wellbeing of the patient. Its clinical and functional expression is all the more important as the affected joint - knee - is one of the pivots of the lower driveline with human specific purpose – orthostatic posture and walking. The knee joint (the largest joint in the human body is intensely stressed in both locomotion and repose, with the rapid deterioration of its elements) is one of the most common sites of osteoarthritis (even the most frequent in some studies), with major dysfunctional impact on the body (Hinman et al., 2010; Heiden et al., 2009; Bathia et al., 2013).

Presently, knee osteoarthritis is a major social and health problem and a cause of disability among the aging population, generating an increasingly heavy financial burden on health care systems in modern societies (Liikavainio et al., 2008). Osteoarthritis of the knee is one of the five leading causes of physical disability in non-institutionalized elderly men and women. Knee osteoarthritis significantly contributes to functional limitations and disability in the elderly, affecting the ability to walk and climb the stairs more than any other disease. The risk for disability attributable to knee OA is as great as that attributable to cardiovascular disease and greater than that due to other medical conditions in the elderly. The incidence of symptomatic knee osteoarthritis is 1% per year, with a radiographic incidence of 2% per year (Choudhary & Kishor, 2013). Medical care of patients with osteoarthritis is provided by a multidisciplinary team because of the variety of methods used to obtain a pain free knee, stable and mobile, i.e. a knee with optimum functionality.

The available literature data (Table I) mention an apparent paradox regarding the use of exercise in patients with osteoarthritis: on the one hand, physical exercise should be avoided and on the other hand, the idea of exercise that facilitates both the functional status of the knee and the general condition of the body is promoted (Grainger & Cicuttini, 2004; Parmet et al., 2003). Both immobilization and intense physical exercise can contribute to degeneration of the joint and increase the risk of developing the most severe form of OA, which requires arthroplasty, osteotomy or arthroscopy. OA leads to difficulties in performing daily activities and lack of physical activity, as a result of pain (de Almeida Carvalho et al., 2010).

Table I

The effects of physical activity in patients with osteoarthritis.

Determined by its absence in healthcare	1. Encourages increase in body weight, with additional joint strain 2. Lowers overall body strength 3. Decreases parameters for quadriceps muscle (and other muscles)
Determined by constant inclusion in healthcare	1. Reduces pain 2. Increases the range of movement, prevents joint stiffness 3. Normalizes parameters of periarticular muscle groups and entire leg 4. Decreases the harm caused by knee osteoarthritis 5. Increases overall strength, wellbeing and the quality of life

Hypothesis

In the present study, we aim to highlight the role of physical exercise in the recovery of the clinical and functional status of elderly patients with osteoarthritis. Probably, the judiciously chosen parameters of physical exercise will permit to perform the kinetic program in healthcare for this type of patients.

Material and methods

We mention that we obtained the approval of the Ethics Committee of the University of Medicine and Pharmacy of Craiova No 97/12.12.2014 and a signed informed consent from all the subjects participating in our study. Our research was performed on 44 elderly patients, all diagnosed with knee osteoarthritis.

Research protocol

Period and place of the research

We conducted our study during the period December 2014 - July 2015 in the Rehabilitation Department of the "Filantropia" Hospital Craiova.

Subjects and groups

The study was a randomized controlled trial including two groups of elderly patients, homogeneous in terms of biographical and rheumatic disease features, each consisting of 35 patients (Table II).

Table II

Patient biographical data and mean values of the studied scales.

Group	Group 1 (study)			Group 2 (control)		
Sex	20 F/15 M			24 F/11 M		
Age (years) limits	68.83 ± 3.005 (65-75)			68.71 ± 3.214 (65-75)		
Urban/rural	17 urban/18 rural			16 urban/19 rural		
Smoking	13 smokers/22 non-smokers			11 smokers/24 non-smokers		
Evaluated parameters	**T1**	**T2**	**T3**	**T1**	**T2**	**T3**
VAS Scale (Mean value ± SD)	6.4*±1.24	4.06*±0.90	3.46*±0.74	6.89*±0.96	4.94*±0.99	4.66*±0.83
WOMAC Scale (Mean value ± SD)	52.37±3.63	49.03*±3.35	48.49±3.65	52.23*±3.45	49.11*±2.64	49.74*±2.82

* Correlation (p) is significant at the 0.01 level (2-tailed). Pearson correlation;
SD = standard deviation; F = female; M = male; U = urban; R = rural.

The inclusion criteria taken into account when designing the groups were:

- patients older than 65 years diagnosed with primitive osteoarthritis according to the American College of Rheumatology, criteria also accepted in our country;
- at least 10 years of disease progression;
- painful knee for a period of 48 hours after physical activity;
- absence of knee injuries at least 6 months before;
- absence of major disturbances in the frontal plane alignment of the knee;
- patients with stable cardiovascular and respiratory function, with normal blood pressure;
- compliance with physical exercise during the healthcare program.

Tests applied

We completed an initial etiopathogenic, clinical, laboratory (laboratory screening, imaging examination - radiography and ultrasound) and functional assessment. All tests applied are mentioned below.

The *etiopathogenic* and *clinical assessment* included:

- careful patient history to determine pain parameters, accompanying symptoms;
- general physical examination (system examination including sensory evaluation);
- musculoskeletal examination – somatoscopic exam, assessment of the range of motion and manual muscle testing of the leg muscles, especially the knee muscles, patellar shock assessment;
- exam in loaded bipodal, unipodal and sitting position;
- examination of gait, pace and dynamics, analysis of pain during walking (on flat ground and stairs).

During the examination, we conducted *laboratory* and *radiological examination* of the knee and also *ultrasound* to evidence clinical changes at this level. For the ultrasound examination, we used the Esaote AU5 ultrasound machine, with the 7.5 MHz probe. To assess the strength of the quadriceps muscle (most important stabilizing muscle) in the studied patients, an ultrasound examination was performed in the lower third of the thigh and in the suprapatellar area with the patient in dorsal decubitus with the knee extended. This was done bilaterally during both relaxation and isometric contraction at moments T1 and T3. All patients examined were ranked 1 if there was not a clear change in muscle size during isometric contraction and 2 if the change was obvious (Figure 1a and 1b).

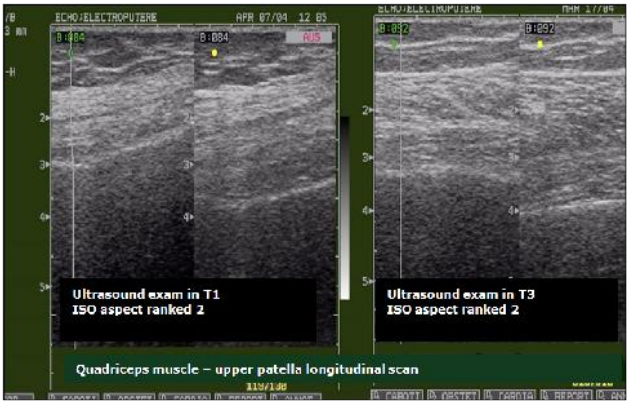


Fig. 1a **Fig. 1b**

Fig. 1 – Ultrasound exam of the quadriceps muscle (longitudinal scan).

For a *functional assessment,* we used the VAS - Visual Analogue Scale (from 0 to 10, 0 = absence of pain and 10 = maximum pain score, other values between 0 and 10 are directly proportional to the intensity of pain, depending on the individual pain threshold), scales for pain and the WOMAC scale to assess the impact of osteoarthritis on lower limbs in performing activities of daily living (total score = 0 = maximum functional status and functional status 96 = minimum, with maximum disruption of daily activities).

Evaluation of patients was carried out in three stages - initial (T1), after 2 weeks (T2) - during which an in-hospital program of rehabilitation was conducted, and after a further 10 weeks (T3) in an outpatient setting. Between T2-T3, patients in group 1 followed a home-training program (components learned during hospitalization).

The healthcare objectives were:

- painful status control;
- controlling the inflammatory process;
- regaining stability and mobility of the knee, muscle and ligament balance, restoring balance to the muscle groups serving the entire "knee" complex;
- correcting the abnormal walking scheme, with recovery of normal walking;
- keeping the knee functional in the biomechanical structure of the limb;
- regaining motor control, optimal knee function.

Healthcare was complex, based on non-surgical measures in both groups of patients, and included:

- non-pharmacological measures - educational, dietary and hygienic, posture, physical (thermotherapy - paraffin and electrotherapy - magnetodiaflux, TENS, ultrasound), massage and kinetic measures;
- pharmacological measures - analgesics, chondroprotective medicine, anti-inflammatory drugs.

The kinetic program was applied only to patients complying with the idea of physical exercise (Table III), who formed the study group. This program was intended for upgrading the periarticular muscle groups. The principles underlying the kinetic program were:

- individualized, depending on the severity of pain, knee stability and patient resources;
- structured - posture, active exercise without load (passive mobilization and active stretching), isometric exercises, isotonic exercises with a progressive load, exercises in open and closed kinematic succession (pedaling on a cycloergometer with a high saddle), exercises for gait coordination;
- complete, with tactics for increasing patient compliance - setting realistic objectives, explanations to the patient, gradual initiation and slow advancement, planning exercises at the optimum time, group physical therapy.

At discharge, patients were recommended a set of exercises to perform at home (home-training program).

In Table 3, three main types of exercises are included, which consist of physical therapy sessions and home-training for the study group.

Statistical processing

Data were statistically analyzed using SPSS 12.0 for Windows (Statistical Package for Social Sciences). If $p < 0.05$, comparisons or correlations (Pearson correlation and regression curves) had statistical significance.

Results

All patients in the two groups, diagnosed with primitive bilateral knee arthritis with painful and functional decompensation, attended a recovery program and were evaluated at 2 months' intervals after inclusion in the study groups.

Regarding the quadriceps muscle, improvement of muscle strength assessed by manual muscle testing and supported by ultrasound examination was significant for each of the two groups, with no statistical difference between the groups when comparing values.

The recovery program resulted in a favorable trend of relieving pain and improving functional status. The mean scores of the VAS and WOMAC scales improved, at times T2 and T3, with no statistically significant difference when comparing the averages for the two groups. For the study group, the pain parameter improvement was 25% at T1 and 47% at T2, while the WOMAC scale score improved by 6% and 7% at T1 and T2, respectively. The percentages of the mean values for the control group improved by 28% at T1 and 32% at T2 for VAS and were 5% at T1 and 4% at T2 when analyzing WOMAC. Synchronicity of the favorable evolution was maintained for the average values of the subgroups of patients depending on the environment of origin and sex, in both groups.

The only values that were statistically significantly correlated were the averages of the pain parameter (VAS scale score) and the WOMAC functionality scale score, in the study group, at times T3 and T2, a result that suggests the importance of a kinetic program applied to elderly patients with knee arthritis (Table IV).

The same results were obtained with statistical significance, by studying the regression equations for the mean values of the two scale scores for each of the groups (Table 4). The higher the R values are, the better the average values expressing the beneficial effect of the nursing programs correlate. In the same table we included the R square values over 0.5. A value higher than 0.5 R^2 expresses that half of those cases follow a regression model equation, supported by ANOVA analysis, where the sum of

Table III

Components of the kinetic program applied to the studied patients with knee OA.

Objective	Exercises	
	Example exercises	Exercise parameters
Flexibility (ROM)	Passive movement of lower limbs Stretching of calf muscles, hamstrings and quadriceps	Daily, 5 sets for each of the lower limb joints, from distal to proximal Daily, 5 sets of 6 seconds for each muscle group
Muscle strength	Isometric contraction of vastus medialis oblique of the quadriceps muscle and gluteus maximus	Daily, 3 sets, 5 repetitions/set, 6 seconds for isometric contraction, 1 minute rest between contractions
	Isotonic contraction of leg flexor and leg extensor, quadriceps muscle, calf muscles	Daily, in antigravity position for each muscle, 2 sets, 10 repetitions/ set, 2 minutes rest between sets. Intensity equal to maximal voluntary contraction
Endurance	Cycling, walking, housework	Daily, 30-40 minutes. Intensity equal to submaximal voluntary contraction
Control of movement and gait coordination	Frenkel exercises for lower limbs Exercises on the balance board Front and back cross over stepping Tandem walking Walking with eyes closed (supervised!)	3 per week
ADL (functional activities)	Sitting to standing in chair, bed, other places Stair climbing Getting in and out of car	Daily

Every session was preceded by Cyriax kinetic massage of the knee.
For relative repose, the patient was asked to comply with the correct posture, alternating the position (with knees slightly flexed) with functional position (with knees in extension).
During the walking scheme, with slight variants, we used a cane for weight unloading.
Learning and respecting the orthopedic hygiene of the knee completed the program

Table IV

Correlations between the studied parameters.

Correlation between mean values		Study group			Control group		
Correlation ISO1 – ISO3		ISO1 – ISO3 R = 0.523; R square = 0.489 *			ISO1 – ISO3 R = 0.510; R square = 0.262		
VAS Scale		VAS1	VAS2	VAS3	VAS1	VAS2	VAS3
VAS1	Pearson correl.	1	.706	.499	1	687	.269
	Sig. (2-tailed)	.	.000	.002	.	.076	.107
VAS2	Pearson correl.	.706	1	.623	.687	1	.280
	Sig. (2-tailed)	.000	.	.000	.076	.	.093
Correlation VAS1 – VAS2		R = 0.70; R square = 0.499 *			R = 0.499; R square = 0.249		
Correlation VAS1 – VAS3		R = 0.598; R square = 0.557 *			R = 0.520; R square = 0.270		
WOMAC Scale (W)		W1	W2	W3	W1	W2	W3
W1	Pearson correl.	1	.825	.707	1	.741	.590
	Sig. (2-tailed)	.	.000	.000	.	.008	.001
W2	Pearson correl.	.825	1	.856	.741	1	.712
	Sig. (2-tailed)	.000	.	.000	.008	,	.001
Correlation W1 – W2		R = 0.835; R square = 0.688 *			R = 0.741; R square = 0.549		
Correlation W1 – W3		R = 0.702; R square = 0.593 *			R = 0.590; R square = 0.348		

ISO = alternation during ultrasound exam when performing an isometric contraction;
Pearson correlation is significant at the 0.01 level (2-tailed);
* Anova analysis, having statistical significance Sig. = .000.

the sum of square values is about equal between values obeying the equation and residual ones, and the frequency graph is relatively close to the ideal curve; namely, R square expresses predictivity in obtaining those results in a group of patients similar to those examined when performing therapeutic rehabilitation measures.

The graph frequencies for muscle parameters, VAS and WOMAC, are expressed by curves in Figures 2, 3a and 3b, 4a and 4b. Taking this into account, how to structure and implement a recovery program has a real chance of success.

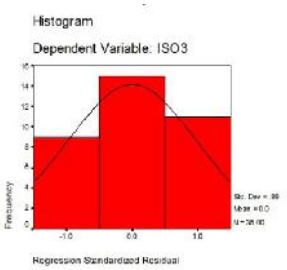


Fig. 2 – The graph frequencies for the muscle ultrasound parameter (study group).

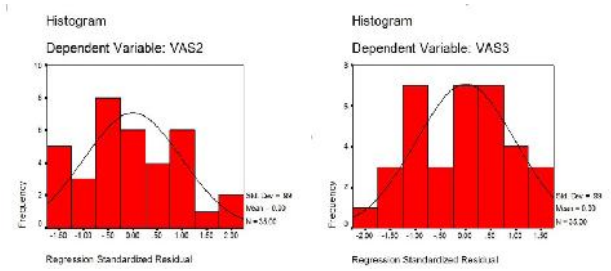


Fig. 3a **Fig. 3b**

Fig. 3 – The graph frequencies for VAS scores at T2 (VAS2) and T3 (VAS3) (study group).

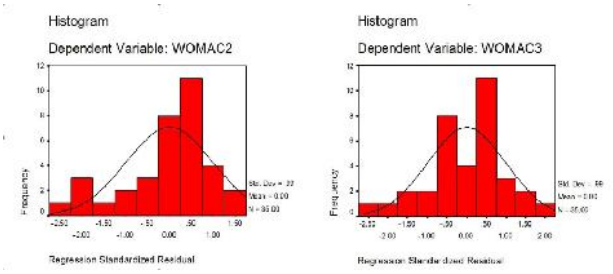


Fig. 4a **Fig. 4b**

Fig. 4 – The graph frequencies for WOMAC scores at T2 (WOMAC2) and T3 (WOMAC3) (study group).

Discussions

Reviewing the literature shows that there are numerous clinical benefits of the regular practice of physical therapy exercises in patients with osteoarthritis of the knee(s) in a program with appropriate guidance. The regular practice of exercises in patients with knee OA, in this type of program (intervention through appropriate guidance), can help prevent the loss of muscle strength and restrictions in day-to-day activities. A real and straightforward kinetic program enables elderly patients with knee OA to achieve a significant improvement in pain, ROM knee flexion, muscle strength and functional capacity.

Our results reflect the data found in the medical literature, according to which, when applying an individualized kinetic program based on the severity of the disease, age, gender, and the individual's functional status, pain relief and functional improvement are achieved in patients with OA of the knee (Esser & Bailey, 2011; Bhatia et al., 2013).

The duration of the kinetic program in most previous studies is approximately 8 weeks, with the inclusion of muscle strengthening, proprioception, and flexibility exercises; knee bracing; and patient education (Miller & Block, 2014).

In our study, we recommended that patients compliant with the kinetic program continue home exercises and orthopedic hygiene rules of the knee for a period of 10 weeks, the reason being that subjects should get accustomed to this program for the more distant future, in order to lead a normal life and to preserve the functional gain achieved during the study.

Patients did not have abnormal alignment of the knee, which would raise the risk of negative impact that increased muscle strength of the quadriceps, especially the vastus lateralis and the medial muscles, may have on frontal biomechanics in the femoral-tibial compartment (Brandt, 2003).

Improvement in a higher percentage of the pain parameters compared to the percentage for the functional WOMAC scale is explained by conditioning of the complex functional status, especially in elderly patients. Moreover, the WOMAC scale score was a global one, taking into account all functional aspects. This explains the difference between our study and other studies, where WOMAC subscale scores are referred to (Miller & Block, 2014; Davis, 2012).

Our program for improving muscle strength was effective, controlling pain, maintaining the range of movement in the knee joint, and reducing functional incapacity.

To obtain these results, the choice of parameters for each exercise (intensity, duration, frequency) was very judicious for the studied patients aged over 65 years, and the cardiovascular and neuro-myo-arthro-kinetic status was balanced for the age groups concerned. We used submaximal loading exercise and in the case of aerobic exercise for restoring the effort capacity, the target heart rate was set between 50% and 70% for a minimum of 30 minutes, three times a week (Bhatia et al., 2013; Roddy et al., 2005).

During each kinetic session over the 2 weeks of hospitalization, and then during the home-training program, we observed each patient closely in order to achieve a balance between rest and exercise. For this kind of elderly population, we cannot consider a kinetic program with good compliance without alternating physical exercise with appropriate resting sessions. Also, the interval between sessions for regaining exercise capacity followed the guidelines in the literature (Wang et al., 2011). Only in this way, we could make elderly patients with knee OA feel better, help reduce the joint pain, and make it easier for them to perform daily tasks (McQuade & de Oliveira,

2011).

During the program, we used several categories of kinetic exercises (stretching, strengthening, and aerobic exercise) and performed the exercises for the entire kinematic chain of the lower limb muscle groups, conferring a greater importance to biarticular muscle groups (hip - knee). There are few studies in knee arthrosis where the kinetic program also involves the hip muscle groups. Because the two hip - knee joints are closely biomechanically related, and ensure functionality of the lower limb along with the foot complex, we recommended global exercises involving the hip-knee-ankle-foot for our patients (Sled et al., 2010).

Stretching exercises were included in the program with the aim of maintaining or improving kinetic ROM. Joint mobility should be maintained or improved in patients with OA because the loss of ROM causes shortening and contraction of the muscles and capsular structures, and it can impair functionality (Deyle et al., 2005).

We did not perform any global isometric exercises because in elderly patients, this type of contraction may cause increased heart rate and blood pressure, which could be a severe contraindication. In patients with high compliance and no significant previous cardiovascular history, we performed isometric contractions for the vastus medialis oblique muscle, the most important component of the quadriceps muscle for active knee stability.

The need for the inclusion of a permanent recovery program based on exercise for elderly patients with osteoarthritis is justified by the benefit of this complex exercise, as outlined in many randomized trials and systematic reviews (Hicks-Little et al., 2008; Jamtvedt et al., 2008):

- articular cartilage degeneration may regress, more exactly, arthrogenic muscle inhibition of the knee muscles (especially quadriceps) decreases
- correction of muscle weakness that plays an important role in the development of OA;
- increase of muscle endurance and improvement of proprioceptive acuity;
- reduction of pain and improvement of muscle strength, functional ability, and psychological well-being.

Since we did not have the necessary equipment available for the assessment and coordination of the walking/gait scheme, we could not make judgments on these issues. However, the literature is not encouraging in this regard. Exercise interventions for strength, flexibility and endurance have resulted in only modest improvements in motor control of walking (Brach et al., 2015). So, we included in our physical program special exercises for joint proprioception in all lower limb joints, especially for the knee. Better knee joint proprioception means better functional ability, greater improvement of symptoms and lower fall risk (Choudhary et al., 2013).

Weakness of the quadriceps muscle is considered one of the most important risks in the progression of the OA of the knee. The strength of this muscle naturally decreases with age, leading to functional limitation (Mikesky et al., 2006). Strength-building exercises designed for the flexor muscles of the knee are just as important for the quadriceps in the rehabilitation of knee OA because of the dynamic stability of this joint.

We performed ultrasound examination of quadriceps muscles for assessing the direct impact that the exercise program had on knee muscles. Clinical studies mention the fact that patients with knee OA have impaired physical function and muscle strength and QFM composition compared with healthy controls. Also, the effect of quadriceps strength on physical function is recognized (Liikavainio et al., 2008). The echogenic pattern of knee muscle directly depends on the muscle composition. In knee OA patients, impaired physical function is associated with muscle hypotrophy and atrophy, which can be proved through ultrasound exam (increased echogenicity and decreased muscle thickness). The ultrasound examination of the quadriceps muscle and the results obtained by statistical processing of data certify kinesiology data according to which functional muscle hypotrophy is not always accompanied by a decrease in muscle mass and the relatively rapid improvement of the parameter is proof of the neural recovery factor conditioning the muscle strength (Appell, 1990; ***, 2005). Musculoskeletal ultrasound of patients with osteoarthritis highlights other elements of the inflammatory process of osteoarthritis at this level - joint effusion, synovial reaction, allowing to follow their dynamics (Filippucci & Iagnocco, 2006).

The kinetic program applied during hospitalization should be adjusted accordingly on discharge, to be applied at home; continuity is one of the "secrets" of success, in order to obtain an improvement of the quality of life. Even when this program is followed at home without constant supervision, the use of the printed manual for orientation on the performance of exercises for osteoarthritis of the knee is beneficial. Correct exercise ensures optimum functionality of the periarticular muscle groups, which help the knee during various daily movements without causing pain; it is considered that the muscles act as a shock absorber at the joint, having a protective role. The magnitude of improving the two parameters conditions adherence and compliance of the patients in continuing exercises in a secondary kinetic program for painful arthritic decompensations.

For patients in the early stage of the disease with minimal or no painful experience, it is particularly useful to perform physical exercise (***, 2000).

Articular repose during evolutionary flares helps managing the pain, but prolonged rest accentuates stiffness, osteoporosis and hypotrophy/atrophy of muscle. Therefore, it is recommended to rest in the functional position.

The patient will become familiar with the rules of energy conservation in various daily activities, as well as with how to optimally use the functional sector of all joints. Instructions on how to sit, lift, carry heavy objects and walk correctly are important and useful in the treatment of OA.

Conclusions

1. Osteoarthritis of the knee, one common and crippling site of osteoarthritis, requires complex and individualized medical care.

2. Regular aerobic exercise, with judiciously chosen parameters is one of the most recommended non-pharmacological, non-surgical measures in healthcare for elderly patients with osteoarthritis.

3. Isometric exercises, necessary but insufficient in the kinetic program for the control of the algo-dysfunctional status of the knee with osteoarthritis, can be applied to elderly patients, with cardiovascular precautions.

4. Physiotherapy continues to be the best "drug" for patients with osteoarthritis, which obviously contributes to the control of a slow, progressive and irreversible evolution of osteoarthritis, with a favorable impact on the whole body and wellbeing.

Conflicts of interests

There are no conflicts of interest.

References

de Almeida Carvalho NA, Bittar ST, de Souza Pinto FR, Ferreira M, Sitta RR. Manual for guided home exercises for osteoarthritis of the knee. CLINICS, 2010; 65(8):775-780.

Appell H. Muscular atrophy following immobilization. A review. Sport Med.,1990;10:42-58.

Bhatia D, Bejarano T, Novo M. Current interventions in the management of knee osteoarthritis. J. Pharm. Bioallied Sci., 2013;5(1):30-38.

Brach JS, Lowry K, Perera S, Hornyak V, Wert D, Studenski SA, VanSwearingen JM. Improving Motor Control in Walking: A Randomized Clinical Trial in Older Adults With Subclinical Walking Difficulty. Arch Physical Med Rehab, 2015; 96(3):388-394. doi: 10.1016/j.apmr.2014.10.018.

Brandt KD. Is a Strong Quadriceps Muscle Bad for a Patient with Knee Osteoarhritis?. Ann. Inten. Med.,2003;138:678-679.

Choudhary N, Kishor A. Effectiveness of Modified Agility and Perturbation Training In Patients with Osteoarthritis Knee - A Case Control Study. Iranian Rehab J, 2013;11(17): 94-96.

Davis AM. Osteoarthritis year 2011 in review: rehabilitation and outcomes. Osteoarthritis and Cartilage, 2012;20:201-206.

Deyle GD, Allison SC, MAtekel RI et.al. Physical therapy treatment effectiveness for osteoarthritis of the knee: a randomized comparison of supervised clinical exercise and manual therapy procedures versus a home exercise program. Phys. Ther., 2005;85(12):1301-1317.

Esser S, Bailey A. Effects of exercise and physical activity on knee OA. Curr. Pain Headache Rep., 2011;15(6):423-430. doi: 10.1007/s11916-011-0225-z.

Filippucci E, Iagnocco A, Meenagh G, Riente L, Delle Sedie A, Bombardieri S, Valesini G, Grassi W. Ultrasound imaging for the rheumatologist. Clin. Exp. Rheumatol., 2006; 24(1):1-5.

Grainger R, Cicuttini F. Medical management of osteoarthritis of the knee and hip joints. Med J Australia; 2004;180(5):232-236.

Heiden T, Lloyd D, Ackland T. Knee extension and flexion weakness in people with knee osteoarthritis: Is antagonist contraction a factor ? J. Orthop. Sports Phys Ther. 2009;39(11):807-815.

Hicks-Little CA, Hubbard TJ, Cordova ML. The Role of Exercise in the Treatment of Knee Osteoarthritis. Athletic Therapy Today, 2008;13(3):7-10.

Hinman RS, Hunt MA, Creaby MW, Wrigley T, McManus FJ, Bennell KL. Hip muscle weakness in individuals with medial knee osteoarthritis. Arthritis Care Res. 2010;62(8):1190-1193.

Jamtvedt G, Thuve Dahm K, Christie A, Moe RH, Haavardsholm E, Holm I, Hagen KB. Physical Therapy Interventions for Patients With Osteoarthritis of the Knee: An Overview of Systematic Reviews. PHYS THER., 2008; 88(1):123-136.

Liikavainio T, Lyytinen T, Tyrväinen E, Sipilä S, Arokoski JP. Physical Function and Properties of Quadriceps Femoris, Muscle in Men With Knee Osteoarthritis. Arch Phys Med Rehabil, 2008; 89(11): 2185-2194. doi: 10.1016/j.apmr.2008.04.012.

McQuade KJ, de Oliveira AS. Effects of progressive resistance strength training on knee biomechanics during single leg step-up in persons with mild knee osteoarthritis. Clin Biomech, 2011;26(7):741-748.

Mikesky AE, Mazzuca SA, Brandt KD, et.al. Effects of strength trening on the incidence and progression of knee osteoarthritis. Arthritis Rheum., 2006;55(5): 690-699.

Miller LE, Block JE. An 8-Week Knee Osteoarthritis Treatment Program of Hyaluronic Acid Injection, Deliberate Physical Rehabilitation, and Patient Education is Cost Effective at 2Years Follow-up: The OsteoArthritis Centers of America Experience. Clinical Medicine Insights: Arthritis and Musculoskeletal Disorders, 2014;7:49-55. doi: 10.4137/CMAMD.S18356.

Murphy L, Schwartz TA, Helmick CG, Renner JB, Tudor G, Koch G, Dragomir A, Kalsbeek WD, Luta G, Jordan JM. Lifetime risk of symptomatic knee osteoarthritis. Arthritis Rheum., 2008; 59(9):1207-1213.

Parmet S, Lynm C, Glass RM. Osteoarthritis of the Knee. JAMA, 2003;289(8):1068.

Roddy E, Zhang W, Doherty M. Aerobic walking or strengthening exercise for osteoarthritis of the knee? a systematic review. Ann. Rheum. Dis.,2005;64:544-548.

Sled EA, Khoja L, Deluzio KJ et al. Effect of a Home Program of Hip Abductor Exercises on Knee Joint Loading, Strength, Function, and Pain in People With Knee Osteoarthritis: A Clinical Trial. Phys Ther., 2010;90:895-904. doi:10.2522/ptj.20090294.

Wang C, Bannuru R, Ramel J, Kupelnick B, Scott T, Schmid CH. Tai chi on psychological well-being: Systematic review and meta-analysis. BMC Complement Altern. Med., 2010;10:23. doi: 10.1186/1472-6882-10-23.

Weiss E, Jurmain R. Osteoarthritis revisited: a contemporary review of aetiology. Int J Osteoarch, 2007;17:437-450.

***. EULAR report on the use of ultrasonography in painful knee osteoarthritis. Annals of the Rheumatic Diseases. 2005;64:1703-1709.

***. Recommendations for the Medical Management of Osteoarthrits of the Hip and Knee. Arthritis & Rheumatism, Official J Ameri Coll Rheumatol, 2000;43 (9):1905-1915.

Palestrica of the third millennium – Civilization and Sport
Vol. 16, no. 4, October-December 2015, 315–318

Effects of tramadol administration on the oxidant/ antioxidant balance in trained rats

Efectele administrării de tramadol asupra balanței oxidanți/ antioxidanți la șobolani antrenați

Andreea Marilena Ionescu [1], Simona Tache [2]
[1] Clinical Rehabilitation Department, Elias Emergency University Hospital, Bucharest
[2] Physiology Discipline, "Iuliu Haţieganu" University of Medicine and Pharmacy, Cluj-Napoca

Abstract

Background. Oxidative stress is very intense during high intensity physical exercise, and free radical production represents an important factor of muscle fatigue.

Aims. To assess the effects of tramadol administration on the oxidant/antioxidant balance in trained rats.

Methods. The experimental study was conducted in October-November 2014, at the Physiology Department of the "Iuliu Haţieganu" University of Medicine and Pharmacy in Cluj-Napoca. 24 male Wistar rats were included in the study, over a period of 14 days. They were divided into two homogenous groups: the control group (intraperitoneal physiological serum administration, 1 mg/kg body weight), and the tramadol group (intraperitoneal tramadol administration, 1 mg/kg body weight). The animals were trained daily in the swimming pool, and the oxidant/antioxidant indicators were assessed: malondialdehyde - MDA (free radical marker), hydrogen donors - HD (antioxidant marker), and pain threshold values on the 1st, the 7th and the 14th day of the study.

Results. A significant decrease in MDA values and an increase in HD values were observed among the animals receiving tramadol. Pain threshold values significantly increased in animals receiving tramadol.

Conclusions. Tramadol administration during physical exercise improved the pain threshold and antioxidant defense.

Keywords: tramadol, oxidants/antioxidants, physical exercise.

Rezumat

Premize. Stresul oxidativ este foarte puternic în contextul efortului fizic intens, iar formarea radicalilor liberi reprezintă un factor important și determinant al oboselii musculare.

Obiective. S-au urmărit efectele administrării de tramadol asupra balanței oxidanți/antioxidanți la șobolani antrenați.

Metode. Studiul experimental s-a desfășurat în perioada octombrie-noiembrie 2014 la Disciplina Fiziologie a Universității de Medicină și Farmacie "Iuliu Haţieganu", Cluj-Napoca. 24 șobolani masculi, rasa Wistar au intrat în studiu pentru 14 zile. Au fost împărțiți în 2 loturi omogene: martor (administrare ser fiziologic, 1 mg/kg corp intraperitoneal) și tramadol (administrare tramadol, 1 mg/kg corp intraperitoneal). Animalele au fost antrenate zilnic prin proba de înot, urmărindu-se indicatorii balanței oxidanți/antioxidanți: malondialdehida - MDA (marker al stresului oxidativ), donorii de hidrogen - DH (marker antioxidant), precum și valorile pragului algic în prima, a 7-a și a 14-a zi a studiului.

Rezultate. La animalele lotului care a primit tramadol s-a constatat o scădere semnificativă a valorilor MDA și o creștere semnificativă a valorilor DH. Pragul algic a crescut semnificativ la animalele care au primit tramadol.

Concluzii. Administrarea de tramadol în timpul efortului fizic a determinat creșterea pragului algic și îmbunătățirea apărării antioxidante.

Cuvinte cheie: tramadol, oxidanți/antioxidanți, efort fizic.

Received: 2015, August 3; *Accepted for publication:* 2015, August 25;
Address for correspondence: No.17, Mărăşti Av., 1st Dist., Postal Code 011416, Bucharest, Romania
E-mail: andreea2a@yahoo.com
Corresponding author: Andreea Marilena Ionescu, andreea2a@yahoo.com

Introduction

Stress is a natural and indispensable phenomenon because it produces adaptive processes. Reactive oxygen species determine cellular lesions translating into the majority of diseases (Radak et al., 2008).

High intensity physical exercise determines high levels of free radicals in skeletal muscles, producing oxidative stress through mechanisms that are not completely understood, including intracellular calcium balance, inflammation, and cellular oxygen consumption.

In time, oxidative stress induces the destruction of lipids, proteins and nucleic acids, leading to a decrease of physical performance, muscle fatigue, muscle injuries and overtraining among athletes (Tache & Staicu, 2010).

At the same time, oxidative stress induces antioxidant defense in order to limit the damaging effects of free radicals. This translates into a decrease of oxidative stress and an increased tolerance of the human body to oxidative stress. Regular aerobic physical exercise and a regular diet have antioxidant effects (Tache et al., 2009).

Physical exercise represents a complex stress: neuromuscular, oxidative, cardiovascular, respiratory, endocrine, metabolic, emotional, as well as a physiological activator of the endogenous opioid system; therefore, pain suppression should be considered an adaptation response (Tache & Staicu, 2010).

Physical exercise improves the quality of life through all its aspects. Exercise-induced analgesia is a relatively new subject of interest in medical research. The implication of the endogenous opioid system, as well as of serotonin and noradrenaline in the modulation of pain, is currently accepted (Koltyn, 2000).

Hypothesis

The aim of this experimental study was to assess the effects of tramadol administration on the pain threshold and oxidative stress balance in trained animals, and to collect data guiding the design of a larger hypothesis-testing study. This was based on previous positive experimental observations regarding the effects of tramadol on aerobic exercise capacity (Ionescu & Tache, 2011).

Material and methods

Tramadol is a centrally acting synthetic analgesic, with low abuse potential, which produces its effects by binding to opioid receptors and by inhibiting noradrenaline and serotonin reuptake (Ionescu et al., 2015). Tramadol is a mix of enantiomers, in which the (+) enantiomer is four times more powerful than the (-) enantiomer, because it binds the μ-opioid receptor (Zacny, 2005). The non-opioid mechanism is powered by the fact that the effects of tramadol are only 50% blocked by naloxone - the main opioid antagonist (Raffa & Friederichs, 2003). It produces its effects by binding plasma proteins, and its analgesic effect has a peak in the first 2-3 hours after administration. It is extensively metabolized in the liver and it is excreted by the kidneys, with a halftime of 6.3 hours (Mohammad et al., 2013; Ozturk et al., 2008; David et al., 2007).

The assessment of lipid peroxides and aldehydes is the most frequent method used to evidence oxidative stress. Malondialdehyde is an oxidative stress indicator used during physical exercise and was assessed from blood samples.

The antioxidant capacity was assessed using the hydrogen donor capacity from animal serum.

Research protocol

a) Period and place of the research

The study was conducted in accordance with ethical standards on animal experimentation, following the approval of the Ethical Committee of "Iuliu Haţieganu" University of Medicine and Pharmacy, Cluj-Napoca. The study and the measurements were carried out between October and November 2014 at the Physiology Department of the same university.

b) Subjects and groups

The research was performed on 24 male Wistar rats, aged 18 weeks, over a period of 14 days. They were divided into two study groups as follows:

Group I: control group: 12 subjects, receiving placebo, i.e. physiological serum, intraperitoneally, 1 mg/kg body weight, once a day, on the 2nd, 5th and 9th day of the study.

Group II: tramadol group: 12 subjects, receiving tramadol, intraperitoneally, 1 mg/kg body weight, once a day, on the 2nd, 5th and 9th day of the study.

c) Tests applied

All the animals performed a training program daily, for a period of 14 days, by swimming in a pool 100/40/60 cm in size, water level 30 cm, water temperature 21-23 degrees Celsius. Supplement weights were placed on the animals' body and they swam as long as they could float without difficulties (Nayanatana et al., 2005).

The following parameters were assessed:

1. The pain threshold was evaluated by the tail flick test on the 1st, 7th and 14th day of the study, using an Ugo-Basile 37215 device, specially designed to test the pain threshold in small laboratory animals. The device exerts a known constant force on the animal's tail situated on a biological Teflon ring. When the pain threshold is reached, the animal withdraws its tail. The time (seconds) until the animal withdraws its tail is registered. The pain threshold was recorded at 4 different moments of each measurement day: at T0, then after 15 minutes (T15), after 30 minutes (T30), and after 60 minutes (T60) from the first evaluation.

2. At the end of the study, blood samples were obtained from the retro-orbital sinus in order to assess MDA and HD, markers of the oxidant/antioxidant balance.

d) Statistical processing

For data processing, we used StatsDirect v.2.7.2. and Microsoft Office Excel 2010, with comparison statistics as described below.

Results

The two investigated groups were compared. There were no statistical differences between the groups regarding age, body mass, and gender.

As shown in Table I, in the placebo group the pain threshold was higher on the 1st day of evaluation, but it was significantly lower on the 7th day, and continued to decrease on the 14th day of the study. In the tramadol group (Table I), the pain threshold was lower on the 1st day of the study, but it began to increase in a significant manner starting with the 7th day of the research, and maintained this

increasing trend until the last day of the study.

When comparing the two groups, the pain threshold was significantly raised by tramadol and physical exercise (i.e. swimming).

The statistical analysis of the oxidant/antioxidant balance indicators yielded the following results: MDA significantly increased in both groups compared to reference values, but when comparing the two groups, MDA was significantly lower in the tramadol group on the 14th day, as shown in Table II. HD significantly decreased in both groups compared to reference values, but this indicator was significantly higher in the tramadol group on the last day of the study, as shown in Table III.

Discussion

The aim of this study was to investigate the effects of the administration of tramadol on the pain threshold and oxidant/antioxidant balance in trained rats.

It was found that tramadol improved all the evaluated parameters. This was also supported by the results of the

Table I

Comparative analysis of pain indicators studied in the two groups and statistical significance.

Day	Group	Time	Mean	SE	Median	SD	Minimum	Maximum	p			
TF, D1	I	T0	5.1	0.050	5.1	0.172	4.90	5.40	T0-T15	0.0023	I-II, T0	0.179
		T15	5	0.041	5	0.141	4.80	5.20	T0-T30	0.123		
		T30	5.2	0.028	5.2	0.095	5	5.30	T0-T60	0.0068		
		T60	5.3	0.041	5.25	0.141	5.1	5.5	T15-T30	0.0038	I-II, T15	0.1916
									T15-T60	0.001		
									T30-T60	0.0234		
	II	T0	5.00	0.052	5	0.181	4.70	5.30	T0-T15	0.1596	I-II, T30	0.896
		T15	5.1	0.062	5.05	0.213	4.80	5.40	T0-T30	0.0152		
		T30	5.2	0.044	5.2	0.154	4.90	5.40	T0-T60	0.1255		
		T60	5.1	0.044	5.1	0.154	4.8	5.3	T15-T30	0.0671	I-II, T60	0.0053
									T15-T60	1		
									T30-T60	0.0671		
TF, D7	I	T0	5.2	0.033	5.2	0.113	5	5.40	T0-T15	0.1834	I-II, T0	9.29×10^{-13}
		T15	5.1	0.057	5.08	0.197	4.80	5.45	T0-T30	0.0892		
		T30	5.3	0.048	5.3	0.165	5.10	5.60	T0-T60	> 0.9999		
		T60	5.2	0.052	5.1	0.180	5	5.55	T15-T30	6.23×10^{-5}	I-II, T15	3.76×10^{-15}
									T15-T60	0.1294		
									T30-T60	0.1094		
	II	T0	6.3	0.054	6.3	0.186	6	6.70	T0-T15	2.17×10^{-5}	I-II, T30	5.43×10^{-16}
		T15	6.6	0.043	6.55	0.148	6.40	6.90	T0-T30	1.92×10^{-6}		
		T30	6.8	0.029	6.8	0.100	6.60	6.95	T0-T60	0.0005		
		T60	7.1	0.074	7	0.256	6.8	7.5	T15-T30	0.0003	I-II, T60	< 0.0001
									T15-T60	0.0005		
									T30-T60	0.0005		
TF, D14	I	T0	5.1	0.025	5.1	0.088	5	5.25	T0-T15	0.0098	I-II, T0	< 0.0001
		T15	4.9	0.058	4.9	0.201	4.60	5.25	T0-T30	0.0122		
		T30	5.3	0.059	5.33	0.206	5	5.60	T0-T60	> 0.9999		
		T60	5.1	0.041	5.1	0.141	4.9	5.3	T15-T30	0.0001	I-II, T15	2.10×10^{-19}
									T15-T60	0.0048		
									T30-T60	0.0035		
	II	T0	7.3	0.078	7.4	0.271	6.85	7.70	T0-T15	5.12×10^{-6}	I-II, T30	3.55×10^{-18}
		T15	7.8	0.068	7.83	0.236	7.45	8.20	T0-T30	1.7×10^{-6}		
		T30	8	0.075	8	0.260	7.60	8.40	T0-T60	3.06×10^{-7}		
		T60	8.3	0.053	8.325	0.185	7.9	8.55	T15-T30	0.0003	I-II, T60	6.87E-23
									T15-T60	2.89×10^{-6}		
									T30-T60	0.0002		
Group I	T0	D1-D7	0.019	T15	D1-D7	0.1926	T30	D1-D7	0.1748	T60	D1-D7	0.2334
		D1-D14	0.8438		D1-D14	0.0015		D1-D14	0.1602		D1-D14	0.002
		D7-D14	0.0322		D7-D14	0.0307		D7-D14	1		D7-D14	0.3804
Group II	T0	D1-D7	5.46×10^{-10}	T15	D1-D7	4.04×10^{-11}	T30	D1-D7	6.16×10^{-12}	T60	D1-D7	0.0005
		D1-D14	1.29×10^{-10}		D1-D14	1.33×10^{-12}		D1-D14	5.34×10^{-14}		D1-D14	1.35×10^{-13}
		D7-D14	7.36×10^{-9}		D7-D14	5.47×10^{-9}		D7-D14	7.74×10^{-9}		D7-D14	0.0005

Table II

Comparative analysis of malondialdehyde studied in the two groups and statistical significance.

Indicator	Group	Moment	Mean	SE	Median	SD	Minimum	Maximum	p		
MDA	I	D1	1.63	0.040	1.64	0.140	1.39	1.80	D1-D14	D1	0.9774
		D14	2.403	0.161	2.695	0.558	1.33	3	0.0024	I-II	
	II	D1	1.63	0.043	1.66	0.148	1.39	1.80	D1-D14	D14	0.0913
		D14	2.04	0.060	2.075	0.208	1.63	2.38	0.0005	I-II	

Table III

Comparative analysis of hydrogen donors studied in the two groups and statistical significance.

Indicator	Group	Moment	Mean	SE	Median	SD	Minimum	Maximum	p		
HD	I	D1	33.12	0.726	33.55	2.514	27.22	36.59	D1-D14	D1	0.7283
		D14	20.96	1.216	20.4	4.211	15.4	29.1	1.44×10^{-6}	I-II	
	II	D1	33.46	0.634	33.99	2.197	28.25	36.69	D1-D14	D14	0.0147
		D14	25.98	1.443	25.75	4.997	16	35.9	0.0006	I-II	

correlation analysis.

The analgesic effect of tramadol is well known and extensively studied. Our results prove that tramadol not only induces analgesia during intense physical exercise, but this effect has nothing to do with its halftime, because we showed that the pain threshold continued to rise 5 days after the last tramadol administration.

Endogenous pain modulation by the opioid system and central serotonin and adrenaline during physical exercise has become a subject of interest since 2006, when Pallazo proved this implication (Pallazo et al., 2006).

Our results demonstrate the antioxidant effects of tramadol when administered during intense physical exercise, i.e. swimming.

In accordance with our findings, an experimental study showed antioxidant effects of tramadol in myocardial ischemia, suggesting its cardioprotective potential (Bilir et al., 2007; Elmawgoud, 2013).

Meanwhile, in our study, tramadol reduced oxidative stress produced by high intensity physical exercise, by decreasing the levels of the MDA marker. This effect could be linked to its important analgesic role, by decreasing muscle pain through opioid receptor and central nervous system modulators.

A clinical study shows positive effects of tramadol administration on aerobic exercise capacity and pain (Ionescu et al., 2015) in subjects suffering from chronic non-specific low back pain. Our results confirm this finding.

On the other hand, in real life, tramadol is prescribed to many subjects suffering from moderate to severe pain, including athletes, because it is not included in the World Anti-Doping Agency Code (1).

As we previously stated, tramadol reduced muscle pain in healthy trained rats during its administration, and its analgesic effect continued 5 days after the last injection. Moreover, it seems that tramadol has benefits on the oxidant/antioxidant balance when administered during intense physical exercise.

Conclusions

1. Tramadol administration during physical exercise improved the pain threshold and antioxidant defense.
2. Taking into account the aforementioned, we strongly recommend that tramadol should be carefully administered to athletes, because it could act as a doping substance.

Conflicts of interests

Nothing to declare.

Acknowledgments

The present article processes data from the doctoral thesis of the first author.

References

Bilir A, Erkasap N, Koken T, Gulec S, Kaygiviz Z, Tanriverdi B, Kurt I. Effects of tramadol on myocardial ischemia-reperfusion injury. Scand Cardiovasc J. 2007;41(4):242-247.

David C, David I, Tache S, Moldovan R. Influența tramadolului asupra capacității aerobe maxime de efort și asupra pragului sensibilității algice la șobolani antrenați. Palestrica of the IIIrd Millennium – Sports and Civilisation. 2007; 28(2): 108-212.

Elmawgoud AA. Effect of tramadol on fentanyl induced-cough: a double blind, randomised, controlled study. Egypt J Anaesth. 2013; 29:301-304.

Ionescu AM, Manolescu BN, Popa R, Badea R, Savulescu S, Tache S, Berteanu M. Effects of tramadol treatment on aerobic exercise capacity in subjects with chronic non-specific low back pain. Palestrica of the IIIrd Millennium - Sports and Civilisation. 2015;16(3):214-218.

Ionescu AM, Tache S. The effects of acute tramadol administration upon effort capacity in rats. Palestrica of the IIIrd Millennium – Sports and Civilisation. 2011;12(1):11-14.

Koltyn KF. Analgesia following exercise. A review. Sports Med. 2000;29(2):85-98.

Mohammad AT, Jahanshahi A, Sotoudeh A, Mohammad HD, Aslani K, Tackhtfooladi HA. Neuroprotective effects of tramadol on cerebral injuries caused by hind limb ischaemia/reperfusion in rats. Compar Clin Pathol. 2013; 45: 290-301.

Nayanatana AK, Nagaraja HS, Anupama BK. The effect of repeated stimulus stress on organ weights and lipid peroxidation in rats. J Phys Sci. 2005;18(1):3-9.

Ozturk E, Zinnouroglu M, Sezer OA, Gokyar I, Beyazova M, Kaya K. Effects of perineural tramadol on sensory and motor conduction of ulnar nerve. J Opioid Manag. 2008; 4(6): 345-349.

Pallazo E, de Novellis V, Petrosino S, Marabese I, Vita D, Giordano C, Di Marzo V, Mangoni GS, Rossi F, Maione S. Neuropathic pain and the endocannabinoid system in the dorsal raphe: pharmacological treatment and interactions with the serotoninergic system. Eur J Neurosci. 2006;24(7):2011-2020.

Radak Z, Chung HY, Koltay E, Taylor AW, Goto S. Exercise, oxidative stress and hormesis. Ageing Res Rev. 2008;7(1):34-42.

Raffa RB, Friederichs E. Profile of tramadol and tramadol analogues. In Taylor & Francis Group. Pain. Marcel Dekker Inc. 2003,728-739.

Tache S, Bidian C, Ciocoi-Pop DR, Popovici C. Oxidants/antioxidants balance paradox during physical exercise. Palestrica of the IIIrd Millenium – Sports and Civilisation. 2009;36(2):145-152.

Tache S, Staicu ML. Physical effort adaptation of the human body. 1st edn. Risoprint Ed. Cluj-Napoca. 2010,185-191.

Zacny JP. Profiling the subjective, psychomotor, and physiological effects of tramadol in recreational drug users. Drug Alcohol Depend. 2005;80:273-278.

Websites

(1) 2015 Prohibited List. Available from: www.wada-ama.org/en/World-Anti-Doping-Program/Sports-and-Anti-Doping-Organisations/International-Standards/Prohibited-List. Accessed in December 2015.

Palestrica of the third millennium – Civilization and Sport
Vol. 16, no. 4, October-December 2015, 319–323

The effect of hypothermia on exercise capacity
Efectul hipotermiei asupra capacităţii de efort

Sergiu David [1], Nikolaos Mavritsakis [2], Anne-Marie Constantin [3], Monica Popa [4]
[1] Physical Education and Sport discipline, Department 12 of Medical Education, "Iuliu Haţieganu" University of Medicine and Pharmacy
[2] The Geriatrics and Gerontology Centre, Alba Iulia
[3] Histology discipline, Department 1 of Morphological Sciences, "Iuliu Haţieganu" University of Medicine and Pharmacy, Cluj-Napoca
[4] Hygiene discipline, Department 4 of Community Medicine, "Iuliu Haţieganu" University of Medicine and Pharmacy, Cluj-Napoca;

Abstract

Background. Hypothermia, which is a basal body temperature below 35°C, has numerous effects: cardiovascular, respiratory, neuromuscular, metabolic, immunologic, hormonal, renal, and gastrointestinal effects. The body's short-term adaptation to low temperatures is mainly accomplished through vegetative and somatic mechanisms.

Aims. The aim of the experiment was to observe in exercise-trained adult rats the effect of intermittent hypothermic stress on their aerobic exercise capacity, on the one hand, and the cardiovascular changes produced by hypothermic stress, on the other hand.

Methods. The research was conducted on groups of white Wistar rats (n=10 animals/group), thus: group I (the control group) was subjected to thermoneutral conditions, at a temperature of 18-20°C, in the laboratory; group II was subjected to intermittent hypothermia, at 12-13°C, in a cold room; group III was subjected to intermittent hypothermia of 4-5°C, in a cold room. The aerobic exercise capacity was tested based on the swimming test, and the cardiovascular changes during exercise were studied based on direct blood pressure and pulse measurement and on indirect pulse pressure and average blood pressure determination.

Results. A significant increase in the aerobic exercise capacity was noticed in animals that had undergone exercise-training for 14 days and were subjected to the following temperature conditions: 18-20°C, 12-13°C, 4-5°C, as compared to the original values; a significant decrease in the aerobic exercise capacity in animals that had undergone exercise-training for 14 days and were subjected to hypothermia conditions, as compared to the control group; and significant drops in CAE in animals that had undergone exercise-training for 14 days and were subjected to hypothermia conditions of 4-5°C, as compared to those subjected to hypothermia of 12-13°C.

Conclusions. Intermittent hypothermic stress causes a significant decrease in the aerobic exercise capacity in exercise-trained animals and affects the cardiovascular adaptation to exercise, causing bradycardia and hypotension.

Keywords: hypothermia, aerobic exercise capacity, cardiovascular adaptation.

Rezumat

Premize. Hipotermia, temperatura bazală a corpului <35°C, are numeroase efecte: cardiovasculare, respiratorii, neuromusculare, metabolice, imunologice, hormonale, renale, gastrointestinale. Adaptarea de scurtă durată a organismului la temperaturi scăzute se face în principal prin mecanisme vegetative şi mecanisme somatice.

Obiective. S-a urmărit experimental, la şobolani adulţi antrenaţi la efort, efectul stresului hipotermic intermitent asupra capacităţii aerobe de efort şi modificările cardiovasculare produse de stresul hipotermic.

Material şi metodă. Cercetările s-au efectuat pe loturi de şobolani albi, rasa Wistar (n=10 animale/lot), astfel: lotul I – lot martor supus condiţiilor termoneutre la temperatură de 18-20 C în laborator; lotul II – lot supus hipotermiei intermitente, de 12-13°C, în camera frigorifică; lotul III – lot supus hipotermiei intermitente, de 4-5°C, în camera frigorifică. Testarea capacităţii aerobe de efort (CAE) s-a făcut pe baza probei de înot, iar modificările cardiovasculare la efort s-au studiat pe baza determinărilor directe ale tensiunii arteriale şi pulsului şi indirecte pentru presiunea pulsului şi tensiunile arteriale medii.

Rezultate. S-au observat creşteri semnificative ale CAE la animalele antrenate timp de 14 zile, supuse condiţiilor de temperatură: 18-20°C, 12-13°C, 4-5°C, faţă de valorile iniţiale; scăderi semnificative ale CAE la animalele antrenate timp de 14 zile, supuse condiţiilor de hipotermie, faţă de lotul martor; scăderi semnificative ale CAE la animalele antrenate timp de 14 zile, supuse condiţiilor de hipotermie de 4-5°C, faţă de cele supuse hipotermiei de 12-13°C.

Concluzii. Stresul hipotermic intermitent determină scăderi semnificative ale capacităţii aerobe de efort la animalele antrenate şi afectează adaptarea cardiovasculară la efort, determinând bradicardie şi hipotensiune.

Cuvinte cheie: hipotermia, capacitatea aerobă de efort, adaptarea cardiovasculară.

Received: 2015, June 23; *Accepted for publication:* 2015, July 15;
Address for correspondence: "Iuliu Haţieganu" University of Medicine and Pharmacy Cluj-Napoca 400012, No. 8, Victor Babeş St.
E-mail: sergiu.david@yahoo.com
Corresponding author: Sergiu David, sergiu.david@yahoo.com

Introduction

Hypothermia is defined as a basal body temperature below 35°C, caused by environmental exposure to low temperature (below 18°C), drug intoxication or metabolic or nervous system dysfunctions (Meiman et al., 2015).

Hypothermia has a variety of effects:

- cardiovascular effects (initially tachycardia, peripheral vasoconstriction, and consecutively, an increase in the circulating blood volume; as hypothermia progresses, bradycardia sets in, with the reduction of myocardial and blood vessel contractility) (Hauton et al., 2011; Schubert, 1995) and blood-related effects (bone marrow suppression and sideroblastic anaemia, reversible platelet sequestration, reduction of the coagulation activity and the intensification of fibrinolysis) (Mallet, 2002);
- respiratory effects: tachypnea is present in the early stages of moderate hypothermia, followed by a reduction of the respiratory minute volume, of O_2 consumption, and of CO_2 production; in the severe stages of hypothermia, hypoventilation and apnoea, tissue hypoxia, and sometimes pulmonary oedema progressively set in. The reduction of the respiratory function may be followed by a reduction in CO_2 elimination, which leads to the onset of respiratory acidosis (Polderman, 2008);
- neuromuscular effects: due to the reduction in cerebral circulating blood volume, confusion and amnesia set in and, at a later stage, apathy, impaired discernment, dysarthria, unconsciousness, and, ultimately, coma. In the moderate stages of hypothermia, shivering is initially intense but subsequently, as the temperature drops, it subsides. Joint and muscle stiffness sets in (Erecinska et al., 2003; Wartenberg & Mayer, 2008; Cahill et al., 2011; Castellani et al., 2006);
- metabolic effects: the metabolic rate drops by ~ 6-7% with each degree; on the other hand, the generation of lactic acid rises and metabolic acidosis occurs (Schubert, 1995; Mallet, 2002);
- immunological effects: reversible pancytopenia (leukocyte depletion, diapedesis impairment and impairment of neutrophil cell mobility and of the phagocytosis process, with a predisposition to infections) (Sessler, 2009);
- hormonal effects: a decrease in antidiuretic hormone and oxytocin secretion; an increase in the plasma level of corticoids, prolactin, and thyroid stimulating hormone (Staicu & Tache, 2011). Hypothermia that sets in rapidly may induce hyperglycaemia; if hypothermia develops slowly, glycogen stores are depleted and a state of hypoglycaemia may occur (Mallet, 2002);
- renal effects: high diuresis and saliuresis, a reduction in glomerular filtering, through a decrease in cardiac output and in the tubular function (Schubert, 1995; Mallet, 2002);
- gastrointestinal effects: a reduction in intestinal motility, absorption impairment, gastric erosions, deterioration of the hepatic function and of the lactic acid metabolic clearance rate, contributing to metabolic acidosis and pancreatic function impairment, with an increase of the serum amylase level (Schubert, 1995; Mallet, 2002).

Thermoregulation involves a balance between heat loss (thermolysis) mechanisms and heat production (thermogenesis) mechanisms, with the purpose of maintaining the body's thermal homeostasis (Mallet, 2002).

The body's short-term adaptation to low temperatures is achieved via: vegetative mechanisms (an increase of sympathetic tone and adrenaline secretion, and the stimulation of thyroxine production), somatic mechanisms (an increase of muscle tone, thermal shivering), and other mechanisms (favourable microclimate conditions, clothing) (Staicu & Tache, 2011; Gavhed, 2003; Barrett et al., 2010).

Objectives

The following were monitored in the case of adult rats subjected to physical exercise:

- the effect of acute intermittent hypothermic stress on their aerobic exercise capacity;
- the cardiovascular changes produced by hypothermic stress.

Hypothesis

Acute exposure to cold environment conditions causes the body to acclimate, with the conservation of heat through vasoconstriction and the stimulation of heat generation through chemical thermogenesis, a process stimulated especially by physical exercise, where observations have shown a decrease in the aerobic exercise capacity. Our aim was to study whether acclimation through laboratory-controlled acute exposure could influence the physical exercise capacity and cardiovascular adaptation.

Material and methods

The experimental studies conducted on rats were prospective longitudinal analytical studies. The research was carried out as per approval no. 189/8.04.2015 of the Bioethics Commission, in accordance with the legislation in force.

a) Period and place of the research

The research was carried out during the period February 1 – March 10, 2015, in the Experimental Physiology Laboratory of the "Iuliu Haţieganu" University of Medicine and Pharmacy, Cluj-Napoca.

Research protocol

b) Subjects and groups

The research was carried out on groups of white Wistar rats (n=10 animals/group), aged18 weeks, weighing 280-300 grams, kept under adequate vivarium conditions: temperature and humidity, normocaloric food of 20 g/day/animal consisting of granulated combined feed, and water ad libitum. During the research period, the legislation in force regarding animal protection was observed; at the end of the experiment, the animals were euthanised.

Groups

The animals were exposed to low temperatures for 4 hours, on a daily basis, in the cold room of the Experimental Physiology Laboratory of the "Iuliu Haţieganu" University of Medicine and Pharmacy, Cluj-Napoca. The research was conducted on 3 groups of animals (n=10 animals/group):

- group I, the control group, which was subjected to thermoneutral conditions at a temperature of 18-20^0 C in the laboratory and was exercise-trained;
- group II, which was subjected to intermittent hypothermia (12-13°C), in the cold room;
- group III, which was subjected to intermittent hypothermia (4-5°C), in the cold room.

After being exposed, the animals of groups II and III were subjected to hypothermia and physical effort.

c) Tests applied

- The aerobic exercise capacity was tested based on the swimming test in a tank 100x40x60 cm in size, with a water level of 30 cm, the water being thermostatic at a temperature of 21-23ºC[101]. The measurements were made at 7 a.m. The duration of the test was timed (in seconds), from the moment the animals were immersed in the tank until they became exhausted (floating, tendency to sink or attempts to cling to the edge of the tank). The aerobic exercise capacity values were expressed in seconds. The duration of the physical exercise period was 14 days. The moments of time taken into study were day 1, day 7, and day 14.

- The cardiovascular changes under exercise conditions were studied based on direct blood pressure and pulse measurements and on indirect measurements of pulse pressure and average blood pressures, which was achieved with the aid of a tail cuff and the Biopack MP 150 device. Blood pressure values were expressed in mmHg and pulse values were expressed in cycles/min. The measurements were made one hour after the completion of the experiment, on day 14.

The calculation formulas used were the following:

$$PP=SBP-DBP$$

$$MAP=DBP + (SBP-DBP)/3$$

in which:

PP = pulse pressure, SBP = systolic blood pressure, DBP = diastolic blood pressure, MAP = mean arterial pressure.

d) Statistical processing

Descriptive statistics elements were calculated, the data being presented using centrality, localization, and distribution indicators.

For the testing of normal distribution, the Shapiro-Wilk test was used. Variance was tested via the F or Levene and/or Bartlett tests.

Statistical processing was performed using the Excel application (of the Microsoft Office 2007 package) and the StatsDirect v.2.7.2 program. The results were graphically represented via the Excel application (of the Microsoft Office 2007 package).

Results

The influence of hypothermic stress on the aerobic exercise capacity of exercise-trained animals (Table I)

In the statistical analysis of the exercise capacity values, *taking into account all three groups,* statistically highly significant differences were observed between at least two of the groups, on days 1, 7, and 14 ($p < 0.0001$).

In the statistical analysis of the exercise capacity values *for non-paired tests,* the following were observed:

- on day 1 – statistically highly significant differences between groups I-II, I-III, and II-III ($p < 0.001$);
- on day 7 – statistically highly significant differences between groups I-II, I-III, and II-III ($p < 0.001$);
- on day 14 – statistically highly significant differences between groups I-II, I-III, and II-III ($p < 0.001$).

In the statistical analysis of the exercise capacity values, *taking into account all three days (the moments of time),* statistically highly significant differences ($p < 0.001$) were observed between at least two of the days, in the case of all groups.

In the statistical analysis of the exercise capacity values *for paired tests,* the following were observed:

- in the case of group I – statistically highly significant differences between days 1-7, 1-14, and 7-14 ($p < 0.001$);
- in the case of group II – statistically very significant differences between days 1-7, 1-14, and 7-14 ($p < 0.01$);
- in the case of group III
- statistically highly significant differences between days 1-14 ($p < 0.001$);
- statistically very significant differences between days 1-7 and 7-14 ($p < 0.01$).

Cardiovascular changes through hypothermic stress, dependent on physical exercise (Table II)

In the statistical analysis of the pulse values, *taking into account all three groups,* statistically significant differences were observed between at least two of the groups ($p = 3.58 \times 10^{-15}$).

In the statistical analysis of the pulse values *for non-paired tests,* statistically highly significant differences were observed between groups I-II and I-III ($p < 0.001$).

In the statistical analysis of systolic blood pressure, *taking into account all three groups,* statistically highly significant differences were observed between at least two of the groups ($p = 0.0004$).

In the statistical analysis of systolic blood pressure *for non-paired tests,* the following were observed:

- statistically highly significant differences between groups I-II ($p < 0.001$)
- statistically very significant differences between groups II-III ($p < 0.01$).

In the statistical analysis of diastolic blood pressure, *taking into account all three groups,* statistically very significant differences were observed between at least two of the groups ($p = 0.017$).

In the statistical analysis of diastolic blood pressure *for non-paired tests,* statistically highly significant differences were observed between groups I-III ($p < 0.001$).

In the statistical analysis of the mean arterial pressure values, *taking into account all three groups,* statistically

Table I

Comparative analysis for the (dry) exercise capacities in the case of the studied groups and statistical significance.

Group	Day	Average	SE	Median	SD	Min.	Max.			p	
	1	1863.1	18.9106	1874	59.8005	1770	1937	Day 1		Group I	
I	7	2305	28.8074	2308	91.097	2181	2418	I-II	2.3×10^{-17}	d1 - d7	3.65×10^{-9}
	14	2704.7	29.389	2694	92.9361	2592	2876	I-III	8.89×10^{-19}	d1 - d14	3.81×10^{-11}
	1	943	21.4326	927	67.7758	863	1068	II-III	5.22×10^{-9}	d7- d14	1.05×10^{-9}
II	7	1129	15.8015	1158	49.9689	1041	1175	Day 7		Group II	
	14	1481.7	31.2972	1508.5	98.97	1339	1581	I-II	< 0.0001	d1 - d7	0.002
	1	638.3	11.3823	624	35.994	594	693	I-III	< 0.0001	d1 - d14	0.002
III	7	758.3	7.68411	751.5	24.2993	732	787	II-III	< 0.0001	d7- d14	0.002
	14	977.6	17.3251	985	54.7869	903	1062	Day 14		Group III	
	1	1.63×10^{-27}		Days	group I	2.38×10^{-18}		I-II	< 0.0001	d1 - d7	0.002
I-II-III	7	< 0.0001		1-7-14	group II	< 0.0001		I-III	3.5×10^{-18}	d1 - d14	1.83×10^{-8}
	7	< 0.0001			group III	< 0.0001		II-III	< 0.0001	d7- d14	0.002

Table II

Comparative analysis for the values of pulse (cycles/min), systolic blood pressure, diastolic blood pressure, mean arterial pressure (mmHg), and pulse pressure in the case of the studied groups and statistical significance.

	Group	Average	SE	Median	SD	Min.	Max.		p
Pulse	I	93.9	1.5308	93.5	4.8408	87	101	I-II	5.75×10^{-10}
	II	68.9	0.9481	69.5	2.9981	64	73	I-III	9.64×10^{-11}
	III	66.4	1.2401	65.5	3.9215	61	73	II-III	0.1277
	I-II-III				3.58×10^{-15}				
Systolic blood pressure	I	84	0.6325	83.5	2	82	88	I-II	< 0.0001
	II	69.6	1.3013	71	4.1150	60	73	I-III	0.6823
	III	82.9	2.5318	85.5	8.0062	69	91	II-III	0.0016
	I-II-III				0.0004				
Diastolic blood pressure	I	65.1	1.2863	64	4.0678	60	73	I-II	0.0877
	II	61.4	1.5861	60	5.0155	54	69	I-III	0.0003
	III	58.1	0.6046	58	1.9120	55	61	II-III	0.0757
	I-II-III				0.0017				
Mean arterial pressure	I	71.4	1.0229	70.7	3.2348	67	78	I-II	0.0003
	II	64.13	1.2474	64.17	3.9447	59	70	I-III	0.0021
	III	66.37	1.0357	67.83	3.2752	60	69	II-III	0.2024
	I-II-III				0.0009				
Pulse pressure	I	18.9	0.9244	19.5	2.9231	15	22	I-II	0.0002
	II	8.2	1.7565	7.5	5.5538	2	19	I-III	0.1082
	III	24.8	2.4258	25.5	7.671	14	34	II-III	4.46×10^{-5}
	I-II-III				0.0001				

highly significant differences were observed between at least two of the groups ($p = 0.0009$).

In the statistical analysis of the mean arterial pressure values *for non-paired tests,* the following were observed:

- statistically highly significant differences between groups I-II ($p < 0.001$);

- statistically very significant differences between groups I-III ($p < 0.01$).

In the statistical analysis of the pulse pressure values, *taking into account all three groups,* statistically highly significant differences were observed between at least two of the groups ($p = 0.0001$).

In the statistical analysis of the pulse pressure values *for non-paired tests,* statistically highly significant differences were observed between groups I-II and II-III ($p < 0.001$).

Discussions

Our results show the following:

- a significant increase in the aerobic exercise capacity of animals that were exercise-trained for 14 days, subjected to the following temperature conditions: 18-20°C, 12-13°C, 4-5°C, as compared to the initial values;

- a significant decrease in the aerobic exercise capacity of animals that were exercise-trained for 14 days, subjected to hypothermia conditions, as compared to the control group;

- a significant decrease in the aerobic exercise capacity of animals that were exercise-trained for 14 days, subjected to hypothermia conditions of 4-5°C, as compared to the ones subjected to hypothermia of 12-13°C.

Like all environmental stressors, thermal stress represents an event ranging from deterioration in performance to life-threatening pathology. In athletes, for example, immersion in cold water causes cardiovascular problems, by reducing circulating blood volume, due to hydrostatic squeeze and cold-induced vasoconstriction, producing diuresis during immersion (Tipton & Bradford, 2014). The cold shock response on initial immersion includes a gasp response, uncontrollable hyperventilation, tachycardia, hyperventilation and an increase in circulating levels of stress hormones (Tipton, 1989).

When the muscle and deep body temperature is lowered, there is a drop in the maximum aerobic capacity (Tipton, 1999). Cooled muscle is required to use anaerobic metabolism at lower submaximal workloads; this can result in an earlier appearance of blood lactate (Choi et al., 1996) and more rapid depletion of carbohydrate stores and, as a consequence, an earlier onset of fatigue (Martineau & Jacobs, 1988; Bergh, 1980).

Globally, the decrease in the aerobic exercise capacity (AEC) under the influence of hypothermic stress can be due to:

- the activation of certain vegetative mechanisms, with peripheral vasoconstriction;

- the constriction of the arrector pili (hair-raising) muscles;

- the increase in the sympathetic tone and adrenaline secretion;

- the increase in the production of thyroxine and its effect of enhancing calorigenesis by adrenaline;

- somatic mechanisms: the position of the animals, muscle tone increase, thermal shivering;

- the activation of antioxidant mechanisms (Xing et al., 2014);

- the subsiding of hypothalamic hypothermia (Staicu & Tache, 2011; Fonseca et al., 2014; Brazaitis et al., 2012);

Our results show that the cardiovascular indicators that were measured one hour after exercise, on day 14, indicate cardiovascular adaptation:

- a significant decrease in the pulse rate of animals subjected to hypothermia (groups II and III), as compared to the control group (group I);

- a significant decrease in systolic blood pressure, mean arterial pressure, and pulse pressure in the case of the group subjected to hypothermia of 12-13°C, as compared to the control group;

- a significant decrease in systolic blood pressure and pulse pressure in the case of the group subjected to hypothermia of 4-5° C, as compared to the group subjected to hypothermia of 12-13°C.

The cardiovascular changes under the influence of intermittent hypothermic stress may be due to the influence of the temperature of the thermogenic hypothalamic centre of the posterior and lateral hypothalamus, inhibited by the

anti-thermal centre situated in the anterior hypothalamus in interrelation with the hypothalamic centres (Staicu & Tache, 2011).

Exercise under hypothermic conditions may induce significant changes in anabolic hormones and circulating inflammatory mediators. Also, hypothermia may occur in athletes competing during open water swimming events (Castro et al., 2009). During passive hypothermic recovery or rewarming, the choice of the oxidative substrate for sustaining shivering is regulated entirely by changes in the carbohydrate oxidation rate (Haman et al., 2007).

In human competitions, there is a continuous search of legal means for improving athletic performance. Precooling techniques can be used, for example, in order to improve intermittent sprint exercise performance (Castle et al., 2006).

In fact, cold therapy (cryotherapy) is widely used to treat sports injuries, as a recovery method following training and competition that may cause some level of traumatic muscle injury (Barnett, 2006; Wilcock et al., 2006) and also, for the recovery between training sessions in order to reduce muscle soreness (Lane & Wenger, 2004; Yanagisawa et al., 2003).

The influence of hypothermia on the body's exercise capacity may be involved in:

- mountain climbing at medium and high altitudes and mountain climbing in areas that are more difficult to access;
- sporting activities in the cold season: sledding, alpine skiing, cross-country skiing, biathlon, Nordic sports;
- activities under difficult climatic conditions: cold, snow, wind, fog, winter season activities;
- military applications of the mountain gendarmes and mountain troops;
- the activities of mountain rescuers and personnel working in high-altitude weather stations.

Conclusions

1. Acute intermittent hypothermic stress causes significant drops in the aerobic exercise capacity of exercise-trained animals.

2. Acute intermittent hypothermic stress affects cardiovascular adaptation to effort, causing bradycardia and hypotension.

Conflicts of interests

Nothing to declare

Acknowledgments

This paper represents a partial exploitation of the results of the fist author's current thesis.

References

Barnett A. Using recovery modalities between training sessions in elite athletes: does it help? Sports Med, 2006; 36(9):781-796.

Barrett KE, Barman SM, Boitano S, Brooks HL, Ganong`s Review of Medical Physiology, 23 rd. Ed, Mc Graw Hill Lange, International Edition, 2010.

Bergh U. Human power at subnormal body temperatures. Acta Physiol Scand.1980;478:1-39.

Brazaitis M, Skurvydas A, Pukėnas K, Daniuseviciūtė L, Mickevicienė D, Solianik R. The effect of temperature on amount and structure of motor variability during 2-minute maximum voluntary contraction. Muscle Nerve, 2012;46(5):799-809.

Cahill F, Kalmar JM, Pretorius T et al. Whole-body hypothermia has central and peripheral influences on elbow flexor performance. Exp Physiol, 2011;96(5):528-538.

Castellani JW, Young AJ, Ducharme MD et al. Prevention of cold injuries during exercise. Med Sci Sports Exerc, 2006;38(11):2012-2029.

Castle PC, Macdonald AL, Philp A, Webborn A, Watt PW, Maxwell NS. Precooling leg muscle improves intermittent sprint exercise performance in hot, humid conditions. J Appl Physiol (1985), 2006; 100(4):1377-1384.

Castro RR, Mendes FS, Nobrega AC. Risk of hypothermia in a new Olympic event: the 10-km marathon swim. Clinics (Sao Paulo), 2009;64(4):351-356.

Choi JS, Ahn DW, Choi JK, Kim KR, Park YS. Thermal balance of man in water: prediction of deep body temperature change. Appl Hum Sci. 1996;15(4):161-167. doi: 10.2114/jpa.15.161.

Erecinska M, Thoresen M, Silver AI. Effects of hypothermia on energy metabolism in mammalian central nervous system. J Cerebr Blood Flow Metab. 2003; 23(3):513-530.

Fonseca CG, Pires W, Lima MR, Guimarães JB, Lima NR, Wanner SP. Hypothalamic temperature of rats subjected to treadmill running in a cold environment. PLoS One, 2014;9(11):e111501. doi: 10.1371/journal.pone.0111501.

Gavhed D. Human responses to cold and wind. Ed. National Institute for Working Life, Stockholm, Sweden, 2003;7-9.

Haman F, Scott CG, Kenny GP. Fueling shivering thermogenesis during passive hypothermic recovery. J Appl Physiol (1985), 2007;103(4):1346-1351.

Hauton D, May S, Sabharwal R et al. Cold-impaired cardiac performance in rats is only partially overcome by cold acclimation. J Exp Biol. 2011;214(Pt 18):3021-3031.

Lane KN, Wenger HA. Effect of selected recovery conditions on performance of repeated bouts of intermittent cycling separated by 24 hours. J Strength Cond Res 2004;18(4):855-860.

Mallet ML. Pathophysiology of accidental hypothermia. Q J Med. 2002; 95:775-785. DOI: http://dx.doi.org/10.1093/qjmed/95.

Martineau L, Jacobs I. Muscle glycogen utilization during shivering thermogenesis in humans. J Appl Physiol. 1988;65(5):2046-2050.

Meiman J, Anderson H, Tomasallo C. Hypothermia-related deaths-Wisconsin, 2014, and United States, 2003-2013. MMWR Morb Mortal Wkly Rep, 2015;64(6):141-143.

Polderman KH. Induced hypothermia and fever control for prevention and treatment of neurological injuries. Lancet, 2008;371:1955-1969.

Schubert A. Side effects of mild Hypothermia. J Neurosurg Anesth. 1995;7(2):139-147.

Sessler DI. Thermoregulatory defense mechanisms. Crit Care Med, 2009;37(7):S203- S210.

Staicu ML, Tache S. Adaptarea organismului la efort fizic *(i.e., The Body's Adaptation to Physical Effort)*. Vol. 2. Ed. Risoprint, Cluj-Napoca, 2011,114-116,183-191,204-205.

Tipton M, Bradford C. Moving in extreme environments: open water swimming in cold and warm water. Extrem Physiol Med, 2014;3:12. doi: 10.1186/2046-7648-3-12.

Tipton MJ, Franks CM, Gennser M, Golden FSC. Immersion death and deterioration in swimming performance in cold water. Lancet, 1999;354(21):626-629.

Tipton MJ. The initial responses to cold-water immersion in man. Clin Sci, 1989;77:581-588.

Wartenberg KA, Mayer SA. Use of induced hypothermia for neuroprotection: indications and applications. Future Neurol. 2008;3(3):325-361.

Wilcock IM, Cronin JB, Hing WA. Physiological response to water immersion: a method for sport recovery? Sports Med, 2006;36(9):747-765.

Xing JQ, Zhou Y, Chen JF, Li SB, Fang W, Yang J. Effect of cold adaptation on activities of relevant enzymes and antioxidant system in rats. Int J Clin Exp Med, 2014;7(11):4232-4237.

Yanagisawa O, Miyanaga Y, Shiraki H, Shimojo H, Mukai N, Niitsu M, Itai Y. The effects of various therapeutic measures on shoulder strength and muscle soreness after baseball pitching. J Sports Med Phys Fitness 2003;43(2):189-201.

Palestrica of the third millennium – Civilization and Sport
Vol. 16, no. 4, October-December 2015, 324–328

A method for the analysis of the take-off and the flight start in the long jump

O metodă de analiză a desprinderii și a debutului fazei de zbor din proba de săritură în lungime

Maria Violeta Guiman [1], Ioan Burcă [2]
[1] *Transylvania University of Braşov*
[2] *University of Medicine and Pharmacy, Târgu Mureş*

Abstract

Background. In order to improve the technique of the long jump, aimed at achieving performance, a detailed analysis of each phase of the jump is done.

Aims. In this paper, a method of analysing from a mechanical point of view the moment of the take-off (both take-off velocity and take-off angle) and the beginning of the flight phase is presented.

Methods. The used method is based on the video data processing for some athletes during the performance test, records obtained with a high-speed video camera.

Results. Using the Adobe After Effects code, the markers' trajectory was analysed, and the main coordinates of these markers were obtained. Through the MATLAB code, calculations for both the take-off velocity and the take-off angle were completed.

Conclusions. The jumper's take-off velocity with its two components (vertical and horizontal) and the take-off angle have a major influence on the length of the jump.

Keywords: biomechanics, movement analysis, long jump, take-off velocity, take-off angle

Rezumat

Premize. În vederea îmbunătățirii tehnicii de executare a săriturii în lungime, care are ca scop obținerea performanței, se realizează o analiză, cât mai detaliată, a fiecarei faze a săriturii.

Obiective. În acest articol este prezentată o metodă de analiză a fazei de desprindere, cât și a debutului fazei de zbor, din punct de vedere mecanic (viteza de desprindere, unghiul de desprindere).

Metode. Metoda de analiză are la bază prelucrarea înregistrărilor video ale unor atleți în timpul executării probei, înregistrări obținute cu o cameră video de mare viteză.

Rezultate. Cu programul Adobe After Effects a fost urmărită traiectoria markerilor, ulterior obținându-se coordonatele acestor markeri. Prin intermediul programului MATLAB s-a realizat calculul vitezei de desprindere și a unghiului de desprindere.

Concluzii. Viteza de desprindere a atletului, cu cele două componente ale sale, componenta verticală si cea orizontală, cât și unghiul de deprindere au o influență majoră asupra lungimii săriturii.

Cuvinte cheie: biomecanică, analiza mișcării, săritura în lungime, viteza de desprindere, unghiul de desprindere.

Introduction

The subject of this paper is based on the interest in the human ability to set new records in athletic tests. The aim of exercise biomechanics is to improve the mechanical efficiency of the human body forces and to indicate practical methods to increase performance, depending on the purpose of training. The athletic trial selected in the present work is the long jump test, including a very important stage of it, which is thoroughly analysed, especially from a mechanical point of view. The long jump phases, in the order of their succession, are as follows (Burcă et al., 2010; Hay et al., 1990; Ionescu-Bondoc, 2007; Mihăilă et al., 2008): the run-up, the take-off, the flight, and the landing.

The take-off is considered an essential phase in the long jump test, being at the same time the most difficult one because during the execution of this phase the entire system of forces is recovered, especially at the time of getting vertical speed and keeping as much as possible horizontal speed, and these components require a high performance level. From a biomechanical point of view, the take-off is very difficult to perform. This difficulty is given by the driving actions at the time of the contact with the ground, by the switch to the flight phase, resulting in

Received: 2015, September 5; *Accepted for publication:* 2015, September 26;
Address for correspondence: Transylvania University of Braşov, Department of Mechanical Engineering, Postal address: Politehnicii Street, room NP-1, 500024, Braşov, Romania, Phone +40 - 722473872
E-mail: violeta.guiman@unitbv.ro
Corresponding author: Violeta Guiman violeta.guiman@unitbv.ro

the ground run-up of the athlete.

A segmentation of this phase into successive moments includes:

- the moment of placing the take-off foot on the board;
- the moment of shock taking up;
- the moment of active take-off.

At the time of the take-off, the horizontal velocity developed in the run-up phase decreases by 1-2 m/s, which represents 9.5-14% of the take-off velocity. The high value of the correlation coefficient (r = 0.66) between the decreasing horizontal velocity and the increasing vertical velocity indicates the fact that specific decrease is higher when both the projection angle of the athlete's mass centre (MC) and the height of the jump (trajectory) increase (Popov, 1971; Tiupa et al., 1982).

In the case of research performed on a sample of elite athletes, it appears that the distance of the jump is mainly influenced by horizontal speed, the value of the correlation between horizontal speed and the jumping distance being D = 0.79, and that of the correlation between vertical speed and the jumping distance D = 0.68 (Nigg, 1974).

Research carried out on a diversified group of long jumpers (in terms of performance) showed that the jump distance is influenced by the dominant vertical speed (Ballreich et al., 1986; Kollath, 1982).

According to Popov, it is better to obtain a projection angle of the detachment around 20-22º; a higher value than the above mentioned involves a higher influence of the take-off velocity, and a lower value of the angle influences the ground run-up force (Popov, 1971).

From a mechanical point of view, the ideal take-off angle is 45º, but this statement is based on the assumption that the speed issue is a constant that is independent of the projection angle; in reality, however, neither the speed nor the take-off angle is independent. Depending on both the take-off speed and the processing power of the upward force, take-off angles between 22-28º are found.

One way of calculating the optimum take-off angle is given by Tsuboi. The proposed model of the take-off includes three parameters: horizontal velocity of the mass centre, speed and angle of the take-off. The optimum take-off angle is determined as a function of these parameters. Fig. 1 illustrates the take-off model characterised by three parameters V, w and ψ. The V parameter defines the horizontal velocity of the athlete's mass centre, which before represents the run-up velocity. The w parameter is the take-off speed generated by the foot jump, and Ψ is the take-off angle that represents the angle between the horizontal velocity of the mass centre and the take-off speed (Tsuboi, 2010).

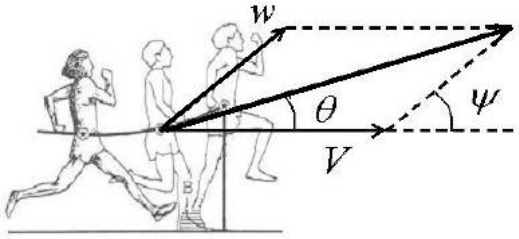


Fig. 1 – The take-off model (Tsuboi, 2010).

Considering the model described above, one can find the take-off speed component (u_i, v_i):

$$u_i = V + w\cos\psi \quad (1)$$

$$v_i = w\sin\psi \quad (2)$$

from which the angle of the resultant velocity θ is obtained (Fig. 1):

$$\tan\theta = \frac{v_i}{u_i} = \frac{w\sin\psi}{V + w\cos\psi} \quad (3)$$

Based on Fig. 1 and relations (1) - (3), the optimum take-off angle relation is obtained (Tsuboi, 2010):

$$\cos\psi_{opt} = \frac{1}{3}\left(\frac{V}{w}\right)\left\{\frac{1}{2} + \left(\frac{w}{V}\right)^2 + \frac{gh}{V^2}\right\}\left(2\cos\frac{\varphi}{3} - 1\right) \quad (4)$$

where

$$\cos\varphi = -1 + \frac{27}{2}\left(\frac{w}{V}\right)^2\left\{\frac{1}{2} + \left(\frac{w}{V}\right)^2 + \frac{gh}{V^2}\right\} \Big/ \left\{\frac{1}{2} + \left(\frac{w}{V}\right)^2 - \frac{gh}{V^2}\right\}^3 \quad (5)$$

and h is the vertical displacement of the mass centre (MC).

Long jumpers during the flight phase move due to inertia. From the take-off moment, the jumper's MC is influenced by gravity and an accelerated motion follows with a uniform downward acceleration that is the acceleration of gravity. In terms of vertical motion, in the first half of the jump, the jumper's MC has a uniform slowed rise, and in the second half, it falls uniformly accelerated (Mihăilă et al., 2008). The proposed model of the jumper's body was validated by an experimental test consisting of video data recording with a high speed camera (AOS X - PRI).

Hypothesis

The aim of this paper is to develop a method, based on a mechanical concept, which can offer the possibility to analyse the take-off phase from the moment of ground run-up and the flight phase.

Material and methods

The following aspects were presented to each athlete: the nature of the research, the fact that the obtained data will be strictly used for research purposes, and at the end of the tests, each athlete and each coach signed an informed consent regarding their involvement in experimental research. The records were done during training, without any disturbance of the athletes' activity.

Research protocol

a) Period and place of the research

The experimental records were done during training in a summer camp conducted by the Athletics Squad at the National Sports Complex located in Poiana Brasov. The tests were performed during a period of two weeks in July, 2014.

b) Subjects and groups

The research included four international long jump athletes with high level competition performance: two females and two males. All of them were members of the

Romanian National Athletic Team and they had different jump techniques.

c) Tests applied

The data were obtained based on the trajectory of special coloured markers that were attached on each athlete's body (Fig. 2). The positions of the markers were established considering both the mechanical model and the suggestions and acceptance of the trainers. The position of each marker was chosen on the same side as the video camera, at a proper distance. The video recorded data were later used to analyse the motion trajectory (Mihălcică et al., 2014a).

Fig. 2 – Attachment of markers.

d) Statistical processing

All four jumpers performed 10 jumps. The jumpers' trajectories were recorded with a video camera that had a resolution of 800x600 pixels at 500 frames/s.

Using the recorded images of the markers, based on inverse kinetics, accelerations and velocities can be found. Also, considering the video records of the markers, the geometrical dimensions of the body segments and the angles between them can be established.

Results

The recorded data were processed with the Adobe After Effects code. The code allows obtaining the main motion trajectory and can be used in professional video editing and visual effects creation (Christiansen, 2007). Fig. 3 shows the trajectory of the jumper's mass centre.

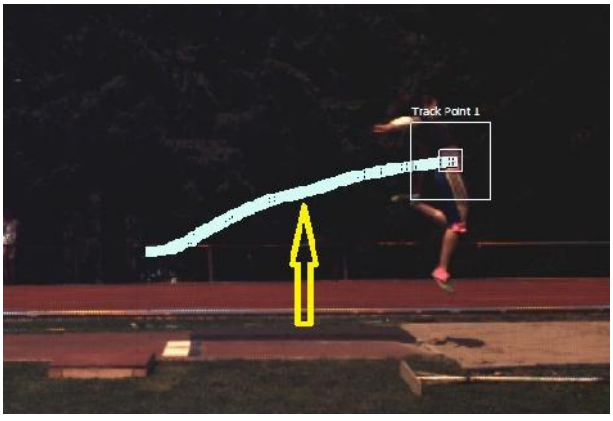
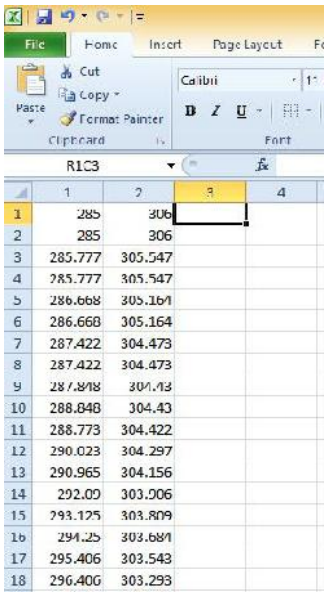


Fig. 3 – Marker position-based trajectory (Adobe After Effects).

The Adobe After Effects code is not specially designed for direct motion analysis. The code does not achieve export of automatic marker coordinates. As a result, it is necessary to copy the recorded data in a desired format to be processed with a specialised program (Mihălcică et al., 2014b). The specialised code used was EXCEL (Fig. 4).



	1	2	3	4
1	285	306		
2	285	306		
3	285.777	305.547		
4	285.777	305.547		
5	286.668	305.164		
6	286.668	305.164		
7	287.422	304.473		
8	287.422	304.473		
9	287.848	304.43		
10	288.848	304.43		
11	288.773	304.422		
12	290.023	304.297		
13	290.965	304.156		
14	292.09	303.906		
15	293.125	303.809		
16	294.25	303.684		
17	295.406	303.543		
18	296.406	303.293		

Fig. 4 – Marker position exported in EXCEL.

Based on converted data in EXCEL, the facilities of the MATLAB code were used for the analysis of some important phases of the long jump: the last stride of the approach run-up, the take-off, and the start of flying through the air (Mihălcică et al., 2014b; Guiman et al., 2014).

Considering the measured data, a graphical representation of the real motion could be completed. From a mechanical point of view, it was useful to find, considering experimental data, an approximate equation of the jumper's trajectory within an acceptable range.

Polynomial approximations were performed. Trajectory approximation considering the path markers by this method is beneficial as multiplication coefficients are determined, based on which other parameters such as speed or acceleration can be derived.

Considering the case of a second degree polynomial function approximation, the shape of the trajectory should be given by:

$$y = a_0 + a_1 x + a_2 x^2 \qquad (6)$$

which by first derivative leads to the velocity relation:

$$\dot{y} = 2a_2 x + a_1 \qquad (7)$$

and by second derivative leads to acceleration:

$$\ddot{y} = 2a_2 \qquad (8)$$

Using the routine *cftool* of the MATLAB code, in the *Curve Fitting Tool* window (Fig. 5) (Mihălcică et al., 2014c), the following were obtained:

- abscissa data - time, in this case;
- ordinate data - jump height;
- degree of the polynomial function (second degree in this case).

The code allowed determining the coefficients of the relation (6). Based on the coefficients found, the graph of the equation (6) and the graph obtained from the considered experimental data could be compared. At the same time, the regression coefficient could be found for an image of the accuracy of the approximation that was performed (Fig. 5).

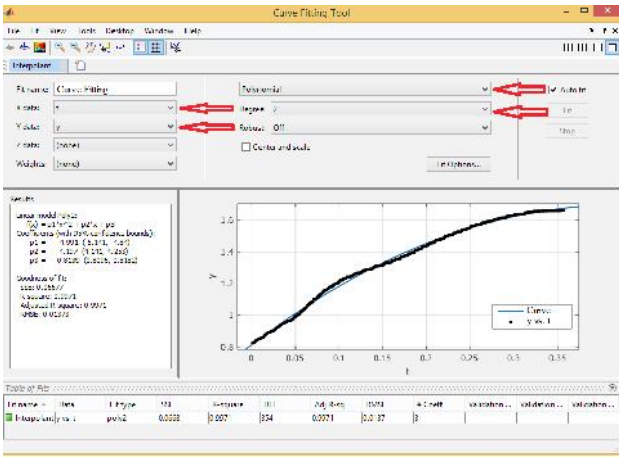


Fig. 5 – Selected options in the *Curve Fitting Tool* window.

Considering the facilities of the code (*File->Print to Figure->Edit->Figure Properties*) (Fig. 6), the comparison between the recorded data and polynomial function approximation is highlighted.

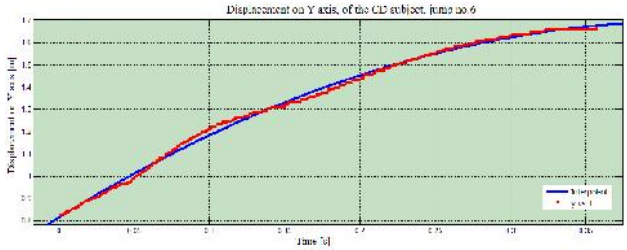


Fig. 6 – Jump height vs. time.

Another representation refers to the length of the jump. Based on the *Curve Fitting Tool* (Fig. 5), the following data were found:

- abscissa data - time, in this case;
- ordinate data - jump length;
- degree of the polynomial function (first degree in this case).

Again, a comparison between the recorded data and polynomial function approximation was made (Fig. 7).

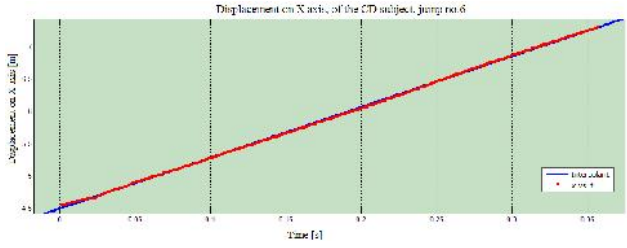


Fig. 7 - Jump length vs. time.

Denoting with V_x the horizontal velocity of the mass centre (MC) at the take-off and with V_y the vertical velocity of the mass centre (MC) at the same moment, the take-off angle of the mass centre relative to the horizontal direction is given by the relation:

$$tg\,\theta = \frac{V_y}{V_x} \qquad (9)$$

and the angle value results:

$$\theta = arctg\left(\frac{V_y}{V_x}\right) \qquad (10)$$

Considering the relations (9) and (10), the angle of the mass centre relative to the horizontal direction can be obtained.

Discussions

From an experimental point of view, the presented method provides some facilities. The system used is an integrated one, allowing its application to similar research. At the same time, data recording requires a laptop and a high speed video camera, both with batteries. Experimental data regarding the long jump trial can be obtained indoors or outdoors. The ideal recording environment is outdoors (e.g. stadiums), where there is natural light, while indoors, additional light sources are needed.

From the point of view of processing, the proposed method is a simple one and involves the use of a code that has special data processing and curve fitting facilities. The obtained data were processed using a video code and a specialised mathematical code. At the end, based on measurements, different approximation curves as well as polynomial approximations could be defined.

Conclusions

1. Generally, the parameters that influence the quality of the long jump are: the length of the run-up, the run-up velocity, the moment of the take-off, the angles between different parts of the athlete's body, the take-off angle of the mass centre in relation to the horizontal direction, the take-off velocity of the mass centre with its two components (horizontal and vertical).
2. The main parameters that can increase the athlete's performance are the take-off velocity and the take-off angle.
3. The above model can be applied to increase and optimise the performance of jumpers considering their human driving forces.

Conflicts of interests

There are no conflicts of interests.

References

Ballreich R, Bruggemann P. Biomechanik des weitsprungs. In: Biomechanik der leichtathletik, Stuttgart, 1986.

Burcă I, Szabo B, Ciulea L. Atletism 1 - Note de curs, Litografiat Universitatea de Medicină şi Farmacie, Târgu-Mureş, 2010.

Christiansen M. Adobe After Effects CS3 Professional, Studio Techniques, Adobe Press, 2007.

Guiman MV, Mihălcică M, Munteanu MV. A method for determinate the run-up velocity of the long jump. The 5th International Conference ”Advanced Composite Materials Engineering” and The 3rd International Conference ”Research & Innovation in Engineering”, COMAT, Braşov, Romania, 2014,189-191.

Hay JG, Nohara H. Techniques used by elite long jumpers in preparation for take-off. J Biomech. 1990;23(3):229-239.

Ionescu-Bondoc D. Pregătire specializată în atletism. Ed. Universităţii Transilvania, Braşov, 2007.

Kollath E. Biomechanische analyse weitenbestimmender und gelenkbelastender Gróessen beim Weitsprung. Die Lehre der Leichtathletik 1982;38:1275-1277.

Mihăilă C, Neamţu M, Ionescu-Bondoc D, Scurt C, Nechita F. Atletismul pentru toţi. Ed. Universităţii Transilvania, Braşov, 2008.

Mihălcică M, Guiman V, Munteanu V. A cheap and portable motion analisys system. The 5th International Conference ”Advanced Composite Materials Engineering” and The 3rd International Conference ”Research & Innovation in Engineering”. COMAT, Braşov, Romania, 2014a:109-111.

Mihălcică M, Guiman V, Munteanu V. Using curve fitting as a method to analyze motion analysis data for sports. The 5th International Conference ”Advanced Composite Materials Engineering” and The 3rd International Conference ”Research & Innovation in Engineering”. COMAT, Braşov, Romania, 2014c,115-117.

Mihălcică M, Guiman V, Munteanu V. Using motion analysis software to gather sports experimental data. The 5th International Conference ”Advanced Composite Materials Engineering” and The 3rd International Conference ”Research & Innovation in Engineering”. COMAT, Braşov, Romania, 2014b,112-114.

Nigg BM, Sprung, Springer, Sprünge (Jump - jumping - jumps). Juris Verlag, Zürich, 1974.

Popov VB. The long jump (Russian). Phys Cult Sport, Moskow, 1971.

Tiupa VV, Aleshinsky SI, Primakov IN, Pereverzev AP. The biomechanics of the movement of the body’s general centre of mass during the long jump. Theoria i Praktika Fizicheskoi Kulturi 1982;5:21-32.

Tsuboi K. A mathematical solution of the optimum takeoff angle in long jump. Procedia Engineering 2010;2(2):3205-3210.

Palestrica of the third millennium – Civilization and Sport
Vol. 16, no. 4, October-December 2015, 329–332

The relationship between exercise parameters, body weight, and nutritional habits of junior handball players

Stabilirea unei relații între parametrii de efort, greutatea corporală și obiceiurile nutriționale ale unor tineri handbaliști

Ștefan Adrian Martin, Monica Tarcea
University of Medicine and Pharmacy of Târgu Mureș, Faculty of Medicine

Abstract

Background. It is known that young athletes have different nutritional needs than adults. During training, between the period of accumulation and the period of growth, a balance must be established in order to obtain the best physical parameters.

Aims. To assess the relationship between proper food ingestion and physical activities efficiency.

Methods. A cross-sectional qualitative study was conducted to assess the physical parameters of pupils from the Olympic Sports Club in Târgu Mureș in 2015. A sample of 57 players, members of the handball team, aged 10-16, were questioned. The results were analyzed using the Chi-square test.

Results. Significant differences were found between the exercise parameters, exercise duration (p=0.0001), intensity (p=0.018), body mass index (p=0.028) and age of the athletes (p=0.0001). A significant difference was also found between the weight of athletes and the intensity of exercise (p=0.0001). All data were evaluated in relationship with the daily consumed meals, percentage distribution of the intake and food consumption.

Conclusions. We have identified a relationship between food consumption and exercise parameters. For young athletes, the daily food intake plays a significant role in achieving a high level of training within a minimum of 240 minutes per week at high effort parameters.

Keywords: nutrition, athletes, exercise, physical parameters.

Rezumat

Premize. Tinerii sportivi au nevoi nutriționale diferite față de adulți. În pregătire, între perioada de acumulare și perioada de dezvoltare, obținerea unui echilibru, spre dobândirea parametrilor fizici corespunzători, este obligatorie. Buna dezvoltare a organismului, în relaționare cu efortul sportiv, va fi obținută prin crearea unui plan adecvat de alimentare.

Obiective. Identificarea unei conexiuni între consumul alimentar optim și activitatea sportivă specifică.

Metode. A fost inițiat un studiu transversal epidemiologic, calitativ, pentru a evidenția relaționarea dintre consumul alimentar al unui grup de sportivi și parametrii de efort fizic. Un lot de 57 sportivi, din cadrul unui club sportiv de handbal, Tîrgu Mureș, România, cu vârste cuprinse între 10-16 ani, au fost chestionate, preluându-se totodată informațiile efortului prestat.

Rezultate. Date semnificativ statistic au fost obținute între parametrii de efort, durata activității prestate (p=0,0001), intensitatea (p=0,018), IMC (p=0,028) și vârsta sportivilor (p=0,0001), greutatea corporală a subiecților fiind relaționată cu intensitatea efortului prestat (p=0,001). Toate datele au fost analizate/interpretate în relație directă cu aportul energetic, distribuția realizată și alimentele utilizate.

Concluzii. A fost identificată o relație între alimentație și parametrii efortului fizic. În cazul tinerilor sportivi, consumul alimentar zilnic trebuie să stabilească un echilibru energetic astfel încât să se obțină masa corporală dorită. Totodată, consumul alimentar poate influența nivelul de pregătire impus pe parcursul unei săptămâni, prevăzute cu un minim de 240 minute, petrecute la un nivel crescut al acțiunii sportive.

Cuvinte cheie: nutriție, tineri sportivi, intensitate, frecvență, parametri fizici.

Received: 2015, September 6; *Accepted for publication:* 2015, September 26;
Address for correspondence: University of Medicine and Pharmacy, Târgu Mureș, Gheorghe Marinescu Str. No. 38, 540139, Romania. Phone 0040-265-0723261514
E-mail: martinstefanadrian@gmail.com
Corresponding author: Martin Ștefan Adrian martinstefanadrian@gmail.com

Introduction

Cyclicality of sports activity, particularly in the case of young athletes, can influence the development of the body (Dahab et al., 2009). The nutritional practice of the individual, based on a program in accordance with the individual's energy needs, will represent and meet the energy requirements, which will allow to improve physical parameters (Cotunga et al., 2005).

The intensity, volume and duration of exercise are indicators that characterize the complexity of sporting activities. In the medical field, they can indicate direct evidence of specific losses of nutrients, which are mainly provided in the form of micronutrients, liquids, and macronutrients as energy sources. From another perspective, scientific studies have not highlighted the changes that the athlete's body weight can undergo during the specific sports activity (Jakicic et al., 2009). Basic information suggests changes in the total volume of work performed at high intensity. The fact is that this form of effort (based on intensity) is represented by speed, a motor quality developed naturally (Markovic et al., 2007) and improved by specific training. Furthermore, changing this effort parameter through the body mass may be influenced by the interaction between the individual's motor qualities and body weight. Furthermore, correlations have been mentioned between the body weight and the increase of the total average time spent in high-intensity effort (Marquet et al., 2013).

However, the way in which nutrition influences the specificity of effort seems to be related to food complexity and sports nutrition practice (Beck et al., 2015). All the information is based on the daily actions and preparation carried out to recover the body after physical effort (Daneshvar et al., 2013).

Hypothesis

Initiating this study took into account the level of practicability in sports activities under various conditions, influenced by nutrition practice. Moreover, we believe that certain connections between the athlete's body weight and specific activity have not been described in detail. We aim to define and differentiate the activities based on the athlete's body weight and the game tasks for each individual.

Material and methods

Research protocol

A cross-sectional qualitative study was conducted after the approval of the University Ethics Committee and the subjects' informed consent to participate in the study were obtained. We aimed to identify the relationship between the dietary practices of a group of athletes and physical effort parameters.

a) Period and place of the research

The study was performed between February-March 2015, at the Olympic Handball Sports Club, from Târgu Mureş, Romania.

b) Subjects and groups

A sample of 57 athletes, members of the team, aged between 10-16 years, were enrolled in the study.

c) Tests applied

Data extraction was carried out by using a questionnaire (17 question items) that included terms of food consumption. The primary objective was to establish connections between dietary habits and sports activities and secondarily, to determine the impact of body weight on handball specific activity. The sports tests used to obtain the effort information were: long jump from standstill, handball ball throwing, 30 meter shuttle, 40 meter shuttle, 50 meter running.

d) Statistical processing

Data processing was based on descriptive statistics, using the EpiInfo 6.0 test, in a representative sample. The Chi-square test was chosen to interpret nutritional differences in relation to the sport activity performed, effort parameters and daily nutritional intake.

Results

The distribution and development of training took into account the subjects' age. A total of 240 minutes per week were spent in effort by athletes aged between 10-12 years. 300 minutes were spent in effort by athletes aged 12-13 years, and over 300 minutes of activity were associated with specific training of athletes aged between 14-16 years.

In relation to the effort performed (60 minutes daily), we highlighted the main meal consumption frequency during the day: breakfast (85%), snack 1 (73%), lunch (98%), snack 2 (66.1%), dinner (87.5%). These results were related to the full program which included a minimum of 240 minutes per week in effort and a maximum of 360 minutes per week, depending on the individual's age.

The specificity of effort was influenced by the perception of athletes and their daily effort. As a result, the intensity of sports activity was presented differently by athletes (Fig. 1), compared to the schedule reported by coaches (Fig. 2).

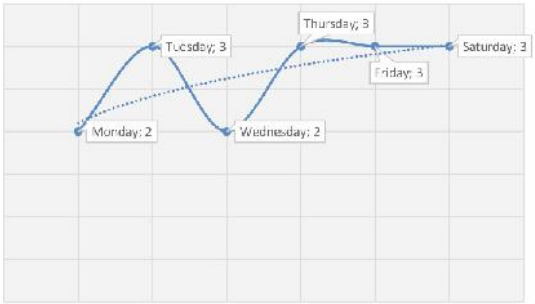


Fig. 1 – Exercise intensity reported by athletes.

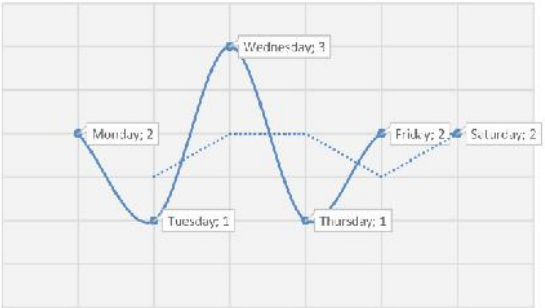


Fig. 2 – Exercise intensity reported by coaches.

The reports suggested statistical differences between the intensity of effort performed and food consumption. Data were associated with sports activity on four distinctive days: Monday (p=0.007), Wednesday (p=0.003), Friday (p=0.0001), and Saturday (p=0.0001). The most prevalent dietary changes were associated with secondary meals (snacks) on 3 distinct days: Tuesday, Thursday, and Friday, which were entirely related to high-intensity effort: Tuesday (intensity characterization equal to 70-85% of total capacity), Thursday (intensity characterization equal to 70-85% of total capacity), Friday (intensity characterization equal to 70-85% of total capacity).

As a result, the most common changes in food consumption were negative in terms of nutrition. Athletes had an additional intake of simple carbohydrates without an association with the sports activity (Table I).

Table I
Possible snack frequency associated with changes in food consumption.

Food that may be associated as snacks	Daily consumption percentage of the product
Yogurt	30.4%
Sweets	55.4%
Crackers	7.1%
Fruit juice	19.4%
Fruits	56%
Oleaginous fruits	1.8%
Apricots, raisins	7.1%

These habits and changes in food consumption could have negative effects on the athletes' body mass and specific effort parameters in handball such as those analyzed. The average values obtained for the parameters were as follows: long jump from standstill - 1.76 m, handball ball throwing - 26.76 m, 30 meter shuttle - 4.99 seconds, 20 meter shuttle - 3.45 seconds, 50 meter running - 7.53 seconds.

These data can indicate the level of specificity in the activity of athletes. Therefore, there were statistically significant correlations between age and specific activity data such as the following: long jump from standstill (p=0.018), 50 meter running (p=0.0001), 20 meter shuttle (p=0.0001), 30 meter shuttle (p=0.0001).

The days characterized by athletes as highly intensive: Thursday (p=0.40), Friday (p= 0.0001) and Saturday (p=0.0001) were significantly correlated with the specific physical data collected. As a result, significant differences in the specific activity were obtained, by lowering the total level of effort (running, shuttle, handball ball throwing, total resistance in exercise) on the days with high intensity effort reported by athletes.

The monitored physical data revealed a number of correlations between specific activity and total effort time, based on 5 sporting efforts: long jump from standstill (p=0.002 - positive correlation), handball ball throwing (p=0.056 - positive correlation), 30 meter shuttle (p=0.001 - negative correlation), 20 meter shuttle (p=0.002 - negative correlation), 50 meter running (p=0.0001 - negative correlation). This information highlights in this case the efficiency of handball activity with the increasing effort time.

Additionally, nutrition knowledge and practice were correlated with the effort specific parameters analyzed. The long jump showed a significant relationship with the body mass index of the athletes (p=0.028). Nutritional practice evidenced a statistically significant difference with the activity involving ball throwing (p=0.045), a parameter related to individual power. In this case, the shuttle (p=0.002) was characterized as a parameter related to the athlete's speed in different circumstances.

All nutritional knowledge influences through the daily practice and the body weight a specific activity such as throwing (p=0.029) and running (p=0.022). In addition, the body weight tends to change, for the most part, the activity studied.

Discussion

The obtained data confirm the hypotheses discussed at the beginning of this paper. The activity expressed through speed specificity is correlated with the total time in which the quality level of the activity can be maintained at a high average point. The longer the activity time, the lower the reported level of speed action is, reaching medium/low effort parameters. On the other hand, activities whose specificity is expressed by power have a favorable short high-intensity period of activity, with a low chance of being maintained at a high level over a long period of time (Knechtle et al., 2015). Moreover, the two motor qualities are intertwined to form motor acts (Sayers et al., 2012). Among them, we can highlight a number of specific technical actions that can be maintained at a high level over short periods of time, divided into sets and reps: speed running, weight lifting, handball specific technical activity (dribbling, ball throwing, passing, defense-specific technical activity) (Wagner et al., 2014).

Along with the total activity time, the specific handball effort, individual body weight, and proper training activity will complete this series of factors (Maciejczyk et al., 2015). As a result of the data obtained, it can be reported that increased body weight tends to have a positive influence

Table II
Influence of the activity depending on effort specificity.

	Long jump from standstill	Running 50 m	Shuttle 20 m	Shuttle 30 m	Handball ball throwing
Long jump from standstill	-	p=0.0001 (-)	p=0.0001 (-)	p=0.0001 (-)	p=0.009 (+)
Running 50 m	p=0.0001 (-)	-	p=0.0001 (+)	p=0.0001 (+)	p=0.0001 (-)
Shuttle 20 m	p=0.0001 (-)	p=0.0001 (+)	-	p=0.0001 (+)	p=0.010 (-)
Shuttle 30 m	p=0.0001 (-)	p=0.0001 (+)	p=0.0001 (+)	-	p=0.0001 (-)
Handball ball throwing	p=0.009 (+)	p=0.0001 (-)	p=0.010 (-)	p=0.0001 (-)	-

on handball ball throwing and a negative influence on running speed and overall resistance effort (Maciejczyk et al., 2014). A mean body weight positively affects speed and resistance activities (shuttle, long jump from standstill, running speed, general resistance in exercise) (Knechtle et al., 2014), while a low body weight (BMI ≤19) will negatively affect the specific force activity parameters along with similar effort performed.

Additional data are presented in Table II. It can be seen that activities based on power are negatively correlated with activities based on speed. Therefore, a hypothesis supported by various studies addresses the relationship between increasing levels of activity in effort exclusively based on power and decline in activity based only on speed (Sayers et al., 2012). This aspect is also influenced by the body weight. A high average BMI value (BMI - 25 to 29.9 – with a body mass imbalance) will decrease activity based exclusively on speed, facilitating actions influenced by power, if the effort is of such kind.

From this point of view, an important role is the differentiation of muscle power (Candow et al., 2012) and muscle mass among athletes, which is entirely feasible after adolescence. Establishing the influence of body mass on activity is important for individualizing work and game tasks during action (Maldonado et al., 2002). Changing food intake depending on the activity is a primary action. However, most often, this is done incorrectly, on the basis of the individual's fatigue status. The presence of appetite loss within a short period of effort completion and first main meal served shortly after the effort represent the most common causes of these actions (Kellmann, 2010). The food type commonly used by athletes includes features such as: increased GI value, increased energy and macronutrient imbalance, and/or their absence, together with the lack of micronutrients.

Conclusions

1. Determination of body mass is important in sports activity. Establishing a number of connections between sporting activity and body weight may indicate the importance of body weight and its influence on activity. However, the data identify a connection between increased body mass, strength and speed, being influenced by their specificity.

2. The nutritional knowledge of athletes affects nutritional practice that provides the decisions made in different states that are reported in daily sports activities, including recovery.

3. Stabilizing body weight as well as nutritional intake and imposing an individualization of the training activity depending on the required characteristics are necessary.

Conflicts of interest

There are no conflicts of interest regarding the results, research method used or conclusions drawn.

Acknowledgements

The study uses partial results from the first author's paper presented at the Marisiensis Congress, carried out at the University of Medicine and Pharmacy of T**â**rgu Mureş, Romania, in 2015.

References

Beck KL, Thomson JS, Swift RJ, von Hurst PR. Role of nutrition in performance enhancement and postexercise recovery. Open Access J Sports Med. 2015;6:259-267. doi:10.2147/OAJSM.S33605.

Candow DG, Chilibeck PD. Differences in Size, Strength, and Power of Upper and Lower Body Muscle Groups in Young and Older Men. J Gerontol A Biol Sci Med Sci. 2005;60(2):148-156.

Cotugna N, Vickery CE., McBee S. Sport Nutrition For Youngh Athletes. J Sch Nurs. 2005;21(6):323-328.

Dahab KS, McCambridge TM. Strength Training in Children and Adolescents: Raising the Bar for Young Athletes? Sports Health. 2009;1(3):223-226. doi:10.1177/1941738109334215.

Daneshvar P, Hariri M, Ghiasvand R, et al. Dietary Behaviors and Nutritional Assessment of Young Male Isfahani Wrestlers. Int J Prev Med. 2013;4(Suppl 1):S48-S52.

Jakicic JM. The Effect of Physical Activity on Body Weight. Obesity, 2009;17(S3):S34-S38. DOI: 10.1038/oby.2009.386.

Kellmann M. Preventing overtraining in athletes in high-intensity sports and stress/recovery monitoring. Scand J Med Sci Sports 2010:20(Suppl. 2):95-102. doi: 10.1111/j.1600-0838.2010.01192.x..

Knechtle B, Stiefel M, Rosemann T et al. Running and the association with anthropometric and training characteristics, Ther Umsch. 2015;72(5):343-355. doi: 10.1024/0040-5930/a000685.

Knechtle B. Relationship of Anthropometric and Training Characteristics with Race Performance in Endurance and Ultra-Endurance Athletes. Asian J Sports Med. 2014;5(2):73-90.

Maciejczyk M, Wiecek M, Szymura J et al. Influence Of Increased Body Mass And Body Composition On Cycling Anaerobic Power. J Strength Cond Res, 2015;29(1):58-65. DOI: 10.1519/JSC.0000000000000727.

Maciejczyk M, Więcek M, Szymura J et al. The Influence of Increased Body Fat or Lean Body Mass on Aerobic Performance. PLoS ONE, 2014; 9(4):e95797. doi: 10.1371/journal.pone.0095797.

Maldonado S, Mujika I, Padilla S. Influence of body mass and height on the energy cost of running in highly trained middle- and long-distance runners. Int J Sports Med. 2002;23(4):268-272.

Markovic G, Jukic I, Milanovic D. Effects Of Sprind And Pylometric Traning On Muscle Function And Athletic Performance. J Strength Cond Res, 2007; 21(2):543-549. DOI: 10.1519/R-19535.1.

Marquet L, Brown M, Tafflet M et al. No effect of weight cycling on the post-career BMI of weight class elite athletes. BMC Public Health. 2013;13:510. doi:10.1186/1471-2458-13-510.

Sayers SP, Gibson K. Effects of High-Speed Power Training on Muscle Performance and Braking Speed in Older Adults. J Aging Res. 2012;2012:426278.doi:10.1155/2012/426278.

Wagner H, Finkenzeller T, Würth S, von Duvillard SP. Individual and Team Performance in Team-Handball: A Review. J Sports Sci & Med. 2014;13(4):808-816.

Palestrica of the third millennium – Civilization and Sport
Vol. 16, no. 4, October-December 2015, 333–337

Research approach for outlining the biomechanical parameters of the tennis serve

Demersuri de cercetare pentru obiectivizarea parametrilor biomecanici ai serviciului în tenis

George Cosac, Dragoş Bondoc Ionescu
Faculty of Physical Education and Mountain Sport, Transylvania University of Braşov

Abstract

Background. In tennis, every technical procedure is influenced by the player's technique. In order to develop a correct technical procedure for a particular type of player with aspirations of becoming a professional, we must take into account the stroke mechanics of every movement, depending on the physical features of the player in question.

*Aims.*The comparative analysis of certain methods for the identification of biomechanical parameters of tennis serves.

Methods. In order to solve the problem related to the technical value and particularities of the tennis serve, a video recording and the DARTFISH analysis program was used as the equipment, together with the methodology of acquisition of kinematic data, developed by Xsens, Moven.

Results. Significant differences between players, which appear to be influential on the kinetic chain, were identified. Each player has individual anthropometric characteristics, which explains both the personal technique and markers that may influence the serve, as each player has different results.

Conclusions. Using the MOTION GRID equipment as opposed to the Dartfish equipment ensures a better stability during the process of the double integration of the accelerometer data, whereas in the Dartfish equipment the technical execution may generate parallax errors, frequent in this measurement method.

Keywords: biomechanical parameters, tennis serve, inertial navigation sensors, video recording.

Rezumat

Premize. În tenis, fiecare procedeu tehnic este afectat de către tehnica jucătorului. Pentru a dezvolta un procedeu tehnic corect pentru un model de jucător, care îşi doreşte performanţa, trebuie să luăm în considerare mecanismele de lovire a fiecărei mişcări, în concordanţă cu caracteristicile fizice ale jucătorului.

Obiective. Analiza comparativă a unor metode de obiectivizare a parametrilor biomecanici ai serviciului în tenis.

Metode. Metoda de studiu experimental al serviciului este înregistrarea video, cu programul de analiza DARTFISH şi echipamentul cu metodologia de achiziţie a datelor de cinematică, dezvoltată de către firma Xsens, Moven, care poate elucida problematica legată de valoarea şi particularităţile tehnice ale serviciului din tenis.

Rezultate. S-au observat diferenţe semnificative între sportivi, pentru indicii ce au o influenţă asupra lanţului kinetic. Fiecare dintre sportivi au caracteristici antropometrice individuale, fapt ce explică atât tehnica personală, cât şi indicele ce poate influenţa serviciul, fiecare sportiv având rezultate diferite.

Concluzii. 1) Utilizarea echipamentelor de tip MOTION GRID în comparaţie cu echipamentul Dartfish asigură o mai bună stabilitate în procesul de dublă integrare a datelor de accelerometrie, în comparaţie cu echipamentul Dartfish în care execuţia tehnică poate produce erori de paralaxă, des întâlnite prin această metodă de măsurare. 2) Dezvoltarea metodelor de măsurare, privind ameliorarea unei execuţii tehnice, va lua în considerare caracteristicile antropometrice individuale şi specifice, în acest caz comparaţia dintre sportivi va avea doar caracter informal.

Cuvinte cheie: parametri biomecanici, serviciul în tenis, senzori de navigaţie inerţială, înregistrare video.

Received: 2015, September 14; *Accepted for publication:* 2015, October 1;
Address for correspondence: Transylvania University of Braşov, Faculty of Physical Education and Mountain Sports, Eroilor Str., No 3, Postal Code 500177, Romania
E-mail: george.cosac@frt.ro
Corresponding author: George Cosac, george.cosac@frt.ro

Introduction

Modern tennis is seen as a sports skill where every shot is executed differently. The player is required to go through the process of "Perception - Decision - Action - Feedback". According to the authors Crespo & Miley, 1998; Gottfried, 1994, when the technique is taught, focus must be placed on tactical intentions and biomechanics, while the technique will be approached as a procedure, rendering tactics more efficient. According to Groppel, 1997, the basic principles of biomechanics in tennis can be easily apprehended by the acronym "BIOMEC" standing for balance, inertia, reaction force, moment, elastic energy, coordination chain. Authors such as Kenichirou et al., 2011; Toshio et al., 2004 have studied the development of sports performance by using effective measurement devices. The role of spatial information in recognizing human and individual movements is the first step towards progress, by using a detailed pattern, which, in time, should lead to knowing one's own efficient style by way of movement perception (Pollick et al., 2001; Stirling et al., 2010). Each human movement is determined by a synergic action of the basic biomechanical units and its precision is calculated using mathematical formulas (Ivancevic & Ivancevic, 2008; Ivancevic et al., 2011). The muscle chain used for serving cannot be merely assessed based on an arm or upper body model; instead it implies the assessment of the entire kinetic chain, from the significant effect of the leg to the impact of the ball on the racket (Pansiot, 2009). This succession of movements is achieved through the coordination chain of the body, which, in the case of the serve is made up of the legs, torso, hip, shoulder-arm, joint (Temprado 2005; Durović et al., 2008). The kinematic analysis of the shot during the serve underlines the important contribution of the internal rotation of the upper arm in the development of the racket. Thus, the muscles in charge of this action should be trained (Elliot, 1995; Elliot et al., 2009). The studies of Girard et al., 2007; Sgrò et al., 2013 analyzed the impact of the movement of the knee when serving. The results indicated that the flexion of the knee before extension (elongation of the body to meet the ball with the racket) is a prerequisite for the effectiveness of the serve, regardless of the player's level.

The study used inertial navigation sensors. These were initially developed for military use, to determine position, speed, acceleration and movement, angular velocities and accelerations. These were derived from the navigational system of plane and ship autopilots.

To carry out inertial sensors, sensors for the simultaneous measurement of rotations around three mutually perpendicular axes are used, as well as sensors that are capable to break down the body acceleration, associated with three directions, identical to the above mentioned rotation axes (Fig. 1).

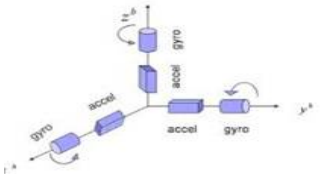


Fig. 1 – Operation principle of an inertial sensor (1).

The evolution of technology has made it possible for each of us to have such inertial sensors on our phones. Those used to pick-up motion in the MVN-BIOMECH technology are small enough not to bother the player and sufficiently precise to provide, after complex processing, the movement of the human body and of its segments. 17 such sensors are used in the making of the garment, placed as shown in Fig. 2.

Fig. 2 – Sensor fastening structure on the player's garment (3).

The inherent processes of integration of the acceleration data generate a "slip" of the body position and a tracking of one of the legs when lifted. To correct this error, the company manufactured and distributed an additional antenna system (Motion Grid), which stabilizes the data received from the player using a stapled reference in the horizontal and vertical movement. Being aware of the difficulties in correctly using the above presented product, we felt compelled to try another option for kinematic recording, that is, MVN-BIOMECH.

Objectives

This study aims to identify a method for assessing the tennis serve shot by comparing two objective measurement tools: Dartfish and Moven.

Hypothesis

The use of the MOTION GRID equipment compared to the Dartfish equipment ensures a better stability of the data when changing leg length and may fight the "drift" effect.

Materials and methods

This study was approved by the Ethics Committee of the Transylvania University, and the subjects' consent to participate in the study was obtained. The research protocol was based on a collaboration agreement between the Romanian Tennis Federation and the National Research Institute for Sport in Bucharest.

Protocol research

a) Time and place of the research

The locations used for conducting the experiment were: the National Tennis Centre, located on 11 Pierre de Coubertin St., 2nd Dist., Bucharest, and the National Research Institute for Sport, located on 41A Basarabia Av., 2nd Dist., Bucharest, between January and February 2015.

b) Subjects and groups

At the time of the recordings, Player S1 was 19 years old, with a 13 year experience in tennis and a national ranking, while internationally, he was ranked 150th in ITF. At the time of the recordings, Player S2 was 29 years old,

with a 22 year experience in tennis and a national ranking, while internationally, he was ranked 100th in ATP.

c) Tests applied

- recording of the players' own services;
- recording of services for the two active players with different body structures.

The comparison of the results obtained for the two tests by recording using the classical method DARTFISH (2) and the product, MVN-BIOMECH.

Research phases

Preparation and acquisition of data from the tennis serve movement with two distinct phases:

- processing of the data collected/recorded for the two active players, the recordings made by us being used only as a personal filter regarding the acceptability of the technology in question in professional training and recording of serves;
- comparative analysis of the two methods considered for assessing the biomechanical parameters of the tennis serves.

Estimating the value of the DARTFISH product (2) for a large number of interesting and useful implementations in the field of sports, we may state that biomechanical applications are affected by coarse errors, given that it is very rare for the motion plane to be and remain perpendicular on the optical axis of the video or photo device. Even more so in the case of the tennis serve shot, where there is a rotational movement of the torso and of the hip from the beginning to the end of the active motion, distancing and approaching the body segments, hence corrupting the measurements of distances and angles.

Results

In Fig. 3, player S1 was evaluated by the Dartfish method. This assessment has a single angle of observation, depending on where the camera is positioned. In this case (Fig. 3), the measurement was performed behind the player.

Fig. 3 shows the result of a quasi-automatic angular measurement in one of the players, measurement that may be considered approximately correct given that the sole of the left foot as well as the leg and the thigh, with a slight error, may be considered to have a parallel direction with the court baseline, and the position of the recording device was chosen to be perpendicular on this line.

For those who regularly watch tennis matches, it is obvious that in the next phase both the hip and the torso, segments of the lower body, will follow curving trajectories, in forward motion, with the left side of the body moving away from the camera and the right side approaching the camera and offering other apparent dimensions of the segments.

Fig. 3 – Measurement of the angle between the leg and the thigh in the left leg of player S1.

Being aware of the difficulties in correctly using the above presented product, we felt compelled to try another option for kinematic recording, that is, MVN-BIOMECH. Just like with any other measurement device, we were aware that there were objections to the use of this product. Following a presentation of its operational principles, we will attempt to analyze the strengths and weaknesses related to its use.

We simultaneously performed video recordings and recordings of the parameters provided by the MVN-BIOMECH inertial navigation technology. As shown in the figures below, the players were always wearing the garment indicated in the previous chapter.

In order to exemplify the way in which the data were acquired, we highlighted images of the same serve, recorded from behind and from the side, to present the results of the kinematic recordings for two of the three players, S1 and S2.

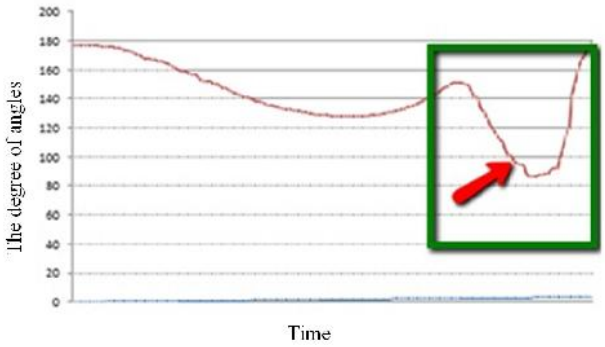


Fig. 4 – S1- Evolution of the thigh-leg angle in the left knee.

As an argument for the superiority of using inertial navigation equipment, we present in Fig. 4 the evolution in time of the thigh-leg angle in player S1, where the approximate point/moment of the player in preparation of the shot is marked with a red arrow. An additional outcome in this case is a clear image of the evolution in time of this angle and a clearer delimitation of the evolution of relative positions during the actual shot (green frame).

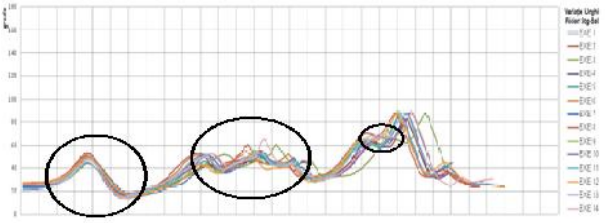


Fig. 5a – Variation of the angle between the pivot foot (left) and the floor in player S1.

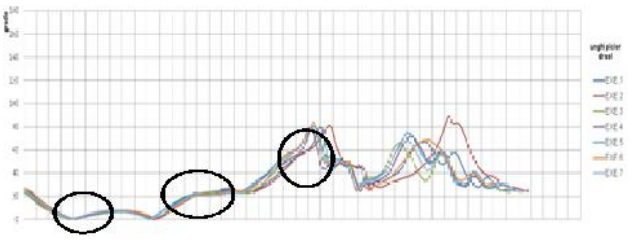


Fig. 5b – Variation of the angle between the pivot foot (right) and the floor in player S2.

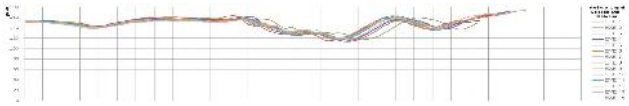


Fig. 6a – Variation of the ankle angle for the pivot foot (left) in player S1.

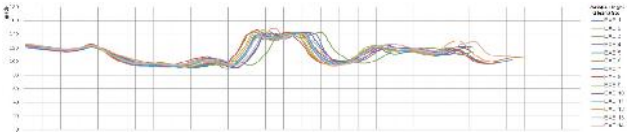


Fig. 6b – Variation of the ankle angle for the pivot foot (right) in player S2.

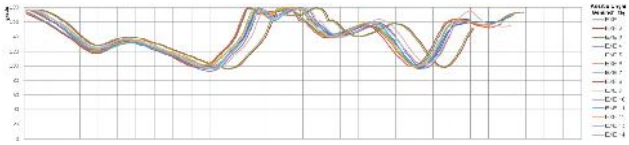


Fig. 7a – Variation of the thigh-leg angle for the pivot foot (left) in player S1.

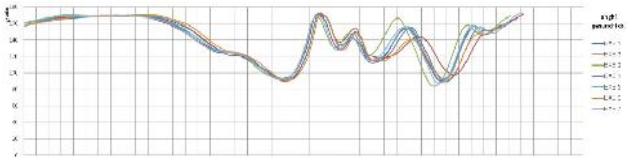


Fig. 7b – Variation of the thigh-leg angle for the pivot foot (right) in player S2.

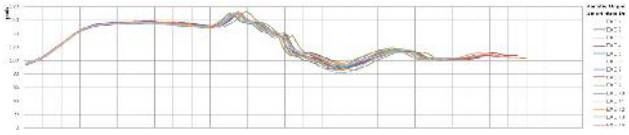


Fig. 8a – Variation of the angle between the shoulder line and the right arm in player S1.

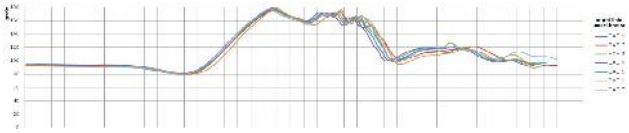


Fig. 8b – Variation of the angle between the shoulder line and the left arm in player S2.

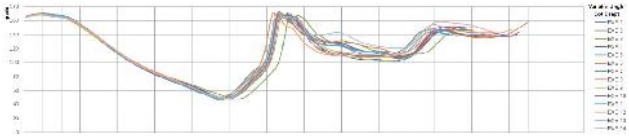


Fig. 9a – Variation of the arm-forearm angle in the right arm in player S1.

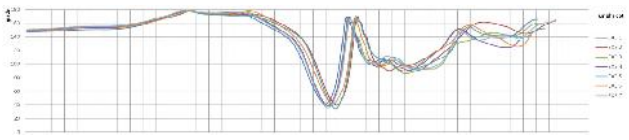


Fig. 9b – Variation of the arm-forearm angle in the left arm in player S2.

Discussions

As it can be seen in the diagrams, in the case of each player the curves are relatively grouped, which means that the movements in question are a well-rooted dynamic stereotype. It can also be said that both in the preparation phase and in the shot and movement closure phase, there are significant differences between the players; we consider these to be differences in style, as long as they do not indicate technical deficiencies or technical errors in the measured joint.

In Figure 5a (player S1), compared to Figure 6a, it can be seen that the preparation of the shot is delayed, when rising on tiptoes is required.

Player S1 systematically shows an initial rise of the heel followed by a descent and then a long interval when the angle between the foot and the floor is stabilized. After a short lift, the heel is elevated in two gradual steps until full stretch, which is possibly the highest stance, at the time of the shot.

Player S2 shows a smoother and more progressive lifting of the heel, but also a jump upon landing after completing the shot.

If we track the evolution according to the angle formed by the ankle joint on the side of the dominant hand, we find the same individual stability of the movement and behavioral differences between the players (Figs. 7a, 8a, 9a, 10). Player S1 behaves in a similar way to the situation of the angle between the foot and the floor; the player presents an extended time when the angle value is approximately 140^0, fully covering the shot area, while player S2 brings a powerful extension, possibly reaching at the moment of the shot a "peak" of 160^0, close to the maximum extension of 180^0 (Figs. 7a, 7b). We believe, and this is worth an additional analysis, that the impulsion performed by player S2 is much stronger and this may also relate to the fact that the player is shorter and, thus, needs this strength of impulsion to attain a jumping height, which ensures an increased efficiency of the serve.

In what concerns the recording of the angle relation between the leg and the thigh of the pivot foot, player S1 attains spring by flexion in two phases, while the lift up burst is milder, with the same stable aspect of the knee angle in its maximum stretch position. In player S2, after landing, the presence of certain continuous oscillations having the appearance of elastic waves can be seen (Fig. 7a).

Regarding the angle between the thigh and the spine/torso, we can see a better uniformity in player S1 and the same flexion seen in the image analysis of the same player (S2). (Figs. 8a, 8b, 9a, 9b).

We analyzed only these 5 parameters of movement, as we considered them to be sufficient, at this stage, to underline the potential information yielded by the method and knowing that, beside the angles, we could also rely on: angular velocities and accelerations in each joint, stance, in Cartesian coordinates, of each extremity of the 23 segments into which the program divides the human body.

It is obvious that there is still a long way to go before understanding the meaning of each parameter and of the play between their evolutions, associated in an efficient

movement, and that all information must be permanently related to the player's performance and features. This is particularly relevant since tennis is still a game where compensations can play a fundamental role. However, compensations only become useful when we have objective information on movement, when we know how to correctly interpret it and when we have the ability to recognize individual ways of developing performance, for each player.

MVN-BIOMECH provides a higher amount of data in comparison to the Dartfish method. It should be mentioned that the application of both methods might be of use from different perspectives. There is only one entry for the analysis of MVN-BIOMECH, whereas Dartfish examination provides at least four registrations (depending on the position of the camera).

Conclusions

1. Following the use of Dartfish programs for the recording of the main parameters in the tennis serve and the analysis and interpretation of the results, it was found that decisions cannot be made based only on one recording. It is very important for each technical execution to be analyzed from various angles, in order to avoid parallax errors, a frequent fault in Dartfish recordings.

2. We propose the use of the MOTION GRID equipment, which ensures a better stability of the data when changing leg length and may fight the "drift" effect, the shift of references that occurs due to the double integration of the accelerometer data.

Conflict of interests

There were no conflicts of interest, financial or otherwise.

Acknowledgments

This research exploits the partial results of the ongoing thesis at the Faculty of Physical Education and Mountain Sports, Transylvania University of Braşov, entitled "Outlining techniques for striking the ball in tennis serve".

References

Crespo M, Miley D. Manualul antrenorilor avansaţi. ITF Ltd, Bank Lane, Londra, SW15 5XZ, 1998.

Đurović N. Lozovina V, Pavičić L, Mrduljaš D. Kinematic analysis of the tennis serve in young tennis players. Acta Kinesiologica, 2008;2(2):50-56.

Elliot BC, Marshall RN, Notfal GJ. Contribution of upper limb segment rotation during the power serve în tennis. J App Biomech, 1995;11(4):433-422.

Elliott B, Reid M, Crespo M. Technique Development in Tennis Stroke Production. London, UK: Internaţional Tennis Federation, 2009.

Girard O, Micallef JP, Millet G. Influence of Restricted Knee Motion During the Flat First Serve în Tennis. J Strength Cond Res. 2007;21(3):950-957.

Gottfried B. How to play on every surface. Tennis. 1994;31(8):46-53.

Groppel JL. The Biomechanics of Tennis: An Overview. Int J Sport Biomech 1986;2:141-155.

Ivancevic TT, Jovanovic B, Jovanovic S, Djukic M, Djukic N, Lukman A. Paradigm Shift for Future Tennis. The art of Tennis Psychology. Biomechanics and Psychology. Springer. 2011, 41-45.

Ivancevic VG, Ivancevic TT. Human-Like Biomechanics: A Unified Mathematical Approach to Human Biomechanics and Humanoid Robotics. Springer, 2008.

Kenichirou F, Hiroki T, Takaya M, Koichi T. Development of a motion analysis system using acceleration sensors for tennis and its evaluations. Artif Life Robotics, 2011;16(2):190-193.

Pansiot J. Markerless Visual Tracking and Motion Analysis for Sports Monitoring. University of London Imperial College of Science, Technology and Medicine, Department of Computing, Degree of Doctor, 2009, 23.

Pollick EF, Fidiopiasitis C, Braden V. Recognizing the style of spatially exaggerated tennis serves. Perception. 2001;30(3):323-338.

Sgrò F, Mango P, Nicolosi S, Lipoma M. Analysis of Knee Joint Motion in Tennis Flat Serve Using Low-Cost Technological Approach. International Workshop on Computer Science in Sports (IWCSS). 2013;77:250-254.

Stirling DA, Hesami AS, Ritz CH, Adistambha K, Naghdy F. Symbolic modelling of dynamic human motions. In: PA Serra (eds), Biosensors, In-Tech, Vukovar, Croatia, 2010, 281.

Temprado JJ. Apprentissage et contrôle des coordinations perceptivo-motrices. Différentes perspectives dans les sciences du mouvement humain. Bulletin de psychologie, 2005;1(475):5-6. DOI 10.3917/bupsy.475.0005.

Toshio T, Yusaku T, Yoshiyuki T. Analysis of mechanical impedance in human arm movements using a virtual tennis system. Biol. Cybern. 2004;91(5):295-305. doi: 10.1007/s00422-004-0515-1.

Websites

(1) http://bestperformancegroup.com/?page_id=34 Accessed on 12.10.2014

(2) http://www.dartfish.com/ Accessed on 13.10.2014

(3) https://www.xsens.com/tags/gait-analysis/ Accessed on 14.10.2014

Palestrica of the third millennium – Civilization and Sport
Vol. 16, no. 4, October-December 2015, 338–341

Attention and emotional distress in junior athletes practicing judo and alpine skiing

Atenția și distresul emoțional la sportivii juniori de judo și schi alpin

Vlad Teodor Grosu [1], Toader Florian [2], Emil Ciufudean [3], Emilia Florina Grosu [4]
[1] *Technical University of Cluj-Napoca, Romania*
[2] *Jilava School, Ilfov District*
[3] *School Sports Club of Blaj*
[4] *Babeș-Bolyai University of Cluj-Napoca*

Abstract

Background. This is an interesting topic and we aimed to approach it from the perspective of the Olympic judo team who has achieved very good results worldwide compared to the Romanian skiers who have poorer results due to the conditions of training (there are only 3-4 months with snow in Romania). The groups who were applied tests were athletes aged between 11 ± 5 and 15 ± 3 years. The athletes are members of the Romanian Olympic Judo Team and members of ski groups from sports clubs in: Gheorgheni (HR), Baia-Sprie (MM), Toplița (HR), Sibiu (SB), Petroșani (HD).

Aims. This study is part of a larger work where we aimed to analyze correlations between the psychological cognitive processes: emotional distress and attention.

Methods. We applied the following tests: AM - concentration of attention, AD - distributive attention, AP - perception of attention, EMAS - emotional distress, PDE - anxiety. These initial tests were used as starting points in our research with the aim of increasing sports performance through the application of mental training techniques.

Results. The nonparametric Mann-Whitney test (U) for unpaired samples was used to compare scores/ranks on cognitive tests applied to the two groups of athletes. Materiality was $\alpha = 0.05$ (5%), $\alpha = 0.01$ (1%) or $\alpha = 0.001$. To detect the correlation between two continuous quantitative variables, the Spearman rank correlation coefficient (ρ) was used. Analysis of correlation coefficients was performed using Colton's rule.

Conclusions. In the comparative analysis of cognitive test scores in the studied groups and regarding statistical significance, there were positive values for all correlations, apart from one exception in the ski group, where the EMAS test values were negative.

Keywords: attention, emotional distress, junior athletes, alpine skiing, judo.

Rezumat

Premize. Această temă este interesantă și am dorit să o abordăm din perspectiva Lotului olimpic de judo, care are rezultate foarte bune pe plan mondial și lotul de schiori alpini cu rezultate mai slabe din cauza condițiilor de pregătire (doar 3 - 4 luni cu zăpadă în România). Loturile pe care s-au aplicat testele au vârsta cuprinsă între 11±5 și 15±3 ani. Sportivii sunt componenți ale Lotul Olimpic al României de Judo și componenți ale grupelor de schi de la Cluburile sportive școlare din: Gheorgheni (HR), Baia-Sprie (MM), Toplița (HR), Sibiu (SB), Petroșani (HD).

Obiective. Acest studiu face parte dintr-o lucrare mai vastă prin care dorim să analizăm legătura dintre cele două procese psihice: distresul emoțional și atenția. Testările inițiale au fost folosite ca puncte de plecare în cercetarea noastră. Prin aplicarea tehnicilor de antrenament mental dorim să creștem performanța sportivă.

Metode. Am aplicat următoarele teste: AM - concentrarea atenției, AD - atenție distributivă, AP - spiritul de observație, percepția atenției, EMAS - distress emoțional, PDE - anxietate.

Rezultate. Pentru compararea scorurilor/rangurilor la testele cognitive aplicate celor două loturi de sportivi a fost utilizat testul neparametric Mann-Whitney (U) pentru probe neperechi. Pragul de semnificaţie a fost $\alpha = 0,05$ (5%), $\alpha = 0,01$ (1%) sau $\alpha = 0,001$. Pentru decelarea corelației dintre două variabile cantitative continue s-a utilizat coeficientul de corelație al rangurilor Spearman (ρ). Analiza coeficienților de corelație s-a efectuat utilizând regula lui Colton.

Concluzii. Prin analiza comparativă a scorurile testelor cognitive, în cazul loturilor studiate și semnificația statistică putem spune că s-au înregistrat valori pozitive la toate corelațiile, o singură excepție există la lotul de schi, unde la testul EMAS se înregistrează valori negative.

Cuvinte cheie: atenție, distres emoțional, sportivi juniori, schiul alpin, judo.

Received: 2015, September 9; *Accepted for publication:* 2015, October 2;
Address for correspondence: Technical University of Cluj-Napoca, Muncii Av. No. 103-105, Cluj-Napoca, 400641, Romania
E-mail: vtgrosu@yahoo.it
Corresponding author: Vlad Teodor Grosu, vtgrosu@yahoo.it

Introduction

We aimed to approach this topic from the perspective of the Olympic judo team who has achieved very good international results compared to a group of Romanian skiers with poorer results due to the training conditions (there are only 3-4 months with snow in Romania). The groups on which the tests were applied were aged between 11 ± 5 and 15 ± 3 years. The athletes were members of the Romanian Olympic Judo Team and members of ski groups from the sports clubs: Gheorgheni (HR), Baia-Sprie (MM), Toplița (HR), Sibiu (SB), Petroșani (HD). In skiing down a slope in dynamic balance (Fellows, 2011) or in judo practice, athletes coordinate their movements by making continuous and efficient adjustments and by precisely executed techniques.

Focusing on the idea that energy is generated using the same method as in the above exercise, athletes are asked to try and feel the energy and strength pulsing through their own body, by remembering the occasions when they were really energetic (Vittoz & Godefroy, 2001).

Emotions are therefore dependent variables or labels that describe a series of changes occurring at several levels (David, 2006). Thus, after several studies, Watson & Tellegen (1985) concluded that emotion has a structure comprising two unrelated dimensions: positive emotions and negative emotions (psychological distress). Compared to other scales, PDE contains a relatively small number of items formulated in an accessible language and is easy to administer and quote (David et al., 2005). Ellis (1962, 1994) (quoted by David et al., 2007) developed a binary model of distress (David et al., 2002), dividing negative emotions into two categories - functional negative emotions and dysfunctional negative emotions.

Emotional distress profile (PDE) is a tool developed to help in assessing the subjective dimension of functional and dysfunctional negative emotions. Emotional distress profile (PDE) is a 26-item scale that measures dysfunctional negative emotions and functional negative emotions such as "fear" and "sadness/ depression" (David, et al., 2002).

The scale was developed (Opriş & Macavei, 2007) starting from the short version of emotional distress profile (DiLorenzo et al., 1999 quoted by David, 2005). To these items, words that describe emotions identified by a dictionary of synonyms were added. The 26 items form the final version of the scale resulting from a validation with experts and several experimental studies designed to determine their relevance and subscales in which it fits.

In both sports, skiing and judo, the focus is on coordinating muscle groups that create the movement patterns needed for successful skiing and judo. These can be further broken down into categories of stability and mobility (Fellows, 2011). Dynamic balance plays a reinforcement role in the world of functional movement.

The relationship between individual psychological factors and performance will be described in a few sentences below. In the case of sportsmen, who have difficulties staying motivated while they are not competing, strategies of goal assessment can be used, to give them a certain direction or a goal for training (Grosu, 2012). Especially when the sportsman fails to achieve a certain level of competition, mental imagery is used to focus on an image of desired reality, which can develop attention. Results of research (Unsworth et al., 2012) show that elite and successful sportsmen are more dedicated, motivated, more self-trusting, are focusing more on what is essential, are capable to deal with obstacles and show maximum efficiency under pressure. Following the line of previous studies, other researchers have developed specific questionnaires for sportsmen, in order to test their mental abilities taking into account different competitionl and sports standards (Schack & Hackfort, 2007). In the opinion of Filho et al. (2015), psychological variables and abilities that underlie top performance were examined mostly through qualitative interviews or through a combination of questionnaires and interviews. Specialists can use such information for planning, implementing and optimizing psychological interventions, helping in this way expert sportsmen and also novices to achieve the highest possible level (Sadeghi et al., 2010).

Researchers (Burton & Raedeke, 2008; Vealey, 2007; Williams, 2001) have focused on individual psychological factors (setting goals, relaxation, imagery and self-talk) and on their influence on performance. Recently, researchers have used a more holistic aproach, which focuses on the whole and the interdependence of its parts (Hall, 2001; Gucciardi et al., 2009).

Hypothesis

This study is part of a larger work in which we aim to analyze correlations between the psychological cognitive processes: emotional distress and attention. The focus is on the idea of control – this exercise is the natural progression of the two proceedings, and requires a simple process of deduction. In fact, as soon as patients are able to remain calm or summon their energy at will, they are capable of self-control. Therefore, they will not have much difficulty in defining the sensation of control.

Material and methods

This study received the approval of the Ethics Committee of the University. The informed opinion of the subjects participating in the research was also obtained. In the case of underage subjects, the parents gave their consent.

Institutional ethical approval was obtained prior to the commencement of the study, in agreement with the Helsinki Declaration.

Research protocol

a) Period and place of the research

The research took place in Cluj-Napoca, Gheorgheni and Baia-Sprie in the period October- December 2014.

b) Subjects and groups

One group was formed by junior alpine ski athletes aged 11 ± 5 and 15 ± 3 years, from the following sports clubs: CSS Baia-Sprie, Maramureș county, CSS Gheorgheni, Harghita county. The other group was formed by judo athletes of the National Olympic Team, who trained in Cluj-Napoca.

c) Tests applied

We applied the following tests: AM – concentration of attention, AD - distributive attention, AP - perception of attention, PDE - emotional distress. These initial tests were

used as starting points in our research, aimed at increasing sports performance through the application of mental training techniques.

d) Statistical processing

Statistical indicators: Elements of descriptive statistics were calculated; the data are presented using indicators of centrality, location and distribution.

In order to compare the scores/ranks on the cognitive tests applied to the two groups of athletes, the nonparametric Mann-Whitney test (U) for unpaired samples was used. Materiality was $\alpha = 0.05$ (5%), $\alpha = 0.01$ (1%) or $\alpha = 0.001$. To detect the correlation between two continuous quantitative variables, the Spearman rank correlation coefficient (ρ) was used. Analysis of correlation coefficients was performed using Colton's rule. Polynomial regression was the method used to derive the mathematical equation of dependence of a continuous variable by another variable. Statistical processing was performed with Excel (Microsoft Office 2007) and the Stats Direct v.2.7.2 software. The results were graphically represented using Excel (Microsoft Office 2007).

Results

The statistical analysis of scores on the cognitive tests applied to the two groups (unpaired samples) evidenced the following (Table I):

- for MA - lack of statistically significant differences between the two groups ($p > 0.05$)
- for AP2 - lack of statistically significant differences between the two groups ($p > 0.05$)
- for AD - highly statistically significant differences between the two groups ($p < 0.001$)
- for PDE - highly statistically significant differences between the two groups ($p < 0.05$)

Table I
Statistical correlation analysis between the scores for the two groups.

Tests	Judo group		Ski group	
MA – PDE	0.3194	**	0.2440	*
AP2 – PDE	0.1514	*	- 0.2799	**
AD – PDE	0.3540	**	- 0.2652	**

For the judo group**,** statistical correlation analysis between the scores/ranks showed:

- an acceptable positive correlation between MA - PDE (Fig. 1) and AD - PDE (Fig. 2);
- a weak positive correlation between AP2 (perception of attention) - PDE (emotional distress).

For the ski group**,** statistical correlation analysis between the scores/ranks showed:

- an acceptable negative correlation between AP2 - PDE (Fig. 3) and AD - PDE (Fig. 4);
- a weak positive correlation between MA - PDE.

The athletes should learn to feel effective center of mass movement. When one starts moving one's body mass from turn to turn across the skis, it should feel the way a snowboarder looks: like a metronome (Elling, 2003).

In Fig. 1, an acceptable positive correlation between MA (concentration of attention) and PDE (emotional distress) can be seen, which means that concentration of attention will lead to an increase in emotional distress for judo athletes. Judo athletes have very good results, being European, World and Olympic champions.

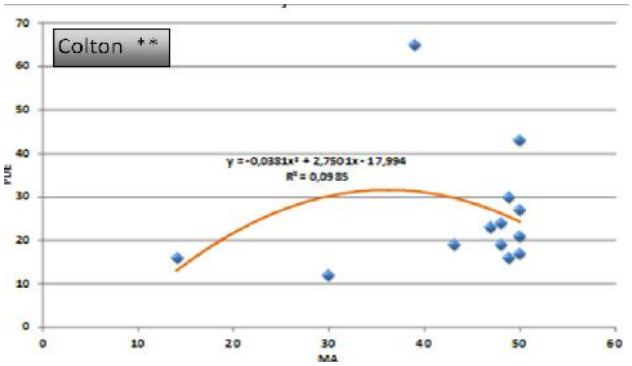


Fig. 1 – Acceptable positive correlations between MA - PDE on cognitive tests in judo athletes.

In Fig. 2, there is an acceptable positive correlation between AD - distributive attention and PDE - emotional distress in the judo group. This means that if distributive attention increases, emotional distress also increases.

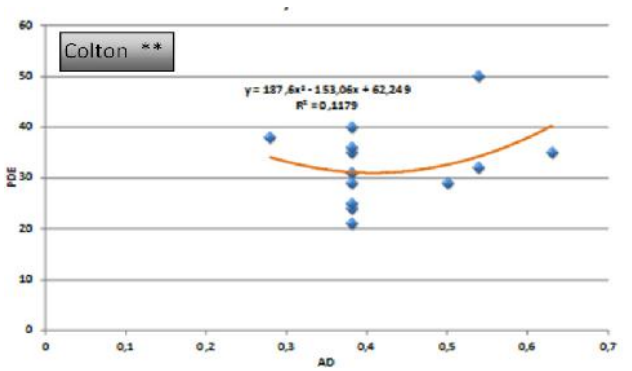


Fig. 2 – Acceptable positive correlations between AD - PDE on cognitive tests in judo athletes.

Fig. 3 shows an inversely proportional relationship between AP2 - perception of attention or spirit of observation and PDE - emotional distress. This relationship is characteristic of ski effort, expressed by the results (Grosu, 2015). In ski, one can only win by having a particular attention or an always activated spirit of observation; thus, the relation with emotional distress is inversely proportional.

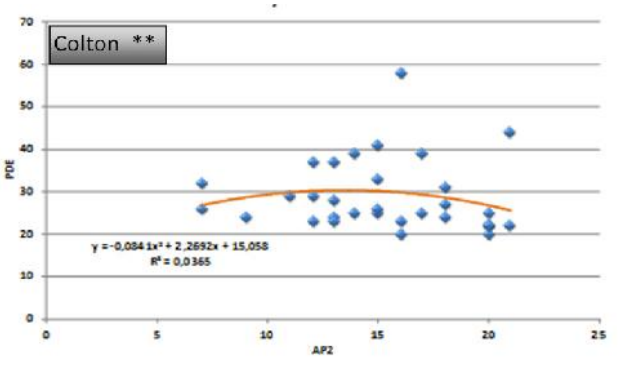


Fig. 3 – Acceptable negative correlations between AP2 - PDE on cognitive tests in ski athletes.

In Fig. 4, acceptable negative correlations between AD - distributive attention and PDE - emotional distress in skiers are evidenced. The same method can be used to establish other sensations (Vittoz & Godefroy, 2001), depending on what we want to change in the athlete's behavior, and in each individual athlete's characteristics.

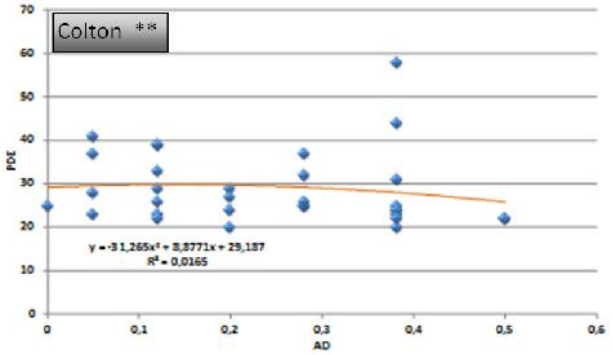


Fig. 4 – Acceptable negative correlations between AD - PDE on cognitive tests in ski athletes.

Conclusions

1. In the comparative analysis of cognitive tests in the studied groups and regarding statistical significance, there were positive values for all correlations, apart from one exception in skiers, where the EMAS test values were negative.

2. We can also conclude that judo athletes are loaded in terms of emotional distress, PDE having higher values in a direct proportional relation with all values of distributive attention (AD) and concentration of attention (MA).

Recommendations

It can be suggested to ski athletes to work harder in order to eliminate the weak correlation between MA - concentration of attention and PDE - emotional distress.

Conflicts of interests

We declare no conflicts of interest.

Acknowledgments

The research uses partial results from the first author's PhD thesis, presented on 18 June 2015 at the Faculty of Physical Education and Sport of the "Babeş-Bolyai" University Cluj-Napoca.

References

Bertollo L, Bertollo M., Robazza C., Dispositional goal orientations, motivational climate, and psychobiosocial states in youth sport. Personality and individual differences, vol. 47; p. 18-24, 2009,ISSN: 0191-8869, doi: 10.1016/j.paid.2009.01.042

Burton D, RaedekeT. Sport Psychology for Coaches. Human Kinetics, 2008.

David D. Metodologia cercetării clinice. Fundamente. Ed. Polirom Iaşi, 2006.

David D, Montgomery, GH, Macavei B, Bovbjerg DH. An empirical investigation of Albert Ellis's binary model of distress. J Clin Psychol, 2005;61(4):499-516.

David D, Schnur J, Belloiu A. Another search for the "hot" cognitions: Appraisal, irrational beliefs, attributions and their relation to emotion. J Ration Emot Cogn Behav Ther. , 2002; 20 (2):93-131.

David D, Macavei B, Moldovan R, Opris D, Szentagotai Tatar A, Trip S. Chestionarul de autoevaluare a sănătăţii mentale. In: David D. (coord). Sistem de evaluare clinică. Ed. RTS. Cluj-Napoca, 2007.

Filho E, di Fronso S, Forzini F, Murgia M, Agostini T, Bortoli L, Robazza C, Bertollo M., Athletic performance and recovery stress factors in cycling: An ever changing balance. Eur. J Sport Sci. 2015, DOI: 10.1080/17461391.2015.1048746.

Elling MR. The All-Mountain Skiers. Second Ed. Ragged Mountain Press/McGraw - Hill, Ragged Mountain Press, P.O. Box 220, Camden, ME, 04843. Available online at: http:// www.raggedmountainpress.com, 2003, 47. Accessed on 20.10.2014.

Fellows C. Total Skiing. United States, Human Kinetics, P.O. Box 5076, Champaign, IL61825- 5076 800-747-4457. Available online at: http:// www.HumanKinetics.com, 2011,8. Accessed on 22.11.2014.

Grosu EF. Tehnici de antrenament mental. Vol.III, Col. Acţiune motorie şi acţiune psihică. Ed. GMI, Cluj-Napoca, 2012.

Grosu VT. Optimizarea performanţei în schiul alpin prin antrenament mental, imagerie şi programare neurolingvistică. Teza de doctorat, susţinută la Universitatea "Babeş-Bolyai", Facultatea de Educaţie fizică şi sport, Cluj-Napoca, 2015.

Gucciardi DF, Gordon S, Dimmock JA. Towards an understanding of mental toughness in Australian football. J App Sport Psych, 2008;20:261-281.

Hall CR. Imagery in sport and exercise. In: Singer RN, Hausenblas HA & Janelle C (Eds.). Handbook of Sport Psychology. New York: Wiley, 2001,529-549.

Opriş D, Macavei B. The profile of emotional distress; norms for the Romanian population. Journal of Evidence-Based Psychotherapies, 2007;7(2):139.

Sadeghi H, Omar-Fauzee MS, Jamalis M, Ab-Latif R, Cheric MC. The Mental Skills Training of University Soccer Players. Int. Edu. Stu, 2010;3(2):81-90.

Schack T, Hackfort D. Action-theory approach to applied sport psychology. In: Tenenbaum G & Ecklund RC (Eds.). Handbook of sport psychology. Hoboken, NJ: John Wiley & Son, 2007,332e351.

Unsworth N, McMillan BD, Brewer GA. Spillers GJ. Everyday Attention Failures: An Individual Differences investigation. J Exp Psychol Learn Mem Cogn. Learning, Memory & Cognition. 2012;38(6):1765-1772.

Vealey RS. Handbook of Sport Psychology. Third Ed. Mental Skills Training in Sport, 2007. DOI: 10.1002/9781118270011.ch13

Vittoz R, Godefroy CH. How to Control Your Brain at Will. IAB, Manufactured in the United States of America, eBooks collection, Available online at: http:// www.positive-club.com/mailto:christiangodefroy@positive-club.com. 2001, 63-64. Accessed on 1.11.2014.

Watson D,Tellegen A.1985 The Two General Activation Systems of Affect: Structural Findings, Evolutionary Considerations, and Psychobiological Evidence. J Pers Soc Psychol, 1999;76(5): 820-838.

Williams B. Developing critical reflection for professional practice through problem-based learning, J Adv Nurs 2001;34(1):27-34.

Palestrica of the third millennium – Civilization and Sport
Vol. 16, no. 4, October-December 2015, 342–346

The study of musculoskeletal injuries in athletes from Târgu Mureș
Studiu privind traumatismele osteoarticulare la sportivii din Târgu Mureş

Flaviu-Stelian Duşa, Dana Bădău
University of Medicine and Pharmacy, Târgu Mureş, Department of Human Movement Sciences

Abstract

Background. Although exercising is beneficial to the human body, it can also have a negative impact on the quality of life. Traumatic injuries and osteoarticular overstressing in a sportsman can be the most important negative effects of sports.

Aims. This study aims to describe osteoarticular traumas, recovery techniques and time needed to achieve athletic fitness.

Methods. We conducted a retrospective observational clinical study in a group of 29 sportsmen. They completed an eight-item questionnaire and the obtained data were processed by the aid of the SPSS20 software program.

Results. The most affected anatomical regions were the joints: the knee in 62.1%, followed by the elbow in 17.3% and the ankle in 13.8%. 17 (58.7%) sportsmen suffered from sprain type injuries, 7 (24.1%) from joint dislocation, 4 (13.8%) were diagnosed with fractures, and one (3.4%) with muscle strain. The average recovery time of the studied group following injury was 12.83 weeks, thus for footballers 13.07 weeks and for volleyball players 12.57 weeks. The recorded values of t_{value} for all items were superior to $t_{critical}$ for $p < 0.05$, and the differences of the obtained results were statistically significant, which contributes to the rejection of the null hypothesis. The r-Pearson index was 0.808, highlighting a strong correlation between age and the duration of exercising. Correlation was good and statistically significant between the duration of recovery and regaining full fitness; $r=0.556$ and $p_{correlation}=0.002$ for $p < 0.01$.

Conclusions. Musculoskeletal injuries are common in athletes from Târgu Mureş and are frequently located at the level of the knee, ankle and elbow joints. Medical rehabilitation outlines a good therapeutic conduct, thus contributing to the regaining of full fitness in a relatively short time.

Keywords: sport, musculoskeletal trauma, medical rehabilitation, full fitness.

Rezumat

Premize. Pe lângă beneficiile aduse organismului, sportul poate avea un impact negativ asupra calităţii vieţii. Principalul efect negativ al sportului este reprezentat de traumatisme şi suprasolicitările osteoarticulare la care este supus sportivul.

Obiective. Studiul îşi propune descrierea traumatismelor osteoarticulare, metodologia de recuperare precum şi timpul necesar ajungerii la forma sportivă.

Metode. Am efectuat un studiu clinic, observaţional, retrospectiv, pe un lot de 29 de sportivi. Aceştia au completat un chestionar cu 8 itemi, iar datele obţinute au fost prelucrate în programul SPSS20.

Rezultate. Cea mai afectată regiune anatomică a fost articulaţia genunchiului 62,1%, urmată de articulaţia cotului 17,3% şi glezna 13,8%. La 17 (58,7%) dintre subiecţi, traumatismul a fost de tip entorsă, 7 (24,1%) au suferit luxaţii, 4 (13,8%) au fost diagnosticaţi cu fracturi şi 1 (3,4%) cu întindere musculară. Durata repausului a eşantionului după accidentare a fost de 12,83 săptămâni, astfel pentru grupa de fotbal 13,07 saptamâni, iar pentru cea de volei 12,57 saptamâni. Valorile înregistrate de t_{value}, pentru toţi itemii, sunt superioare t_{critic}, pentru $p<0.05$, iar p_{value} evidenţiază o semnificaţie puternică a rezultatelor, ceea ce contribuie la respingerea ipotezei nule. Indicele r-Pearson a fost 0,808, evidenţiind o corelaţie puternică între vârstă şi durata practicării. Corelaţia a fost bună şi semnificativ statistică între durata recuperării şi durata reintrării în formă sportivă, r fiind 0,556, iar $p_{correlation}$ 0,002 pentru $p<0,01$.

Concluzii. Traumatismele osteoarticulare sunt frecvente la sportivii din Târgu Mureş şi se localizează frecvent la nivelul articulaţiei genunchiului, gleznei şi cotului. Recuperarea medicală determină o conduită terapeutică bună, contribuind la intrarea în forma sportivă într-un interval de timp relativ scurt.

Cuvinte cheie: sport, traumatisme osteoarticulare, recuperare medicală, formă sportivă.

Received: 2015, June 3; *Accepted for publication:* 2015, June 28;
Address for correspondence: University of Medicine and Pharmacy, Târgu Mureş, 38 Gheorghe Marinescu St., 540139, Phone 0754670730, Romania
E-mail: flaviu.dusa@umftgm.ro, dusa.flaviu@gmail.com
Corresponding author: Flaviu-Stelian Duşa flaviu.dusa@umftgm.ro, dusa.flaviu@gmail.com

Introduction

Besides its benefits in maintaining a healthy body, sports can have a negative impact on the quality of life. Athletes often have to cope with competition anxiety, poor teamwork, psychological and physical stress. The main negative effects of sports undergone by athletes are by far trauma and overstrain of the osteoarticular system. These injuries of the body affect the athletes' quality of life by inducing emotional and physical disabilities ranging from diminished physical performance to permanent abandonment of sports activities (Garrick & Requa 2003; Wiese-Bjornstal, 2010; Deroche et al., 2012; Schwab Rees et al., 2012). Sport rehabilitation is a delicate issue that must be continuously improved through interdisciplinary collaboration (Walker et al., 2007).

Musculoskeletal injuries are common in athletes. They adversely affect subsequent sport and physical activities. An effective medical recovery plan applied by a multidisciplinary team under the tutelage of a sports medicine physician can have a positive influence on recovery activities and on the quality of life of athletes who have suffered musculoskeletal traumas (Monticone et al., 2014).

A very important aspect of sport rehabilitation is to identify risk factors that lead to injury. Tyler et al. (2014) show that the identification of risk factors is essential especially in case of pelvic trauma and lower limb injuries. These factors can have a somatic or psychic origin or can be external factors such as playing conditions or the quality of training. The medical education of athletes, which is an essential issue, has received more and more attention lately. This has a role in prevention, recovery management, as well as in the athletes' quality of life regarding sport activities and social behavior following musculoskeletal trauma (Diamond & Solomon, 2014).

Sports practice shows a rising trend, which inevitably leads to an increasing number of sport accidents and implicitly, to high economic costs. Reducing these costs gives rise to the need to implement prevention strategies achieved through health education carried out by a multidisciplinary team (Öztürk & Kılıç, 2013).

There are numerous studies on the incidence of sport traumas, which help in raising the athletes' awareness about the importance of training and the process of sport recovery and in particular, about the risks athletes are exposed to according to the specificity of the sport they practice. Thus, a study conducted in athletes of the Great Britain's Olympic team shows that 27 (39%) suffered from various injuries during the Winter Olympic Games, in 2014, and the most frequent location of injuries was represented by the lower extremities (Palmer-Green & Elliott, 2015).

Harvey Kelly et al. (2014), in a study performed in 80 patients with preexisting osteoarticular trauma, found a significant decrease in the frequency of sports practice and a diminished performance. This decrease was predominantly observed in those who suffered any trauma at the level of the lower extremity.

Volleyball players frequently suffer from patellar tendinopathy. De Vries et al. (2014) find this condition in 13% of athletes such as volleyball and basketball players. According to Barber Foss et al. (2014), volleyball is the second sport in generating traumas in females. It is known that the incidence of injuries in volleyball players is directly related to the male gender, the duration of training and the degree of participation in competitions. Bahr & Bahr (2014) observed a correlation between these factors and the frequency of jumps during both training and competition; young males jump more often than young females (62.2 jumps/h for boys and 41.9 jumps/h for girls).

A long-term negative effect of volleyball is represented by glenohumeral internal rotation deficit. Interestingly, this issue in women is strictly linked to the performance level, while in men this is related to the dominant arm and the presence of a history of trauma at this level (Hadzic et al., 2014).

Objectives

This study aims to determine the incidence of osteoarticular traumas and the methodology for recovery in athletes from Târgu Mureş. We also aimed to identify those sports that frequently expose athletes to trauma, the anatomical regions exposed to injuries and the type of osteoarticular traumas.

Hypothesis

During this study, we started from the hypothesis that by applying a specific methodology for osteoarticular traumas in our athletes, recovery can be optimized.

Material and methods

This research was conducted with the approval of the Ethics Committee of the University of Medicine and Pharmacy, T**â**rgu Mure**ş**. All subjects included in the study were informed about the purpose of this research and the methods of dissemination; subsequently, the whole group agreed to participate in the study and gave their informal consent for the publication of the obtained data.

Research protocol

a) Period and place of the research

The study was carried out in the period 1 October - 1 November 2014 in the sports clubs and sports associations of Târgu Mureş and in the University Sports Club of the University of Medicine and Pharmacy, T**â**rgu Mure**ş**.

b) Subjects and groups

We conducted a retrospective observational clinical trial in a group of 29 athletes, age ± SD = 20 ± 3.981, of which 15 male football players (N), age ± SD = 2.093 ± 3.812, and 14 female volleyball players (N), age ± SD = 18.71 ± 3.9625. All study subjects are involved in junior and senior competitions.

c) Tests applied

In the framework of this study, we applied a non-standardized questionnaire comprising 10 items and two questions for identifying personal data: gender and age. The questionnaire was applied individually, and the responses were included in tables in order to be statistically processed for both the entire sample and for the two groups of sports: football and volleyball.

Name of the questionnaire – The quality of life of athletes from Targu Mureş following osteoarticular strain

or injuries. The questionnaire comprised the following items:

1. Practiced sport/sports - type and duration
2. Have you suffered any bone or joint injuries while practicing a sport? Specify the injured part of the body
3. Specify the medical diagnosis
4. Have you undergone medical rehabilitation after the accident?
5. How long did you have to stop practicing sports after the accident?
6. Do you think that this accident has negatively influenced your sports career?
7. How often do you experience pain in the injured body part while resting?
8. How long after the accident did you have to stop exercising?

d) Statistical processing

The study used the method of the survey based on a non-standardized questionnaire developed by us according to the aimed objectives and on the statistical-mathematical method for processing data and highlighting relevant aspects. The obtained data were statistically processed with the IBM SPPS Statistics 20 software for Windows, which was designed to calculate the following statistical indicators: arithmetic mean, standard deviation (SD), Student t test (t), threshold of significance (p_{value}), Pearson's correlation coefficient (r), significance threshold of the correlation value r ($p_{correlation}$). For this study, the significance threshold of $p < 0.05$ was considered relevant.

Results

Item 1. *Practiced sport/sports - type and duration* (Tables I, II, III).

Table I

The percentage of subjects according to the practiced sport.

Statistical indicators	N	N Football	% Football	N Volleyball	% Volleyball
Sample	29	15	51.7	14	48.3

Table II

Duration of practice.

Statistical indicators	N	Mean	SD	t	p
Sample	29	10.17	4.80	11.404	.000

Table III

Descriptive statistics according to the different groups of sports.

Group	N	Mean	SD
Football	15	12.13	5.527
Volleyball	14	8.0714	2.75860

Item 2. *Have you suffered any bone or joint injuries while practicing a sport? Specify the injured part of the body* (Table IV).

Item 3. *Specify the medical diagnosis* (Table V).

Item 4. *Have you undergone medical rehabilitation after the accident? For how long?* (Tables VI, VII).

Table VI

Number of weeks of recovery after the accident.

Statistical indicators	N	Mean	SD	t	p
Sample	29	4.52	6.84	3.555	.001

Table VII

Descriptive statistics according to the sports groups.

Group	N	Mean	SD
Football	15	4.00	3.873
Volleyball	14	5.0714	9.16905

Item 5. *How long did you have to stop practicing sports after the accident?* (weeks of rest) (Tables VIII, IX).

Table VIII

Duration of rest after the accident.

Statistical indicators	N	Mean	SD	t	p
Sample	29	12.83	13.45	5.135	.000

Table IX

Descriptive statistics according to the sports groups.

Group	N	Mean	SD
Football	15	13.07	14.538
Volleyball	14	12.5714	12.73224

Item 6. *Do you think that this accident has negatively influenced your sports career?* (Table X).

Table IV

The number of sports injuries and the traumatized region.

Group	Elbow		Knee		Ankle		Metatarsals		Thigh		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Football	4	28.6	8	57.2	1	7.1	1	7.1	-	0	14	48.3
Volleyball	1	6,7	10	66,6	3	20	-	0	1	6.7	15	51.7
Sample	5	17.3	18	62.1	4	13.8	1	3.4	1	3.4	29	100

Table V

The results of the medical diagnosis.

Group	Fractures		Sprain type injuries		Joint dislocation		Muscle tear		Total	
	N	%	N	%	N	%	N	%	N	%
Football	2	14.3	8	57.2	4	28.5	-	0	14	48.3
Volleyball	2	13.3	9	60	3	20	1	6.7	15	51.7
Sample	4	13.8	17	58.7	7	24.1	1	3.4	29	100

Table X
The percentage of the negative influence of accidents on sports career.

Group	Yes		No		Total	
	N	%	N	%	N	%
Football	5	33.3	10	66.7	15	51.7
Volleyball	6	42.9	8	57.1	14	48.3
Sample	11	37.9	18	62.1	29	100

Item 7. *How often do you experience pain in the injured body part while resting?* (Table XI)

Table XI
The percentage of aches and pains in the body parts that were injured while resting.

Group	Yes		No		Total	
	N	%	N	N	N	%
Football	4	26.7	11	73.3	15	51.7
Volleyball	7	50	7	50	14	48.3
Sample	11	37.9	18	62.1	29	100

Item 8. *How long after the accident did you have to stop exercising?* (Tables XII, XIII)

Table XII
Duration of regaining full fitness.

Statistical indicators	N	Mean	SD	t	p
Sample	29	22.21	15.027	7.958	.000

Table XIII
Descriptive statistics according to the sports groups.

Group	N	Mean	SD
Football	15	27.47	16.826
Volleyball	14	16.5714	10.73968

Table XIV
Correlation between age and the duration of sports practice.

	Groups	r	p
Pair 1	Age – duration of practice	.808**	.000

**Correlation is significant at the 0.01 level (2-tailed)

Table XV
Correlation between the duration of treatment and the duration of recovery.

	Groups	r	p
Pair 1	Duration of treatment - duration of recovery	.273	.152

Table XVI
Correlation between the duration of recovery and the duration of regaining full fitness.

	Groups	r	p
Pair 1	Duration of recovery – duration of regaining full fitness	.556**	.002

**Correlation is significant at the 0.01 level (2-tailed)

Discussions

In our study, of all 29 investigated athletes, 51.7% were footballers and 48.3% volleyball players. The duration of sports practice ± SD of the sample was 10.17 ± 4.80, in the case of footballers 12.13 ± 5.52 years and in case of volleyball players 8.07 ± 2.75 years. The most affected anatomical region was the knee 62.1%, followed by the elbow 17.3%, and the ankle 13.8%. In the group of football players, the proportion of the injured areas was 57.2% in the knee joint and 28.6% in the elbow joint, and in the case of volleyball players, the major traumas were localized in the knee 66.7% and in the ankle 20%.

17 (58.7%) of the surveyed subjects suffered from sprain type injuries, 7 (24.1%) from joint dislocations, 4 (13.8%) from fractures, and 1 (3.4%) from muscular strain.

Regarding the duration of recovery, the group of footballers needed 4 weeks to recover, the group of volleyball players 5 weeks, and the average recovery time of the sample was 4.52 weeks.

The duration of rest after injury was 12.83 weeks in the sample, thus in the group of footballers 13.07 weeks and in the group of volleyball players 12.57 weeks.

Regarding the assessment of the influence of accidents on their sports careers, the group of footballers declared in a proportion of 66.7% and the group of volleyball players in 57.1% that these did not have a negative effect on their professional development in sports.

The sample group needed on average 22.21 weeks to regain full fitness.

The recorded values of t_{value} were superior for all items to $t_{critical,}$ $p < 0.05$, and p_{value} highlights a high significance of the obtained results, which contributes to the rejection of the null hypothesis and confirms the research hypothesis. The r-Pearson correlation value (calculated in Table XIV) was 0.808, which suggests a strong correlation between age and the duration of practice, $p < 0.01$. In the case of the correlation between the duration of treatment and the duration of recovery, r=0.273, which reflects a relatively good correlation, but the differences were not statistically significant (see Table XV).

The correlation between the duration of recovery and the duration of regaining full fitness was good and statistically significant, r is 0.556 and $p = 0.002$ for $p < 0.01$ (Table XVI).

Conclusions

1. The current study reveals that the incidence of osteoarticular traumas is higher in the second decade of life, and their frequency affects more females than males.

2. In our study, the most common type of injury is sprain, especially at the level of the knee joint, with a higher incidence among volleyball players compared to footballers.

3. This research highlights the fact that most athletes undergo good quality medical rehabilitation, taking on average 22 weeks to reach the desired fitness to practice sports again.

Conflicts of interests
There were no conflicts of interests.

Acknowledgments
The authors thank all participants and the managers of the institutions involved for understanding and agreeing to participate in this study.

References

Bahr MA, Bahr R. Jump frequency may contribute to risk of jumper's knee: a study of interindividual and sex differences in a total of 11,943 jumps video recorded during training and matches in young elite volleyball players. Br J Sports Med. 2014;48(17):1322-1326.

Barber Foss KD, Myer GD, Hewett TE. Epidemiology of basketball, soccer, and volleyball injuries in middle-school female athletes. Phys Sportsmed. 2014;42(2):146-153.

de Vries AJ, van der Worp H, Diercks RL, van den Akker-Scheek I, Zwerver J. Risk factors for patellar tendinopathy in volleyball and basketball players: A survey-based prospective cohort study. Scand J Med Sci Sports. 2015;25(5):678-684. doi: 10.1111/sms.12294.

Deroche T, Stephan Y, Woodman T. Psychological Mediators of the Sport Injury-Perceived Risk Relationship. Risk Analysis, 2012;32(1):113-121.

Diamond AB, Solomon GS. Modifying factors in sports-related concussion: dangerous style of play. Phys Sportsmed. 2014;42(3):20-25.

Garrick JG, Requa RK. Sports and fitness activities: the negative consequences. J Am Acad Orthop Surg, 2003;11:439-443.

Hadzic V, Sattler T, Veselko M, Markovic G, Dervisevic E. Strength asymmetry of the shoulders in elite volleyball players. J Athl Train. 2014;49(3):338-344.

Harvey-Kelly KF, Kanakaris NK, Obakponovwe O, West R, Roberts CS, Giannoudis PV. The impact of traumatic pelvic fractures on sporting activity and quality of life. J R Nav Med Serv. 2014;100(1):73-80.

Schwab Reesea LM, Pittsingerb R, Yanga J. Effectiveness of psychological intervention following sport injury. J Sport Health Sci, 2012;1(2):71-79.

Monticone M, Ambrosini E, Rocca B, Magni S, Brivio F, Ferrante S. A multidisciplinary rehabilitation programme improves disability, kinesiophobia and walking ability in subjects with chronic low back pain: results of a randomised controlled pilot study. Eur Spine J. 2014;23(10):2105-2113.

Öztürk S, Kılıç D. What is the economic burden of sports injuries? Eklem Hastalık Cerrahisi. 2013;24(2):108-111.

Palmer-Green D, Elliott N. Sports injury and illness epidemiology: Great Britain Olympic Team (TeamGB) surveillance during the Sochi 2014 Winter Olympic Games. Br J Sports Med. 2015;49(1):25-29.

Tyler TF, Fukunaga T, Gellert J. Rehabilitation of soft tissue injuries of the hip and pelvis. Int J Sports Phys Ther. 2014;9(6):785-797.

Walker N, Thatcher J, Lavallee D. Psychological responses to injury in competitive sport: a critical review. J R Soc Promot Health. 2007;127(4):174-180.

Wiese-Bjornstal DM. Psychology and socioculture affect injury risk, response, and recovery in high-intensity athletes: a consensus statement. Scand J Med Sci Sports. 2010;20(Suppl 2):103-111.

Palestrica of the third millennium – Civilization and Sport
Vol. 16, no. 4, October-December 2015, 347–350

A study of the behavior of Romanian and foreign basketball players in the U-Mobitelco team in FIBA Eurochallenge Cup games

Studiu privind comportamentul în joc al unor jucători români și străini din echipa de baschet U-Mobitelco, în competiția FIBA Eurochallenge Cup

Ildiko Manasses
Faculty of Physical Education and Sports, "Babeş-Bolyai" University, Cluj-Napoca

Abstract

Background. The principle of the research started with the notion that in order to objectively evaluate the team members' behavior during play, which in turn would lead to better knowing the players and to a better use of them in competitions based on objective decisions, it is necessary to gather information by the means of recording and building a ready-to-use database.

Aims. The purpose for analyzing the main behavior indicators during games was to obtain data on which the coach could better assess the evolution of his players and could objectively plan the training process in order to increase the players' performing efficiency during competitions. The aim is to determine to what extent the foreign players from U-Mobitelco represent a plus and add value to the basketball game.

Methods. The six players' contribution to the results of the team in this competition was monitored, by comparing the results obtained by the foreign players and Romanian ones, analyzing specific parameters: number of games played, number of minutes played, number of shots, offensive rebounds, defensive rebounds, steals, blocks - blocked basketball throws, decisive passes - assists, stolen balls, scored points.

Results. A model of the Romanian and foreign players' game behavior was subsequently developed. Comparing the main game parameters, the foreign players have better results than the Romanian ones, except for the 2-point throws. The foreigners' game efficiency index is 49.6, whereas the Romanian players' index is only 14.2.

Conclusions. Processing the data regarding game specific parameters gives the coach objective information on which to better know his players, to assess the overall evolution of the team and to take better decisions. On average, the foreigners get to play 10.41 minutes longer than their Romanian teammates. Regarding playing time, the foreigners outperform the Romanians by far, with a mean value of 30.84 vs. 20.43 minutes played.

In the case of 9 out of 10 parameters, the foreigners have better results and thus, they contribute to a greater extent to the achievements of the team and to raising the performance index.

Keywords: basketball, players, men's basketball, Cluj, EuroChallenge.

Rezumat

Premize. În realizarea cercetării s-a pornit de la ideea că pentru aprecierea obiectivă a comportamentului în joc al componenților echipei, care să conducă la mai buna cunoaștere a jucătorilor și optimizarea utilizării lor în competiții pe baza unor decizii obiective, este necesară culegerea de informații pe baza unor înregistrări, realizarea și valorificarea unei baze de date.

Obiective. În urma anlizei principalilor indicatori ai comportamentului în joc s-a urmărit obținerea unor date pe baza cărora antrenorul să cunoască mai bine evoluția jucătorilor și să poată să-și proiecteze pe baze obiective procesul de pregătire în vederea creșterii capacității de performanță în competiții a sportivilor. Se dorește constatarea în ce măsură jucătorii străini componenți ai echipei U-Mobitelco reprezintă un plus valoric în economia jocului de baschet.

Metode. S-a urmărit contribuția celor 6 jucători la rezultatele obținute de echipă în această competiție, prin compararea rezultatelor obținute la principalii parametri specifici jocului de baschet de către jucătorii străini și cei români: numărul de jocuri la care au participat efectiv, minute jucate, aruncările la coș, recuperările ofensive, recuperările defensive, intercepțiile, capacele - blocările mingilor aruncate la coș, pasele decisive, mingile pierdute, punctele marcate.

Rezultate. În final, s-a realizat un model privind comportamentul în competiție al jucătorilor români și cei străini. Analizând parametrii care se referă la comportamentul în joc, exceptând aruncările la coș de două puncte, jucătorii străini au rezultate mai

Received: 2015, August 31; *Accepted for publication:* 2015, September 20;
Address for correspondence: Faculty of Physical Education and Sport, "Babeş-Bolyai" University, Cluj-Napoca, No. 7 Pandurilor Str., Phone: 0751077767
E-mail: ildi.manasses@gmail.com
Corresponding author: Ildiko Manases ildi.manasses@gmail.com

bune. Indicele de eficiență în joc al străinilor este de 49,6, față de 14,2 al jucătorilor români.

Concluzii. Analiza datelor privind parametrii jocului oferă antrenorului date obiective pe baza cărora acesta poate să cunoască mai bine jucătorii, evoluția de ansamblu a echipei și, astfel, să ia decizii mai corecte. Jucătorii străini sunt utilizați, în medie, cu 10,41 minute mai mult decât coechiperii lor români. În ceea ce privește timpul de joc, jucătorii străini, cu o medie de 30,84 minute, sunt net superiori jucătorilor români, media acestora fiind de 20,43 minute.

În cazul a nouă din cei zece indicatori, străinii au rezultate mai bune și, în acest fel, contribuie într-o mai mare măsură la realizările echipei, la ridicarea valorii performanțelor obținute.

Cuvinte cheie: baschet, jucători, masculin, Cluj, Eurochallenge.

Introduction

Basketball is a sport played between two teams whose players are characterized by remarkable somatic and genetic features (Colibaba-Evuleț & Bota, 1997). Their physical abilities are trained to allow them to withstand intense physical effort, alternating submaximal graded exercise with short maximal effort periods (Baroga, 1994), in order to achieve the best results in direct confrontation with an opponent, both in defense and attack. Due to the game's specific requirements, a very important element is basketball shooting, which requires spatiotemporal representation, an above average kinesthetic sense, a high sense of precision and high efficiency. All these skills are acquired over a period of special training oriented in this direction (Predescu & Ștefan, 2010).

Taking into consideration all these factors, in order for basketball players to reach the level and performance of professional senior players, they need to undergo consistent training for about ten to twelve years. This is why selection and initial physical preparation start at very young ages, around seven - nine years old, while the peak performance age will be around 25-27 years old (***, 2007). The work to reach high performance levels requires systematic, long-term and complex training, the intensity of which increases at regular intervals. Designed to prepare the body for intense effort and resilience in competitions, training is built on a set of pedagogic, biological and psychological principles and involves an interdisciplinary approach (Dragnea & Mate, 2002).

The work of a basketball coach, like any other coaching activity, is conditioned by the systematic action of objective and subjective factors that determine the training process and the participation in competitions. Some of these are: the methodology and technology used, conditions and human resources, activity coordination and management, etc. In order to reach the high performance standards of today's competitions and maintain top technical and methodological parameters, the coach is assisted by specialists from different areas of expertise: the theory and methodology of sportive training, medicine, psychology, sociology, informatics (Epuran, 2005). Their research and guidance contribute to the maintenance of the players' health, a better choice of efficient training means and of the right intensity of physical exercise during training.

There are many studies and research papers focusing on different aspects of the basketball game. Depending on demands, research has been focused on basketball learning and reinforcement methods (Pop & Roman, 2003), on the training of higher education sport specialists, on the theory and methodology of physical training (Colibaba-Evuleț & Bota, 1998), progressive training (Berceanu & Moanță, 2007), adaptation and exploitation of the research results in order to optimize the coach's activity (Vicenzi et al., 2007).

In addition to these general approaches, other issues have also been studied such as: basketball seen from a mathematical and physical point of view (Hajossy & Macura, 2011), the study of the biomechanics of technical procedures (Hay, 1980), the study of the behavior during the game (Feflea, 2011), the evolution of technical elements (Schmidt & Clausmayer, 1995), physical exercise (Feflea & Roșca, 2013; Roman & Batali, 2002; Travaillant & Cometti, 2003), and many others.

Exploratory studies are based on significant statistical information, acquired as a result of observing and recording the players' behavior during matches (Bachner, 1998). The purpose is to offer basketball specialists relevant data regarding different aspects of the basketball game and to build databases for the objective analysis of the team as a whole and of the players taken individually (Maroti, 2008).

Objectives

- understanding the game behavior of the best team players on an objective basis;
- comparing the results and efficiency of these players;
- providing the coach with objective data that can help in designing and implementing the training process, optimizing the management of the team during competition, making a more rational use of the players.

Hypothesis

This research aims to provide a better understanding of the performance of the players and also, to rank them, which will result in an objective assessment of the players. Through their game behavior, the foreign players contribute to improving the value of the team.

Material and methods

In order to conduct the research, CSU Mobitelco Cluj-Napoca gave us the permission to consult their FIBA Eurochallenge Cup database, and we also obtained the consent of the players mentioned in this paper.

Research protocol

a) Period and place of the research

The research was conducted during the competitive season 2011-2012, when the U-Mobitelco team competed in the Eurochallenge Cup, in group D. The games were played at home and away, in the hometowns of the group teams: Calton, Antwerp, Enisey and Cluj-Napoca.

b) Subjects and groups

Six players of the Universitatea-Mobitelco Cluj-Napoca basketball team, three foreigners and three Romanians, were included in the study. Representative players were chosen and grouped two by two, according to their position in the team.

c) Tests applied

The study is based on data gathered by observing and recording the main parameters of the basketball game during the six matches played in group D: shots, offensive rebounds, defensive rebounds, interceptions, blocked basketball throws, assists, turnovers, points scored - all related to the playing time of each team member included in the research and downloaded from the competition's website (1).

The following abbreviations were used in the recording process: Min/M - minutes played per game; 3PA - three-point shot attempt; 3PM - scored three-point shot; 2PA - two-point shot attempt; 2PM - scored two-point shot; 1Pa - attempted free throws ; 1PM - scored free throws; REC/M O - offensive rebounds (attack); REC/M D - defensive rebounds (defense), I/M - number of intercepted balls; C/M - number of blocked balls, PD/M - number of assists , MP/M - number of turnovers, PCT/M - total points scored per game, EF - the players' efficiency (coefficient of efficiency).

d) Statistical processing

Data processing and calculation of means, percentages, and efficiency indices were performed using the statistical-mathematical method. Microsoft Excel was used for data processing, tables and graphic representations.

Results

Table I

Number of games and minutes played.

Number	Foreign players			Romanian players		
	MT	ZK	DK	MS	PM	PC
Matches	5	5	6	5	6	2
Minutes	142	144	212	151	132	18

Table III

Player ranking based on contributions to points.

Place	Player	Status	Scored shots			Total	Game average
			3 points	2 points	1 point		
I	DK	Foreigner	12	84	18	114	19.00
II	ZK	Foreigner	15	50	17	82	16.40
II	MT	Foreigner	15	30	8	53	10.40
IV	MS	Romanian	18	24	4	46	9.50
V	PM	Romanian	6	26	2	38	6.33
VI	PC	Romanian	-	2	1	3	1.50

Table IV

Offensive and defensive rebounds.

Parameter	Foreign players			Romanian players		
	MT	ZK	DK	MS	PM	PC
Offensive rebounds	1	14	3	9	3	1
Defensive rebounds	13	24	19	21	13	1

Table V

Balls won through interceptions and blocks.

Parameter	Foreign players			Romanian players		
	MT	ZK	DK	MS	PM	PC
Interceptions	12	9	8	-	3	-
Blocks	-	1	3	-	-	-

Table VI

Comparative presentation of the evolution model.

Parameter		Foreign players	Romanian players	t
Played minutes		30.84	20.43	1.38
3 p	M	2.66	1.53	1.54
2 p	M	5	5.1	2.16
1 p	M	8	2.3	2.49
Rec.	Of.	1.16	0.76	0.35
Rec.	Def.	3.52	2.28	1.06
I/M		1.83	0.16	5.55
MC/M		6.66	3.23	1.79
PD/M		2.36	1.76	0.07
PCT/M		46	17.1	2.40

Discussions

Observing and recording the game behavior related data provides the coach with objective information regarding the players, allowing him to build a database concerning both his own players and the opponent team's players. Data processing and analysis lead to a better understanding of the players, resulting in better and more objective decisions.

The comparative study of the games played and active game time shows us that two players played in all of the games, three players in five games and one player in two games. The actual playing time of the six players involved in the study ranged between 18 and 212 minutes (Table I).

Given the purpose of the basketball game, which is to score as many points as possible against the other team, one of the important indicators of game behavior is the basketball shooting efficiency index.

An analysis of the attempted basketball shots evidences that in the case of 3-point shots, 16.15% were made by foreign players and 12.30% by Romanian players. Of the total 2-point shots, the foreign players achieved 50.30%, while the Romanians achieved only 19.24%. So, foreign players clearly stand out in what concerns basketball throws. If we analyze this proportion individually, the discrepancy is significant: 78 shots (the highest achievement) versus only 5 shots (the lowest achievement). Of all 260 throws, 178 belonged to foreign players, while 82 belonged to Romanian players. The situation is most obvious in the case of free shots, where the number of attempts carried out was 83.12% for foreigners and only 16.88% for Romanians.

Foreign players have a proportion of 53.93% regarding the efficiency of throws in action, while Romanian players have a percentage of 41.46%. Successful free throws

Table II

Shooting efficiency index.

Shots	Foreign players									Romanian players								
	MT			ZK			DK			MS			PM			PC		
	Î	R	%	Î	R	%	Î	R	%	Î	R	%	Î	R	%	Î	R	%
3 points	13	5	38.46	17	5	29.41	12	4	33.33	22	6	27.27	10	2	20.00	-	-	-
2 points	25	15	60.00	45	25	55.55	66	42	63.63	25	12	48.00	20	13	65.00	5	1	20.00
1 point	10	8	80.00	21	17	80.95	33	18	54.54	6	4	66.66	6	6	100	1	1	100

performed by foreigners represent 67.18% and those performed by native players 84.6% (Table II).

The ranking based on the scored points shows that the top three places are occupied by foreign players. From the above data, it can be seen that the contribution of foreigners is much higher than the contribution of Romanian players in what concerns the number of points scored (Table III).

In relation to game strategy, possession of the ball is an important element in the basketball game. It is obtained after a field goal scored by the opponent, as a result of misconduct, of a wrong action of a defense player or as the result of a player's individual actions (recovering the ball after a missed shot, intercepting a pass, blocking, or carrying the ball, etc.). Of all these, we focused on offensive rebounds, given their important role in ball possession. The difference between two teams in what concerns ball possession is in close connection with the number of offensive rebounds made by the members of each team (Table IV).

When comparing the game rebound averages, foreign players have an average of 6 offensive rebounds, while Romanian ones have an average value of only 4.33. This is also the case of defensive rebounds, where foreign players outperform Romanian players, by 18.66 vs. 11.66. An analysis of the other ways to obtain ball possession also shows that the foreigners outperform the Romanians (Table V).

Based on the resulting arithmetic means for the studied parameters, we made a comparison of behavior during play for Romanian and foreign players, which can represent a pattern of their game. Foreign players performed better than Romanian players in the following: 3-point field goals (2.66 vs. 1.53); successful free throws (8 vs. 2.3); offensive rebounds (1.16 vs. 0.76); defensive rebounds (3.52 vs. 2.28); steals (1.83 vs. 0.16); turnovers (6.66 vs. 3.23); assists (2.36 vs. 1.76); scored points (46 vs. 17.1).

Regarding the efficiency index, foreign players scored 49.6, having a good performance, while Romanian players scored 14.2 - a weak performance. The only parameter where the situation was reversed was represented by 2-point shots: 5.00 vs. 5.1 (Table VI).

By analyzing the game behavior during the six matches, we found that this superiority was also visible during each match taken separately. Some of the reasons for this situation are that foreign players are trained in renowned basketball schools, such as the American or the Serbian school, and that they have a vast experience in major competitions.

Conclusions

1. Regarding the game time, foreign players, having an average of 30.84 minutes, outperform by far Romanian players, who average 20.43 minutes. Foreigners play during games for 10.41 minutes more than their Romanian teammates.

2. Except for the 2-point throws, foreign players outperform local players by an average of 2.66 vs. 1.53 in 3-point throws, and 8 vs. 2.3 in free throws.

3. The foreigners' superiority is also visible in turnovers: 1.16 vs. 0.76 offensive rebounds; 3.52 vs. 2.28 defensive rebounds; 1.83 vs. 0.16 steals.

4. The foreigners' efficiency index is 49.6, while the Romanians' efficiency index is 14.2.

5. Considering these results, our hypothesis that foreign players through their results add value to the team is confirmed.

Conflicts of interest

Nothing to declare.

Acknowledgments

The data regarding the parameters of the basketball game used in this research paper were downloaded from the official site of the competition. We thank the players, coaches and managers of U-Mobitelco for their collaboration and support.

References

Bahner L. Obiectivizarea jocului de baschet. Ed Mirton, Timişoara, 1998, 3-51.

Baroga M. Baschet. În: Medicină sportivă aplicată în sport. Ed. Editis, Bucureşti, 1994,386-390.

Berceanu D, Moanţă D, A. Concepţia unitară de joc şi pregătire pe nivele formative. FRB. Ed. Printech, Bucureşti, 2007.

Colibaba-Evuleţ D, Bota I. Jocuri sportive. Teorie şi metodică. Ed. Aldin, Bucureşti, 1998.

Colibaba-Evuleţ D, Bota I. Strategii noi de orientare şi selecţie în jocurile sportive. Vol. Conf. St. Int. „Strategie şi evaluare în sport", Bucureşti, 5-7 octombrie 1997,54

Dragnea A, Mate-Teodorescu S. Teoria Sportului. Ed. Fundaţia pentru Educarea şi Formarea prin Sport a Tinerilor, Bucureşti, 2002,155.

Epuran M. Metodologia cercetării activităţilor corporale. Exerciţii fizice, sport, fitness. Ed. Fundaţia pentru Educarea şi Formarea prin Sport a Tinerilor, Bucureşti, 2005, 49-72.

Feflea I, Roşca E. Caracteristicile efortului fizic în jocul modern de baschet. Palestrica Mileniului III. Civilizaţie şi Sport, 2013;14(4):308-312.

Feflea I. Analiza comportamentului la finalizare a jucătorilor fundaşi în baschetul de performanţă. Palestrica Mileniului III. Civilizaţie şi Sport, 2011;12(4):366-371.

Hajossy R, Macura P. Physics and Mathematics of Successful Shuting in Basketball. Ed. Universităţii din Oradea, Oradea, 2011.

Hay JG. Basket-ball. În: Biomécanique des tehnicque sportives Vigot Ed., Paris, 1980, 202-226.

Maroti Ş. Turneul olimpic de baschet masculin, Beijing, 2008. Palestrica Mileniului III. Civilizaţie şi Sport, 2008;9 (4)278-281.

Pop H, Roman G. Baschet. Teorie şi metodică, Ed. Napoca Star, Cluj-Napoca,2003.

Predescu T, Ştefan C. Pregătirea stadială în jocul de baschet. Ed. Semne, Bucureşti, 2010,193.

Roman G, Batali C. Adaptarea efortului pentru antrenament si competitie in jocul de baschet. Vol. Ses. Int. Com. St. Cluj-Napoca, 6-8 dec., 2002,420-424

Schmidt G, Clausmayer A. Baschet-Evoluţia aruncării de trei puncte. Sportul de performanţă,1995;378-379:25-40.

Travaillant G, Cometti G. Analyse des efforts en basket. CEP Dijon, UFR STAPS Dijon, Université Bourgougne, 2003,1-21

Vicenzi JP, Grosgeorge B, Raimbault N, Rat M. Basket-ball, approche totale, analyse techunique et pedagogique. Ed. Vigot, Paris, 2007,17-75.

***. Concepţia unitară de joc şi pregătire pe nivele formative. Federaţia Română de Baschet, Colegiul Central al Antrenorilor, Bucureşti, 2007.

Websites

(1) www.eurobasket.com Accessed in June 2015.

Palestrica of the third millennium – Civilization and Sport
Vol. 16, no. 4, October-December 2015, 351–354

REVIEWS
ARTICOLE DE SINTEZĂ

Venous pathology in athletes
Patologia venoasă la sportivi

Ioana Para, Nicoleta Leach, Vasile Negrean, Teodora Alexescu
"Iuliu Haţieganu" University of Medicine and Pharmacy, Cluj-Napoca
4th Medical Clinic, Cluj-Napoca

Abstract

Sports activities, at any level, cause great physical stress to the athlete's body. Musculoskeletal injuries are the most common cause of pain and functional impotence in athletes. However, vascular etiology should not be neglected and it should be considered in an athlete with persistent symptoms, refractory to conventional therapy for musculoskeletal pains.

The diagnosis of vascular disease may be overlooked in athletes because they are young, healthy and musculoskeletal impairment may present similar symptoms and signs and seems the most plausible explanation for these.

In this paper, we focused on venous pathology in athletes: deep vein thrombosis and its complications: pulmonary embolism and post-thrombotic syndrome. We reviewed the main risk factors and preventive measures that may be taken; we insisted on warning symptoms and signs that should be considered by the physician and the means of diagnosis; we mentioned the treatment and recovery means for the resumption of sports activities.

Venous pathology in athletes is an important health problem because a delay in diagnosis may have serious consequences for the affected limb, their subsequent sports activity or it may even endanger the athlete's life.

Keywords: deep vein thrombosis, pulmonary embolism, post-thrombotic syndrome, risk factors of deep vein thrombosis in athletes.

Rezumat

Activităţile sportive, la orice nivel, supun organismul sportivului la o mare solicitare fizică. Leziunile musculoscheletale reprezintă cea mai frecventă cauză de durere şi impotenţă funcţională la sportivi. Cu toate acestea, etiologia vasculară nu trebuie neglijată şi trebuie luată în considerare la un sportiv cu simptome persistente, refractare la terapia uzuală pentru suferinţele musculoscheletale.

Diagnosticul de afectare vasculară poate fi trecut cu vederea la sportivi deoarece aceştia sunt tineri, sănătoşi, iar afectarea musculoscheletală poate prezenta simptome şi semne asemănătoare şi pare cea mai plauzibilă explicaţie pentru acestea.

În lucrarea de faţă ne-am oprit asupra patologiei venoase la sportivi: tromboza venoasă profundă şi complicaţiile acesteia, embolia pulmonară şi sindromul posttrombotic. Am făcut o trecere în revistă a principalilor factori de risc şi a măsurilor profilactice ce pot fi luate; am insistat asupra simptomelor şi semnelor de alarmă care trebuie luate în considerare de către medic şi asupra mijloacelor de diagnostic; am precizat tratamentul şi mijloacele de recuperare în vederea reluării activităţii sportive.

Patologia venoasă la sportivi reprezintă o importantă problemă de sănătate, deoarece întârzierea diagnosticului poate avea consecinţe grave asupra membrului afectat, asupra activităţii sportive ulterioare sau chiar poate pune în pericol viaţa sportivului.

Cuvinte cheie: tromboza venoasă profundă la sportivi, embolie pulmonară, sindrom posttrombotic, factori de risc ai trombozei venoase la sportivi.

Introduction

Sports activities of any kind submit athletes to a great physical strain. Many times, their movements and postures push the limits of human anatomy and physiology.

Musculoskeletal lesions are the main cause of pain or functional impairment in athletes. Yet, similar symptoms may also appear in the case of vascular damage. Vascular damage should be suspected in any athlete who presents the following symptoms: pain, paresthesia, early muscular fatigue, oedema, skin discoloration, especially if they are resistant to the usual therapy for musculoskeletal ailments. A thorough medical history check must be carried out for these, as well as a complete clinical exam, which should include specific triggering maneuvers (reproducing the movements specific to the sports type), for a quick and correct diagnosis (Perlowski & Jaff, 2010).

Unfortunately, vascular damage can be overlooked in athletes, because these are young, healthy persons, in whom vascular disease is less likely to exist and a musculoskeletal

Received: 2015, September 12; *Accepted for publication:* 2015, October 5;
Address for correspondence: 4th Medical Clinic, Republicii Str. No.18, Postal Code 400015, Cluj-Napoca
E-mail: ioana.para@yahoo.com
Corresponding author: Ioana Para, phone: 0745417942, ioana.para@yahoo.com

cause to explain the symptoms is more plausible. A delay in diagnosis may have severe consequences on the damaged limb, on the future sports activity and may even threaten the athlete's life (Holzheimer & Stautner-Brückmann, 2008; Perlowski & Jaff, 2010; Hull & Harris, 2013).

In this paper, we focused on venous pathology in athletes: deep venous thrombosis and its complications, pulmonary embolism and post-thrombotic syndrome. We reviewed the main risk factors and prevention measures that can be taken; we focused on the symptoms and alarm signals that need to be considered by the physician, as well as on diagnostic means; we mentioned the treatment and recovery means for the resumption of sports activities.

Deep vein thrombosis

In 1884, Virchow grouped the factors favorable to DVT (deep vein thrombosis) in a triad, which consists of: blood hypercoagulability, venous stasis and vascular wall lesions.

Each of these factors may appear in an athlete, alone or combined, in connection to the athlete's activity. The specific risk factors of vein thrombosis in athletes are:

Factors that increase blood coagulability: dehydration and haemoconcentration (triggered by an insufficient intake of liquids during effort), venous wall inflammation, use of estrogen contraceptives during training or competitions, or use of anabolic steroids (Andersen & Spencer, 2003; Bates & Ginsberg, 2004; Goldhaber & Fanikos, 2004; Hull & Harris, 2013; Grabowski et al., 2013; Burrus et al., 2014).

Factors that favor venous stasis: prolonged immobilisation on planes or buses on the way to sports events, bradycardia and low blood pressure (specific to athletes), congenital musculoskeletal malformations (thoracic outlet syndrome that could trigger Paget-Schröetter syndrome) or congenital venous malformations (May-Turner syndrome, narrowing or absence of the inferior vena cava) (Hull & Harris, 2013; Andersen & Spencer, 2003; Goldhaber & Fanikos, 2004; Grabowski et al., 2013; Burrus et al., 2014).

Factors that favor venous wall damage: orthopedic surgery and repeated trauma and microtrauma (Andersen & Spencer, 2003; Goldhaber & Fanikos, 2004; Hull & Harris, 2013; Grabowski et al., 2013).

Thoracic outlet syndrome

Thoracic outlet syndrome (TOS) is a neurovascular compression syndrome of the upper limb. The thoracic duct is delimited by the scalene triangle (composed by the anterior, middle and posterior scalene muscles), the costoclavicular space (between the clavicle and the first rib), and the subcoracoid space (between the pectoral muscle and the coracoid process). At this level the brachial plexus, the subclavian vein and the subclavian artery pass. If nervous compression prevails, neurogenic TOS occurs (90% of cases). If vascular (arterial or venous) compression prevails, vasculogenic TOS appears (3-5% of cases). Vascular compression mostly occurs in the scalene triangle. TOS rarely develops in athletes, but when it does, it can have devastating effects (DiFelice et al., 2002; Laker et al., 2009).

Paget-Schröetter syndrome

Paget-Schröetter syndrome (PSS) is one of the most frequent manifestations of TOC and it represents the spontaneous effort-induced thrombosis of the axillary or subclavian vein. The syndrome was described in 1875 by Paget and in 1884 by Schröetter. It is the most frequent vascular damage in young athletes. As a severe and possibly lethal complication, pulmonary embolism may occur in 36% of the patients, therefore a quick diagnosis is vital. If correctly diagnosed and treated, it allows the prevention of pulmonary embolism and post-thrombotic syndrome, the athlete being able to resume sports activity within several months (Melby et al., 2008; Laker et al., 2009; Perlowski & Jaff, 2010).

PSS occurs mostly in athletes who perform repetitive upper limb overhead motions (basketball, baseball, volleyball, handball, football, tennis, swimming, weightlifting, gymnastics, wrestling, golf, hockey, rowing), through repeated compression of the axillary or subclavian vein. Compression can be localised at the scalene triangle level, through the presence of the cervical rib (0.5-1.5%), between the clavicle and the first rib, or it may be due to specific muscular hypertrophy (swimmers – the small pectoral muscle; weightlifters – the scalene muscle; pitchers, tennis players – the dominant limb muscle) (DiFelice et al., 2002; Treat et al., 2004; Laker et al., 2009, Perlowski & Jaff, 2010).

The conditions of PSS occur in two stages:

1. The stenosis stage: repeated trauma to the vein leads to inflammation, fibrin deposits, progressive narrowing and development of collateral circulation; for this reason, patients are asymptomatic in this stage (Thompson & Driskill, 2008; Perlowski & Jaff, 2010).
2. The thrombosis stage: when the decrease of venous flow reaches a critical point, platelet adherence and aggregation appear, with the formation of thrombi, and the patient becomes symptomatic (Thompson & Driskill, 2008; Perlowski & Jaff, 2010).

Clinically, the patient presents unilateral oedema of the arm, a sensation of "heaviness", upsetting dull pain or intense arm pain, cyanosis, collateral venous circulation (the anterior side of the thoracic wall or the ipsilateral shoulder) or even pulmonary embolism symptoms: dyspnea, chest pain (exacerbated by breathing) radiating to the shoulder, palpitations, cough (with or without blood expectoration), asthenia, dizziness, fever (Perlowski & Jaff, 2010; Hull & Harris, 2013).

Diagnosis is based on the above mentioned clinical manifestations, occurring suddenly in a young and apparently healthy athlete on physical examination and complementary explorations.

Physical examination can evidence unilateral swelling of the arm, cyanosis, collateral circulation, with unchanged peripheral pulse of the affected upper limb. Maneuvers for the diagnosis of TOS should also be performed: the Adson test and the Wright test. The Adson test is performed by palpating the radial pulse with the arm in supination and abduction at 15 degrees, while the neck is turned towards the affected area; the test is positive if the pulse disappears in deep inspiration. The Wright test is performed by palpating the radial pulse with the shoulder in abduction and external rotation; the test is positive if the pulse disappears (Gilard et al., 2001; Laker et al., 2009; Perlowski & Jaff, 2010).

The following complementary exams are required for

diagnosis: color and 2D Doppler ultrasound (the quickest and most accessible method), which show the presence of thrombi. Computed tomography (CT), CT angiography or magnetic resonance angiography (MRA) (with the upper limb lifted above the head) can be useful because, in addition to showing the presence of thrombi, it also provides anatomical information (the presence of the cervical rib or muscular hypertrophy). The exam of choice is contrast venography, which allows the localisation of the thrombus, assesses its surface and the state of collateral circulation and, if needed, allows to perform thrombolysis. Coagulation tests must also be carried out (Protein C, Protein S, factor V Leiden, lupus anticoagulant, cardiolipin antibodies, antithrombin III, ANA) in order to exclude a precoagulant state with secondary thrombosis. In PSS, these are most frequently within normal parameters (Laker et al., 2009; Perlowski & Jaff, 2010).

Regarding treatment, unfortunately, until today there is no international agreement. It must be individualised, prompt and aggressive. One could either use classic heparin or LMWH (low molecular weight heparin) in order to prevent the propagation of the thrombus and embolisation, or intravenous thrombolysis with or without thrombectomy, followed by anticoagulant treatment. Eventually, if there is significant narrowing by fibrosis, temporary balloon expansion could be attempted (although there is a high risk of restenosis). Inserting a stent is not recommended by most authors, due to a high risk of thrombosis recurrence (Molina et al., 2007; Melby et al., 2008; Laker et al., 2009; Perlowski & Jaff, 2010).

The duration of anticoagulant treatment with classic heparin or LMWH, followed by anticoagulant treatment administered orally, such as Coumadin, warfarin, varies according to each author: 3-6 months (Perlowski & Jaff, 2010); 8 weeks (Laker et al., 2009).

Unfortunately, these patients have a high recurrence risk. This is why surgery must be taken into account, which needs a multidisciplinary approach. The aim of surgery is the mechanical decompression of the subclavian vein (through venotomy and/or venoplasty) (Laker et al., 2009; Perlowski & Jaff, 2010).

A follow-up of these patients is mandatory and is carried out by 2D Doppler ultrasound and venography. Sports activity can be resumed only after the complete disappearance of symptoms and after the completion of anticoagulant treatment (Laker et al., 2009; Perlowski & Jaff, 2010).

Lower limb deep vein thrombosis (DVT)

DVT appears post-trauma mostly at the level of the popliteal vein, posterior tibial vein and peroneal vein, either through direct trauma, or as a consequence of a sudden hyperextension movement of the knee, of knee dislocation or lower limb torsion during kicking or approaching movements (Echlin et al., 2004; Casey et al., 2009).

Just like in the case of PSS, cases of non-traumatic lower limb deep vein thrombosis, induced by effort, have also been described. These are found in skiers and marathon runners. Although it is generally known that physical exercise prevents the formation of thrombi, an extremely intense effort may lead to a decrease in venous flow and vascular wall micro-traumas, which, in turn, lead to the appearance of thrombi. Non-traumatic thrombosis may also occur in the case of popliteal vein compression syndrome, through the median end of the gastrocnemius muscle. This syndrome is specific to athletes prone to gastrocnemius muscle hypertrophy, such as rugby and football players (Ehsan et al., 2004; Casey et al., 2009; Perlowski & Jaff, 2010).

The clinical presentation shows unilateral oedema of the lower limb, particularly visible on the calf and ankle, "tension" or pain in the calf (which does not disappear after the application of ice, after extension or pain killers). Immobilisation can exacerbate the pain, while movement can alleviate it. Clinical examination shows: oedema, warm skin, redness or cyanosis (more pronounced after warm baths), moderate fever and positive Homans sign (calf pain on leg dorsiflexion) (Goodacre et al., 2005; Casey et al., 2009; Burrus et al., 2014).

The complementary exams required for diagnosis are color or 2D venous Doppler ultrasound, which show the presence of the thrombus. Determination of D-dimer in blood is useful because its increased value significantly increases the suspicion of DVT. In order to precisely locate the thrombus, to assess its extension and collateral circulation, CT or MRI angiography can also be carried out. Coagulation tests must also be performed in this case (Protein C, Protein S, factor V Leiden, lupus anticoagulant, cardiolipin antibodies, antithrombin III, ANA) in order to exclude a precoagulant state; generally, they are within normal parameters. If the thrombus cannot be highlighted through the previously mentioned methods, but there is a high DVT suspicion, intravenous venography can also be carried out (Hyers, 2003; Casey et al., 2009; Burrus et al., 2014).

The potential complications are pulmonary embolism and post-thrombotic syndrome (PTS). Pulmonary embolism may occur in 50% of untreated DVT patients and may cause death in 2.1% of cases. It manifests through dyspnea, chest pain (exacerbated by breathing) radiating to the shoulder, palpitations, cough (with or without bloody expectoration), asthenia, dizziness, fever (Perlowski & Jaff, 2010; Hull & Harris, 2013; Boden et al., 2013; Burrus et al., 2014).

Post-thrombotic syndrome occurs in 20-50% of DVT patients in whom complete thrombus resorption has not been reached; there is also the risk that resuming training too early may lead to thrombus recurrence. It clinically manifests by chronic pain, paresthesia, chronic oedema, stasis dermatitis, pigmentation, ulceration. All these manifestations lead to a decrease in the quality of life and sports performance of the athlete (Kahn & Ginsberg, 2002; Echlin et al., 2004; Casey et al., 2009).

The two complications can be prevented through early and correct treatment.

Treatment consists of anticoagulation with classic heparin or LMWH, followed by oral anticoagulant treatment such as Coumadin or warfarin (3-6 months). Some authors also recommend thrombolysis, followed by anticoagulant treatment, which would preserve valve function and prevent PTS. Wearing elastic compression is also very important (Kahn & Ginsberg, 2002; Echlin et al.,

2004; Casey et al., 2009).

In terms of returning to sports activity, a close collaboration between the athlete and the attending physician is necessary. Activity will be resumed gradually, after 4-6 weeks and after the complete disappearance of signs and symptoms. During anticoagulant treatment, sports with a high risk of trauma are forbidden; the athlete may resume light jogging and swimming. Resuming training and attending sport competitions can only be done after the completion of anticoagulant treatment. Wearing compression stockings is mandatory for the prevention of PTS. It is also important to avoid, as much as possible, the risk factors (Hull & Harris, 2013; Burrus et al., 2014).

DVT prophylaxis

Given that it is much easier to prevent than to treat, we can mention some prophylactic measures to prevent DVT in athletes.

Athletes must pay attention to thirst as a sign of dehydration. High caffeine or alcohol intake will be avoided and water electrolyte rehydration will be done during and after practice.

During long travelling, pauses must be taken to mobilize the limbs and body; cramped positions and crossed leg positions must be avoided and elastic compression must be worn.

Female athletes must see a family planning specialist in order to use contraceptives that do not contain estrogens.

The prophylactic use of aspirin can be taken into account, but only as a medical recommendation.

Most importantly, the athlete must "listen to his/her body". If they feel something is not right, they must stop training and ask for a medical consult.

The identification and the management of any hereditary procoagulant condition are necessary in the case of athletes with a history of DVT, in close collaboration with the attending physician (Andersen & Spencer, 2003; Goldhaber & Fanikos, 2004; Hull & Harris, 2013; Burrus et. al., 2014).

Practical considerations

From everything presented above, the following must be kept in mind:

1. DVT can occur in athletes who may have risk factors (sometimes associated) for it.

2. DVT must be taken into account in any trauma episode, especially if there are problems with the differential diagnosis of musculoskeletal lesions, but it can also appear without obvious trauma.

3. DVT can develop anywhere, including in the upper limbs.

4. Due to physical condition, bradycardia and high pain tolerance, athletes may present atypical DVT symptoms.

5. If untreated, DVT may have devastating effects on the affected limb, on sports activity and it may even endanger the athlete's life.

6. Despite the athletes' physical condition and psychological determination, we must not forget that: *To be fit does not mean to be healthy*.

Conflicts of interest

Nothing to declare.

References

Andersen FA jr, Spencer FA. Risk factors for venous thromboembolism. Circulation, 2003;107 (23suppl 1):19-16.

Bates SM, Ginsberg SJ. Treatment of deep-vein thrombosis. N Engl J Med, 2004;351(3):268-277.

Boden BP, Breit I et al. Fatalities in high school and college football players. Amer J Sports Med, 2013;41(5):1108-1116.

Burrus TM, Werner BC, Starman JS et al. Chronic leg pain in athletes. Amer J Sports Med, 2014; 20 (10):1-10.

Casey E, Lento PH, Ihm J, Rodriguez H. Vascular injuries in the lower limb of athletes. in Akuthota V, Herring SA, Nerve and vascular injuries in sports medicine; Springer, New-York, 2009;183-198.

DiFelice GS, Paletta GA Jr., Phillips BB, Wright RW. Effort thrombisis in the elite throwing athlete. Amer J Sports Med, 2002;30 (5):708-712.

Echlin PS, Upshur REG. et al. Traumatic deep vein thrombosis in a soccer player: a case study. Thrombosis Journal, 2004,2:8. doi:10.1186/1477-9560-2-8.

Ehsan O, Darwish A, Edmundson C et al. Non-traumatic lower limb vascular complications in endurance athleytes. Review of literature. Eur J Endovasc Surg, 2004;28:1-8.

Gilard J, Perez-Cousin M, Hachulla E, et al. Diagnosing thoracic outlet syndrome: contribution of provocative tests, ultrasonography, electrophysiology and helical computed tomography in 48 patients. Joint Bone Spine, 2001;68(5):416-424.

Goldhaber SZ, Fanikos J. Prevention of deep vein thrombosis and pulmonary embolism. Circulation. 2004;110:445-447.

Goodacre S, Sutton A, Sampson F. Meta-analysis: the value of clinical assessment in the diagnosis of deep venous thrombosis. Ann Intern Med. 2005;143(2):129-139.

Grabowski G, Whiteside WK, Kanwisher M. Venous thrombosis in athletes. J Am Acad Orthop Surg. 2013;21(2):108-117.

Holzheimer RG, Stautner-Brückmann C. Calf pain in runners may be caused by venous insufficiency. Eur J Med Res, 2008;13(5):218-220.

Hull CM, Harris JA.Venous thromboembolism and marathon athletes. Circulation, 2013;128(25): 469-471.

Hyers TM. Management of venous thrombembolism: past, present, and future. Arch Intern Med, 2003; 163(7):759-768.

Kahn SR, Ginsberg JS. The post-thrombotic syndrome: current knowledge, controversies and directions for future research. Blood Reviews. 2002;16(3):155-165. http://dx.doi.org/10.1016/S0268-960X(02)00008-5.

Laker S, Sullivan WJ, Whitehill TA. Thoracic outlet syndrome, in Akuthota V, Herring SA, Nerve and vascular injuries in sports medicine; Springer, New-York, 2009,112-126.

Melby SJ, Vedantham, Narra VR, Paletta GA Jr, Khoo-Summers L, Driskill M, Thompson RW. Comprehensive surgical management of the competitive athlete with effort thrombosis of the subclavian vein (Paget-Schröetter syndrome). J Vasc Surg. 2008;47(4):809-820.

Molina JE, Hunter DW, Dietz CA. Paget-Schroetter syndrome treated with thrombolytics and immediate surgery. J Vasc Surg, 2007;45(2):328-334.

Perlowski AA, Jaff MR. Vascular disorders in athletes. Vasc Med, 2010;15(6):469-479.

Thompson RW, Driskill M, Neurovascular problems in the athlete's shoulder. Clin Sports Med, 2008;27:789-802.

Treat SD, Smith PA, Wen DY, Kinderknecht JJ. Deep vein thrombosis of the subclavian vein in a college volleyball player. Amer J Sports Med, 2004;32(2):529-532.

Palestrica of the third millennium – Civilization and Sport
Vol. 16, no. 4, October-December 2015, 355–359

Asthma and swimming - benefits and risks
Astmul bronşic și înotul - beneficii şi riscuri

Codruţa Mărginean, Emil Onaca, Mira Florea
Community Medicine Department, "Iuliu Haţieganu" University of Medicine and Pharmacy, Cluj-Napoca, Romania

Abstract
Asthma is a global health problem increasing in prevalence, especially among children. For a long time, swimming has been considered the most suitable sporting activity for asthma patients, due to the lower risk of bronchoconstriction, but also to the observed beneficial effects on lung function, especially in children and young people. In recent years, however, more and more authors have warned about the irritating role on the respiratory tree exerted by chlorine products used for the disinfection of swimming pool water. Various studies certify a higher prevalence of asthma or respiratory symptoms among elite swimmers, compared to other categories of athletes, and some authors blame the irritating role of chlorinated products.

This paper proposes a review of current information related to this issue, focusing on the positive effects that swimming has in controlling asthma symptoms and on the potential risks it entails for asthmatic patients.

Keywords: asthma, swimming, chlorinated products.

Rezumat
Astmul bronşic reprezintă o problemă globală de sănătate, cu o prevalenţă în creştere, mai ales în rândul copiiilor. Multă vreme înotul a fost considerat sportul cel mai potrivit pentru astmatici, datorită riscului mai redus de bronhoconstricţie, dar şi datorită efectelor benefice observate asupra funcţiei pulmonare, în special la copii şi tineri. În ultimii ani însă, tot mai mulţi autori au avertizat asupra rolului iritant pe sistemul respirator exercitat de produsele clorinate, utilizate pentru dezinfecţia apei din piscine. Diferite studii certifică o prevalenţă mai mare a astmului bronşic sau a simptomelor respiratorii în rândul înotătorilor de performanţă, în comparaţie cu alte categorii de sportivi, unii autori invocând rolul iritant al produselor clorinate.

Lucrarea de faţă îşi propune o trecere în revistă a informaţiilor de actualitate privitoare la această problematică, cu accent pe precizarea efectelor benefice pe care le are înotul asupra controlului simptomelor astmului bronşic, dar şi asupra potenţialelor riscuri pe care acesta le implică pentru pacienţii astmatici.

Cuvinte cheie: astm bronşic, înot, produse clorinate.

Introduction

Bronchial asthma is a global health problem that affects 1-18% of the population in various countries, its costs representing a burden for society. Its prevalence is increasing in many countries, especially among children (***, 2015a). Despite the various efficient therapies available, it seems that 75% of European asthma patients are insufficiently controlled (Cazzoletti et al., 2008). Under these circumstances, the identification of additional factors, besides drug therapy with its unquestionable beneficial effects, which may contribute to a better control of the disease, is most welcome (Bacon et al., 2015).

The added value of physical activity in the management of bronchial asthma is highlighted in the GINA guidelines (***, 2015a), which recommend to "encourage people with asthma to engage in regular physical activity because of its general health benefits"; these guidelines also mention that the only sport that brings benefits to the pulmonary function in young asthmatics is swimming and recommend body weight loss in obese patients (***, 2015a).

For a long time, swimming has been considered the most appropriate physical activity for asthma patients, given the reduced risk of bronchial constriction as compared to other sports, and also, its unquestionable benefits in improving symptoms, especially in children and young adults (Goodman, 2008).

In the recent years, however, controversies have appeared regarding this issue. Several authors have shown the potential risk of swimming for respiratory function because of the chlorine products used in the swimming pools (Villanueva & Font-Ribiera, 2012; Bernard, 2007; Nordberg et al., 2012; Bernard et al., 2009; Bernard et al., 2006; Voisin et al., 2010).

This paper aims to review the current information available in the literature on the practice of swimming by asthma patients and to emphasize its benefits and risks.

Received: 2015, August 12; *Accepted for publication:* 2015, September 5;
Address for correspondence: Family Medicine, Iuliu Hatieganu University of Medicine and Pharmacy, Cluj-Napoca, Moţilor Str. No. 19, PC 400001
E-mail: codruta.marginean@yahoo.com
Corresponding author: Codruţa Mărginean, codruta.marginean@yahoo.com

The role of water disinfection products

Water disinfection in the pools is necessary in order to maintain hygiene conditions. This objective can be fulfilled by two methods:

a) chemical methods:

- with residual disinfectants: chlorine, chlorinated products, bromine and bromine based substances;
- without residual disinfectants: ozone

b) physical methods: ultraviolet light

Ozone and ultraviolet radiation destroy or inactivate the existing microbes, without maintaining a residual effect; therefore they are used in combination with chlorine or bromine compounds, which have a residual effect (***, 2014).

At present, chlorinated products are the most commonly used for water disinfection in public swimming pools (***, 2006).

Residual chlorine is chlorine persisting in the water after a 30 minutes contact with the water, and it acts on microorganisms in the water (***, 2014).

According to current regulations, the concentration of free residual chlorine in indoor pools must be between 0.5-1 mg/l, and in outdoor pools between 0.5-1.5 mg/l (***, 2014).

Chlorinated products are known to be direct irritants for the skin and eyes, while inhalation of volatile components irritates the upper airways. The most volatile compound is trichloramine, an extremely irritating gas (Francheck et al., 2009). It is considered that trichloramine reacts with the respiratory epithelium and destroys the integrity of the respiratory mucosa (Song et al., 2010).

WHO acknowledges the secondary "chemical" effect due to chlorine products among the risks of swimming (***, 2006).

This hypothesis is supported by the increased number of patients with respiratory complaints among the personnel of indoor pools and performance swimmers (Bernard et al., 2010; Bougalt et al., 2009; Fisk et al., 2010).

The negative effect of chlorinated products on the airways in asthma patients has been demonstrated by a number of studies (Villanueva et al., 2012; Bernard, 2007; Nordberg et al., 2012; Bernard et al., 2009; Bernard et al., 2006; Voisin et al., 2010). Thus, a more marked bronchial reactivity was evidenced after the administration of metacholine in asthma patients, after 12 minutes spent in chlorinated water (Stav & Stav, 2005).

Responsible for this effect was most probably trichloramine, a gas that causes the typical smell of indoor pools and is considered particularly irritant.

A study performed in Sweden on healthy volunteers, who had not been in the pool for the last two weeks prior to the study, evidenced a significant decrease of the maximum expiratory volume per second after a two-hour exposure to the indoor pool atmosphere. Another component of the study was represented by an epidemiological study on 1741 subjects working in indoor pools. According to their answers to a questionnaire, a statistically significant relation was found between the hours spent daily in the indoor pool environment and the percentage of employees with acute complaints during working hours. The frequently reported symptoms were: dyspnea (13%), cough (23%), nasal irritation (29%), eye irritation (37%) and throat irritation (24%) (Nordberg et al., 2012).

This study did not evidence alterations in the biological markers of the respiratory mucosa in subjects without atopic background exposed to indoor pool chlorine. However, alterations were evidenced in atopic patients (Nordberg et al., 2012).

Obviously, the irritant effect also depends on the concentration of these products.

Thus, it is considered that they should not be harmful if the prescribed concentrations range is observed and if swimming is practiced moderately (Franchek et al., 2009).

A study performed in a group of 2500 Swedish children, assessed based on a questionnaire at the age of 7-8 years, and then 4 years later, at the age of 11-12 years, found a direct correlation between bronchial asthma onset and the practice of recreational swimming (at least once a week) in indoor pools, in atopic children. The correlation was not found in children without atopy. A dose-effect correlation was also found (Andersson et al., 2015).

Bronchial asthma among performance swimmers

Performance athletes have an increased prevalence of respiratory complaints compared to controls (***, 2015a). They suffer more frequently from asthma, allergic or non-allergic rhinitis, vocal cord dysfunction, chronic cough and recurrent respiratory infections. Bronchial hyperresponsiveness is common among athletes, most of the times without reported symptoms. Bronchial asthma in elite swimmers is characterized by a more reduced correlation between symptoms and lung function; higher pulmonary volumes and expiratory flow, less eosinophilic inflammation; more difficult control of symptoms; some improvement in airway dysfunction after discontinuation of practice (***, 2015a).

Various studies document a higher prevalence of bronchial asthma or respiratory symptoms in performance swimmers compared to other athletes (Bougalt et al., 2009; Fisk et al., 2010; Levesque et al., 2006; Romberg et al., 2012a; Romberg et al., 2012b). Among symptoms, cough is the most common in performance swimmers (Heir et al., 1994).

Exposure to chloramine is considered to be an important pathogenic factor in the development of bronchial asthma, and there is a direct correlation between the degree and duration of exposure on the one hand, and bronchial hyperresponsiveness and lower airway inflammation on the other hand (Bernard et al., 2009).

However, the wide spreading of bronchial asthma among swimmers can also be explained by the fact that swimming is a physical activity generally well tolerated by asthmatics, which makes them choose this sport. It is known that some of them have become Olympic and world champions.

Studies have demonstrated that the intensity, duration and type of exercise influence the severity of symptoms (Heir et al., 1994). For example, at the same level of exercise intensity, the symptoms of bronchial asthma are milder in swimmers than in runners or cyclists (Bar-Yishayet al., 1982). This may be a decisive factor in the

asthma patients' choice of the sport they want to practice (Paivinen et al., 2013).

Bronchial asthma in recreational swimmers

Bronchial asthma is common in leisure swimmers. A study performed in a group of more than 1000 swimmers aged between 8-17 years, whose symptoms were assessed based on questionnaires as well as by spirometry, evidenced the presence of symptoms or asymptomatic bronchial obstruction in a higher percentage than in patients previously diagnosed with bronchial asthma, which indicates again that the disease is under-diagnosed (Fiks et al., 2012).

Population studies in children and adolescents evidence an increase of the risk for bronchial asthma after more than 100 hours spent in swimming pools, a number of hours higher than the duration of training in swimming pools in the case of most studies performed in asthma patients (Bernard et al., 2010).

Hence the utility of prospective studies over longer periods of time in cohorts of recreational swimmers, which would provide additional information on the relationship between indoor swimming as a recreation and the onset of bronchial asthma.

Gender differences

As it is known, the prevalence of bronchial asthma in childhood to adolescence is higher among boys; after puberty the gender ratio is reversed, as later in life the female gender presents a higher risk of developing asthma (Leynaert et al., 2012; Vink et al., 2010).

Regarding the gender difference in performance swimmers, a study carried out on 300 athletes in Finland found significant differences in symptoms. Thus, in women cough was more frequent than in men (Paivinen et al., 2013). Another difference was the age of onset, much lower for boys, while it was around puberty in girls (Paivinen et al., 2013). This latter finding is in accordance with the general statistical data on asthma distribution by gender and age.

Documented benefits of swimming and physical exercise in asthma patients

Several studies provide concrete arguments in favor of swimming and also physical exercise in general in improving symptoms and functional respiratory parameters (Wicher et al., 2010; Bacon et al., 2015; Dogra et al., 2009; ***, 2015b; Mancuso et al., 2013; Dogra et al., 2009; Garcia-Aymerich et al., 2009). On the other hand, the absence of regular physical exercise was associated with more frequent hospital admissions or visits to the doctor (Dogra et al., 2009).

Also, the GINA guidelines (***, 2015a) recommend weight loss in obese patients and regular physical exercise for their beneficial effects on health. At the same time, the guidelines indicate swimming as the only sport that improves lung function in young asthma patients.

A study performed in asthma patients in Canada showed that patients who practice leisure sports for 30 minutes a day on most days in a year have 2.5 times more chances of having well controlled asthma than patients who do not exercise (Bacon et al., 2015). Seasonal differences were found in relation to sport practices. As expected, participants tended to engage in physical activities during the warm season. On the other hand, asthma symptoms were better controlled in patients who exercised all the year round. Hence, we may conclude that continuous physical exercise and its cumulative effect are the key elements of its positive influence (Bacon et al., 2015). On the other hand, it is also possible that patients with well controlled asthma may engage in physical activities more often and all the year round (Bacon et al., 2015).

A large prospective study performed on 5738 children in Great Britain, followed up between birth and the age of 10, showed that indoor swimming did not increase the risk of asthma, atopy, or respiratory complaints (Font-Ribera et al., 2011). On the contrary, the study found an improvement of respiratory parameters in children who practiced leisure swimming, especially in those who swam frequently. Moreover, no correlation was found between swimming and bronchial hyperreactivity (Font-Ribera et al., 2011). However, the study only included children who practiced swimming as a recreation, not performance sport.

Recently, a study by Bacon et al. (2015), performed on 643 adult Canadian patients with documented bronchial asthma assessed based on the Asthma Control Questionnaire (***, 2015b) after one year of leisure exercise, showed that physical activity significantly improved the control of symptoms. This study reinforces, once more, the benefits of physical exercise and the value added to therapy (Bacon et al., 2015).

Another recent study compared a group of patients who took supervised aerobic exercise for 12 weeks, one hour 3 times a week, with controls, and found that in the exercise group symptoms were significantly better controlled (according to the Asthma Control Questionnaire score) (***, 2015b).

There is also the possibility that an important percentage of asthma patients may choose swimming as a leisure sport because of its apparently lower risk of bronchial constriction.

Discussion

The literature mainly comprises studies performed in three patient categories: employees of swimming pools, performance swimmers, and children. However, the number of studies on asthmatic adults who practice leisure swimming has lately increased. Such studies are welcome as they provide useful information on other patient categories as well. It is important to distinguish between the benefits of swimming as a physical exercise and the effects of chlorinated air.

Certainly, *the benefits of regular physical exercise* for asthma patients are unquestionable and recommended by guidelines (***, 2015a). Among sports, swimming is considered the least "asthmogenic" and the only one proven to improve the respiratory function in young asthmatics (***, 2015a). Body weight loss is also recommended in obese asthma patients (***, 2015a).

Chlorine products used for water disinfection have an irritant effect on the airways (Villanueva et al., 2012;

Bernard et al., 2007; Nordberg et al., 2012; Bernard et al 2009; Bernard et al., 2006; Voisin et al., 2010), a direct correlation being established between the number of hours spent in indoor pools and the onset of asthma. The atopic background also plays an essential role (Nordberg et al., 2012; Andersson et al., 2015).

WHO acknowledges the secondary "chemical" effect due to chlorine products among the risks of swimming (***, 2006).

Most studies were performed in individuals who swam indoors, where the concentration of chlorine gas is higher than in outdoor pools. Of course, the negative effects of disinfectants are minimized in outdoor swimming pools.

There are authors who consider that if the maximum admitted concentrations are maintained, the irritant effects on the respiratory tree will be insignificant; therefore they do not support a direct causality between indoor swimming and the onset of asthma.

The degree of water chlorination is important, and so is the ventilation of the indoor space, the duration spent indoors, and the presence or absence of atopy.

Consequently, it is recommended to all those who practice swimming, especially indoors, to be informed on the concentration of chlorine products in the air of the swimming pool they go to.

In the case of *performance swimmers,* there is a higher incidence of respiratory complaints compared to controls. On the other hand, this may be explained by the fact that swimming is a well tolerated sport by asthma patients, which determines the choice of this sport.

In the case of elite swimmers, there is a weaker correlation between symptomatology and lung function alteration, cough being the most common reported symptom.

Regarding *gender differences*, these are present in the symptomatology of performance swimmers. Thus, women report cough more often than men (Paivinen et al., 2013).

The age of asthma onset is significantly lower in performance male swimmers, while in females it appears during puberty or later in life (Paivinen et al., 2013).

Conclusions

1. The benefits of regular physical exercise for asthma patients are proven and recommended by guidelines.

2. Swimming is the only sport demonstrated to improve respiratory function in young asthmatics.

3. Chlorine products used for water disinfection have an irritant effect on the airways, but the degree of water chlorination is important, and so is the ventilation of the indoor space, the duration spent indoors, and the presence or absence of atopy; certainly, the negative effects are minimized in outdoor swimming pools.

4. In the case of elite swimmers, there is a higher incidence of respiratory complaints compared to controls, but, on the other hand, this may be explained by the fact that swimming is well tolerated by asthma patients, which determines the choice of this sport.

5. It is important to distinguish between the unquestionable benefits of swimming and the irritant effect of chlorine products on the airways.

Conflicts of interest

The authors state that there are no conflicts of interest related to the content of this paper.

References

Andersson M, Hedman GN, Forsberg B, Eriksson K, Ronmark E. Swimming pool attendance is related to asthma among atopic school children population-based study. Environ Health, 2015;14:37. doi:10.1186/s12940-015-0023-x.

Bacon SL, Lemiere C, Moullec G, Ninot G, Pepin V, Lavoie KL. Association between patterns of leisure time physical activity and asthma control in adult patients. BMJ Open Respir Res, 2015;24;2(1):e000083. doi: 10.1136/bmjresp-2015-000083.

Bar-Yishay E, Gur I, Inbar O. Differences between swimming and running as stimuli for exercise-induced asthma. Europ J App Physiol Occup Physiol, 1982;48(3):387-397.

Bernard A, Carbonnelle S, de Burbure C, Michel O, Nickmilder M. Chlorinated pool attendance, atopy, and the risk of asthma during childhood. Environ Health Perspect, 2006;114 (10):1567-1573.

Bernard A, Nickmilder M, Voisin C, Sardella A. Impact of chlorinated swimming pool attendance on the respiratory health of adolescents. Pediatrics, 2009;124 (4):1110-1118.

Bernard A. Asthma and swimming: weighing the benefits and risks. J Pediatr (Rio J), 2010;86(5):351-352.

Bernard A. Chlorination products: emerging links with allergic diseases. Curr Med Chem, 2007;14(16):1771-1782.

Bougalt V, Turmel J, Levesque B, Boulet LP. The respiratory health of swimmers. Sports Med, 2009;39(4):295-312.

Cazzoletti L, Marcon A, Janson C et al. Asthma control in Europe: a real-world evaluation based on an international population-based study. J Allergy Clin Immunol, 2008;120 (6):1360-1367.

Dogra S, Baker J, Ardern CI. The role of physical activity and body mass index in the health care use of adults with asthma. Ann Allergy Asthma Immunol, 2009;102:462-468.

Fiks IN, Pereira de Albuquerque AL, Dias L et al. Occurrence of asthma symptoms and airflow obstruction in amateur swimmers between 8 and 17 years of age. J Bras Pneumol, 2012;38 (1):24-32.

Fisk MZ, Steigerwald MD, Smoliga JM, Rundell KW. Asthma in swimmers: A review of current literature. Rhys Sportsmed, 2010;38(4):28-34.

Font-Ribera L, Villanueva CM, Nieuwenhuijsen MJ et al. Swimming pool attendance, asthma, allergies and lung function in the Avon Longitudinal Sudy of Parents and Children Cohort. Am J Respir Crit Care Med, 2011;183(5):582-588.

Franchek D (The Swimming Pools Air Study Group). Swimming pools water treatment and its Health impact. State of the art. Apunts Med Esport, 2009;(6):42-47.

Garcia-Aymerich J, Varraso R, Anto JM et al. Prospective study of physical activity and risk of asthma exacerbations in older women. Am J Respir Crit Care Med, 2009(11);179:999-1003. doi:10.1164/rccm.20081.

Goodman M, Hays S. Asthma and swimming:a meta-analysis. J Asthma, 2008;(8)45:639-647.

Heir T, Oseid S. Self reported asthma and exercise induced asthma symptoms in high-level competitive country skiers. Scand J Med & Sci Sports, 1994;4(2):128-133.

Levesque B, Duchense JF, Gingras S, Lavoie R et al. The determinants of prevalence of health complaints among young competitive swimmers. Int Arch Occup Environ Health, 2006;80 (1):32-39.

Leynaert B, Sunyer J, Garcia-Esteban R. et al. Gender differences in prevalence, diagnosis and incidence of allergic and non-allergic asthma: a population-based cohort. Thorax, 2012; 67(7):625-631.

Mancuso CA, Choi TN, Westermann H. et al. Improvement in asthma quality of life in patients enrolled in a prospective study to increase lifestyle physical activity. J Asthma, 2013;50 (1):103-107.

Nordberg G, Lundstrom NG, Forsberg B, Hagenbjork-Gustafsson A et al. Lung function in volunteers before and after exposure to trichloramine in indoor pool environments and asthma in a cohort of pool workers. BMJ Open.2012;2(5): e000973.

Paivinen KM, Keskinen KL, Tikkanen HO. Swimming and Asthma: Differences between Women and Men. J Allergy (Cairo), 2013;2013:520913. doi: 10.1155/2013/520913.

Romberg K, Tufvesson E, Bjermer L. Asthma is more prevalent in elite swimming adolescents despite better mental and physical health. Scand J Med Sci Sports, 2012a;22(3):367-371.

Romberg K, Tufvesson E, Bjermer L. Extended diagnostic criteria used for indirect challenge testing in elite asthmatic swimmers. Respir Med, 2012b;106 (1):15-24.

Song W, Wei S, Zhou Y, Lazrak A, Liu G et al. Inhibition of lung fluid clearance and epithelial Na + channels by chlorine, hypochlorus acid, and chloramines. J Biol Chem, 2010;285(13):9716-9728.

Stav D, Stav M. Asthma and whirlpool baths. N Engl J Med, 2005;353(15):1635-1636.

Villanueva CM, Font-Ribiera L. Health impact of disinfection by products in swimming pools. Ann Ist Super Sanita, 2012;48(4):387-396.

Vink Nm, Postma DS, Schouten JP et al. Gender differences in asthma development and remission during transition through puberty: the Tracking Adolescents individual Lives Survey (TRAILS) study. J Allergy Clin Immunol, 2010;126 (3):498-504.

Voisin C, Sardella A, Marcucci F, Bernard A. Infant swimming in chlorinated pools and the risks of bronchiolitis, asthma and allergy. Eur Respir J, 2010;36 (1):41-47.

Wicher IB, Ribeiro MA, Marmo DB et al. Effects of swimming on spirometric parameters and bronchial hyperrespnsiveness in children and adolescents with moderate persistent atopic asthma. J Pediatr (Rio J), 2010;86(5):384-390.

***. Global Strategy for Asthma Management and Prevention (update 2015). Available online at: www.ginasthma.org. Accessed in November 26, 2015a.

***. Ministerul Sănătății. Institutul Național de Sănătate Publică: Ghid pentru supraveghere și monitorizare a calității apei de piscine și bazine de înot. Bucureşti, 2014.

***. World Health Organisation. Guidelines for safe recreational water environments. Vol. 2. Swimming pools and similar environments. WHO, Geneva, 2006.

***. Exercise improves Asthma Control. Study Suggests. Medscape. Oct. 29, 2015b.

Palestrica of the third millennium – Civilization and Sport
Vol. 16, no. 4, October-December 2015, 360–365

Anthropic topology: an affordable approach in the study of human somatic homomorphism

Topologia antropică: o posibilă abordare în studiul homomorfismului somatic uman

Nicolae Neagu
University of Medicine and Pharmacy, Târgu Mureş

Abstract

Anthropometry is an important area of biological or physical anthropology. It is represented by data sampling techniques on the human body, quantified by instrumental measuring which can be global or segmental, quantitative and qualitative. These measurements are followed by elements of calculation, comparison and interpretation of the relationship between the investigated dimensions, related to a whole series of referential specific indicators, mostly standardized.

The anthropometric assessment provides objective data by direct measurements of body dimensions. It can highlight certain features and completes some aspects observed by somatoscopic examination.

Regarding anthropometry, we propose an approach from a dual perspective, namely quantitative or observational anthropometry (with effective tool measurements, without a comparative analysis of the recorded data) and qualitative or analytical anthropometry (resulting from the analysis of relationships created between different data recorded in relation to body segments or between them and the entire body, all in relation to various anthropometric indices).

This study fits into the second category, qualitative analytical anthropometry, its purpose being the extension of interpretations through an interdisciplinary approach (biometry, biophysics, biomechanics and mathematics). From the mathematical study field, we have found that the topology domain can constitute and generate new references and new perspectives in the investigation of anthropic somatometry. It is part of a larger work which addresses in one of the chapters the issues of anthropic topology in the study of human body morpho-structurality.

Keywords: topological space, constitutional homotype, commutative corporal group, anthropic operand, kinematic binomial.

Rezumat

Antropometria este un domeniu important al antropologiei biologice sau fizice. Ea este reprezentată de ansamblul de tehnici de prelevare de date despre corpul uman, cuantificate prin măsurare instrumentală, care pot fi globale sau segmentare, cantitative și calitative. Aceste măsurători sunt urmate de elemente de calcul, comparare și interpretare a raporturilor dintre dimensiunile investigate, relativizate la o serie întreagă de indici specifici de referință, în marea lor majoritate, standardizați.

Evaluarea antropometrică furnizează date obiective, prin măsurarea directă a unor dimensiuni corporale. Ea poate să pună în evidență anumite caracteristici și vine să completeze unele aspecte observate prin somatoscopie.

În ceea ce privește antropometria, propunem abordarea dintr-o dublă perspectivă, și anume: antropometria cantitativă sau constatativă (realizată prin măsurare instrumentală efectivă, fără o analiză comparativă a datelor înregistrate) și antropometria calitativă sau analitică (rezultată din analiza raporturilor create între diferitele date înregistrate, în relație cu segmentele corporale sau între acestea și corp, raportate la diverși indici antropometrici recunoscuți).

Studiul de față se încadrează în cea de-a doua categorie, antropometria calitativă analitică, având ca scop extinderea interpretărilor printr-o abordare interdisciplinară (biometrie, biofizică, biomecanică și matematica). Din câmpul de studiu al matematicii, am constatat că domeniul topologiei poate constitui și genera noi referințe, noi perspective în investigarea metriei antropice. El face parte dintr-o lucrare personală mai amplă, care abordează într-unul dintre capitole problematica topologiei antropice în studiul morfo-structuralității corpului uman.

Cuvinte cheie: spațiu topologic, homeotip constituțional, grup comutativ corporal, operand antropic, binom kinematic.

Received: 2015, August 28; *Accepted for publication:* 2015, September 15;
Address for correspondence: University of Medicine and Pharmacy, Târgu Mureș, Gheorghe Marinescu Str. No.38, CP 540139, Romania
E-mail: neagu.nicolae@umftgm.ro
Corresponding author: Nicolae Neagu, neagu.nicolae@umftgm.ro

Introduction

The study of human corporality constantly offers new approach possibilities, given its morphological and structural complexity, and particularly, the functional diversity of its biomechanical dynamics, locomotor and non-locomotor, from a double perspective: global (general motricity) and segmental (fine motricity).

One of the segmental corporal dimensions - length -, forms via the joints different degrees of leverage that generate resistant and active forces, inversely proportional to the lengths of the arms adjacent to a joint (relative to the axis of rotation). Depending on these relations, active forces can amplify or decrease the level of motor actions. Other dimensional elements influence the resulting vectors (Gagea, 2002). Vector magnitude induces, in addition to actual force intensity, the direction and sense of action, segment perimeters and diameters, as well as dynamic characteristics: inertia forces (D'Alembert, 2006; Wilde, 2014), execution speed, acceleration, etc.

Based on these reference data, importance should be given to the somatometric study of the human body, to the morphostructural and functional aspects of the locomotion system, with a dual connotation: static and dynamic.

By approaching this investigation from a topological perspective - taken from mathematics, we want to highlight and, finally, by extending some contextual studies, to optimize the rank of factor influence of interconnections linked to anthropometric data regarding the efficiency of simple or complex motor actions (kinematic chains), specific to sports high performance in different sports branches and disciplines. All this could generate a new field of study, proposed by us: anthropokinetics.

Background

Topology (from the Greek words τόπος, "place" and λόγος, "study") is the study of mathematical shapes and topological spaces. It is an "area of mathematics in relation to spatial properties that are maintained in continuous deformations, including stretching and bending, excluding tearing or sticking" (2).

The term was introduced by Johann Benedict Listing (3) in the 19th Century. By the mid-20th century, *topology* became an important branch of mathematics. Extending the approach, *general topology* (4) establishes the fundamental aspects of *topology* and investigates the properties of topological spaces.

By extrapolating specific *topological* concepts from mathematics (Clementini et al., 1994), e.g. the *topological point-set* (Egenhofer & Franzosa, 1991), to the field of *anthropometric measurement references*, the human body can be interpreted as a *topological system* (A/N), presenting a series of anthropometric benchmarks that do not change position or location in the context of normal individual morphological transformations, such as those occurring in the ontological growth and physical development of an individual. These reference points can be defined as *homotopic points* (Fomenko et al., 1986), which are found on the body in the same place for all human individuals (Figs. 1 and 2).

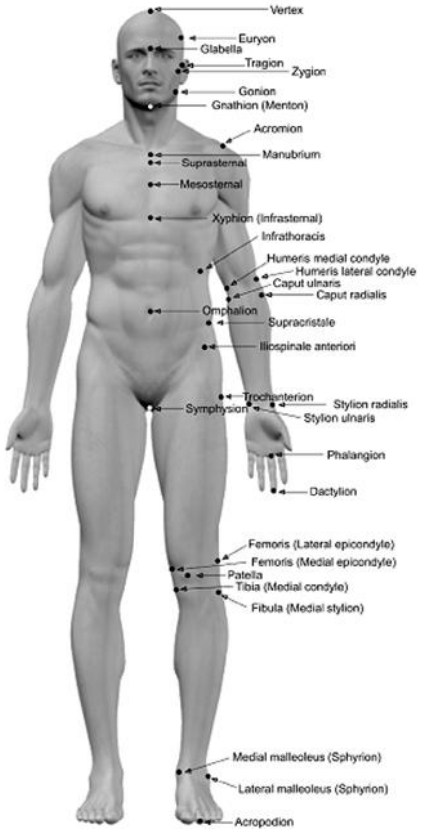


Fig. 1 – Homotopic corporal landmarks or anthropometric set-points – frontal view (Neagu, 2014).

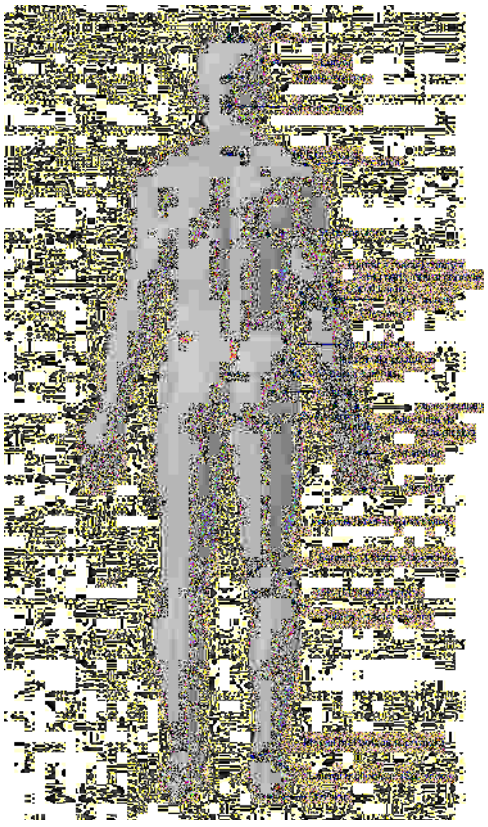


Fig. 2 – Homotopic corporal landmarks or anthropometric set-points – dorsal view (Neagu, 2014).

We can consider that this *topological corporal system* has the characteristics of another concept in *general topology*, i.e., the *topological space*, which is defined as "a set of points, together with a set of neighborhoods for each point, which satisfy a set of axioms on the points and neighborhoods" (5). The definition of the *topological space* allows defining other concepts, such as "continuity, connectivity and convergence" (Schubert, 1968). We estimate that between anthropometric landmarks, interpreted as *homotopic points*, there may be various relations of continuity, connectivity and convergence in the context of body dynamics, locomotor or non-locomotor.

Hence, the *constitutional human homotype* (6) – CHH (A/N) results, which gives identity to the human species biotype in the animal kingdom. Thus, *the constitutional homotype* becomes an invariant category of the human species. Consequently, between two individuals of the human species there may be a *constitutional homomorphism or isomorphism* relationship (A/N) and a biunivocal correspondence between the positions of their corresponding anatomical points (A/N).

Also through extrapolation, this relationship can be transferred to the body organs and segments, which are also in an isomorphism relationship in terms of form, structure, and biochemical composition.

The *constitutional morphism* of an individual can be defined as endomorphism, representing a feature of the individual's body, defined by itself. Thus, the anatomical points as anthropometric references constitute a space of individual body dimensions, forming a *dimensional vectorial space* (A/N), which generates a series of relationships and linear combinations (rectilinear or curvilinear) between these points (Fig. 3).

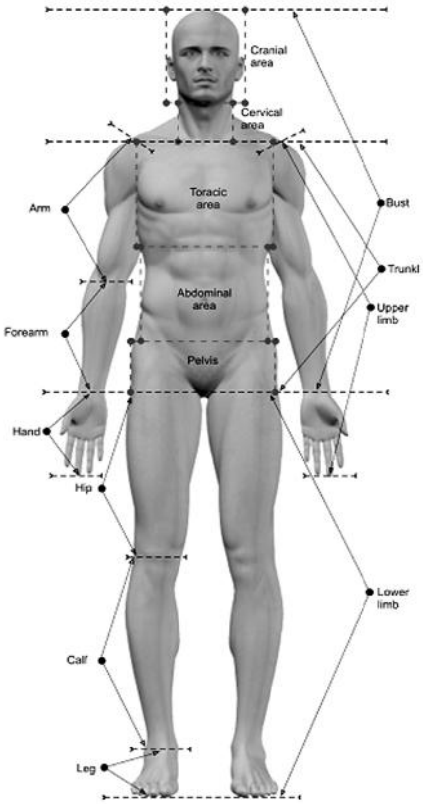


Fig. 3 – Dimensional vectorial system (Neagu, 2014).

These relations can be addressed either from a static or postural perspective, or from a dynamic perspective of the body or its segments, the body acting via locomotor or non-locomotor movements (Fig. 4).

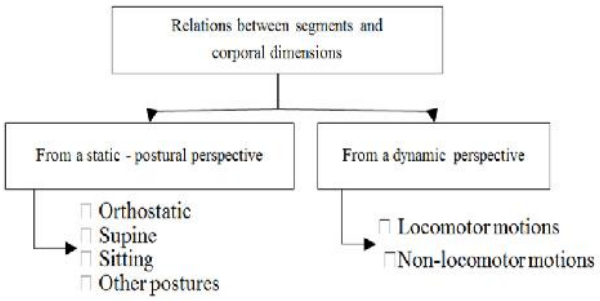


Fig. 4 – Segmental relations of the human body as a dimensional vectorial corporal system (Neagu, 2014)

From the static rectilinear relationships of anthropometric reference points, the *corporal and segmental lengths and diameters* result (Fig. 5).

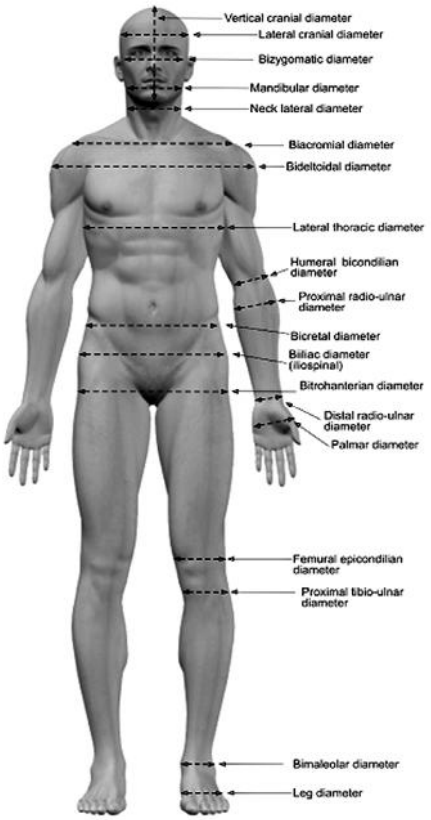


Fig. 5 – Corporal diameters (Neagu, 2014)

From the static curvilinear relationships of anthropometric reference points, the *corporal and segmental perimeters* result (Fig. 6).

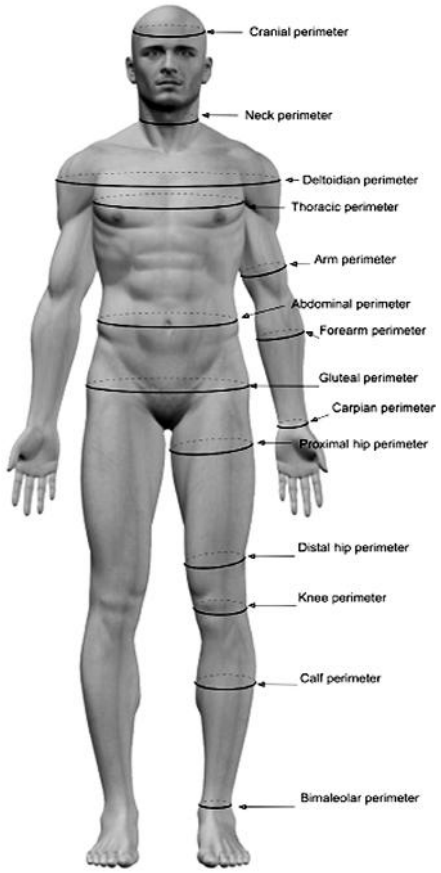


Fig. 6 – Corporal perimeters (Neagu, 2014)

From dynamic relationships, angles, levers, forces and vectors between the body and its different segments, between different body segments, and between the body and the environment result.

From an anthropometric perspective, highlighting these relationships is achieved by goniometric and dynamometric measurements (Fig. 7).

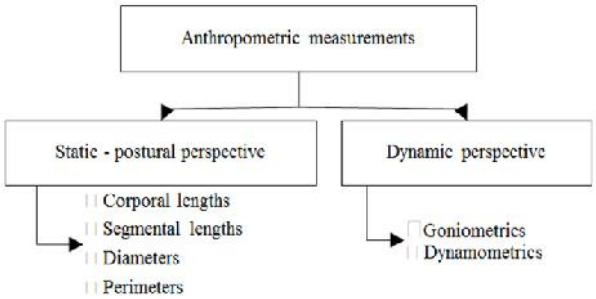


Fig. 7 – Types of anthropometric measurements from a dual perspective – static and dynamic.

Thus, the human body becomes a group of corporal segments forming a *commutative corporal group* (A/N), a term extrapolated from the concept of *abelian group* (Hazewinkel, 2001), introduced by the Norwegian mathematician Niels Henrik Abel (1).

The human body is also in a relationship governed by *the law of internal composition* (Vialar, 2015), a concept borrowed from mathematics, algebra, in which the most important body segments involved in body statics or dynamics are segment pairs called by us *motricity binomials or kinematic binomials* (A/N), which can act in the same direction (synergistic) or in opposite directions (antagonistic).

Taking other concepts from mathematics, we can define the body segments as *anthropogenic operands* (A/N), and the generated vectors as *products* of the action/ interaction of *anthropogenic operands.* The *end product* is the third element of this initially binary vector relationship (Zamansky, 1989) (Fig. 8).

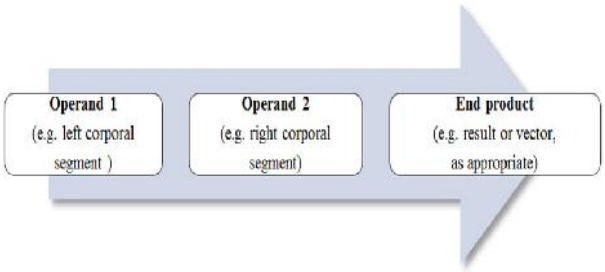


Fig. 8 – Possible components of a commutative binomial corporal group.

We are talking here about a *commutative binomial corporal group* (A/N). These issues will be the subject of an analysis in one of the future volumes of the *Human Biometry* series.

In the case of *commutative binomial corporal groups* (A/N), the number of *operands* can obviously be multiple. The end product of such a relationship will present a series of highly complex physical characteristics (Fig. 9).

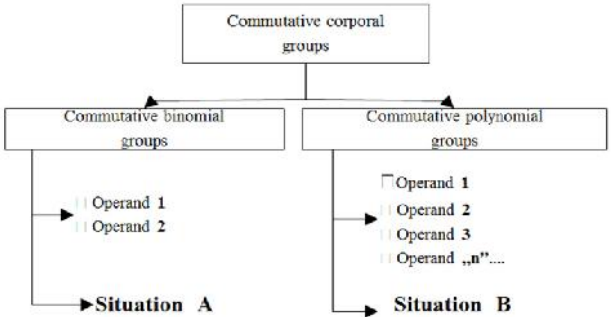


Fig. 9 – Typology of commutative corporal groups.

When the body is static – in stable or unstable equilibrium – we are talking about a *posture-balancing commutative group* (A/N), and if the body is engaged in motion (locomotion or non-locomotion), a *commutative chain* (A/N) or kinematic chain, defined as a *dynamic commutative group* (A/N) is discussed. If the body is in a stable static position, without any maintenance, control or balancing action (supine position), we define the body as a *non-commutative group* (A/N).

The segments of interest of the *commutative corporal group* can be on the same side of the body (homolateral), when the location is on the right or left side of the body, or in the upper or lower region of the body (para-regional). However, they are more frequently situated on opposite

sides (heterolateral, left ↔ right), i.e., *left hemibody - right hemibody* (A/N) or *upper body – lower body* (hetero-regional). In this case we are talking about *upper parabody* or *lower parabody* (A/N) (Fig.10).

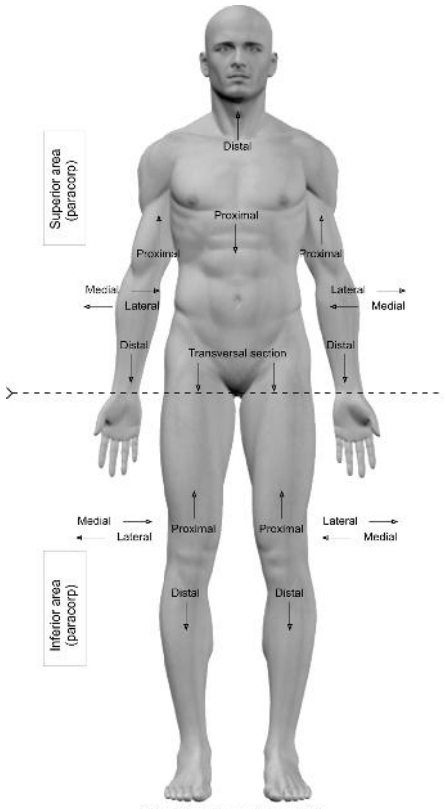


Fig. 10 – Corporal areas (Neagu, 2014).

Their movements can be associated or dissociated, simultaneous or alternative, continuous or syncopated, synchronous or asynchronous, in identical directions and different senses, in different directions and different senses, etc.

The human body, presenting segment pairs that are symmetrical in size and position, is mainly characterized as a *dual modular kinematic system* (A/N), in which its static functions - posture-balancing and dynamic functions - locomotion or non-locomotion are, in most cases, the result of the synergistic or antagonistic action of at least two participants. If the action of the two co-participating elements is agonistic/synergistic, we can talk about an *autodual kinematic system* (A/N), and when the action is antagonistic/non-synergistic-opposite, a *dual kinematic system in itself* can be discussed (A/N) (Fig. 11).

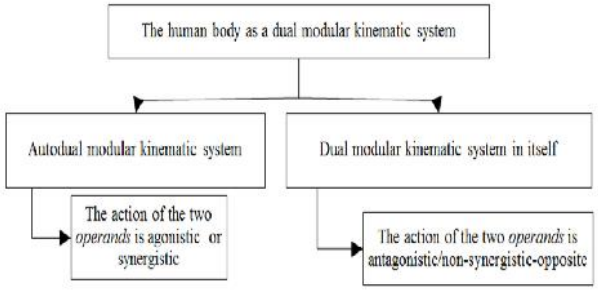


Fig. 11 – The design of dual kinematic corporal systems.

In some cases, the adjustment of the kinematic system or the posture-balancing system is the consequence of an unpaired body segment (*single operating element*), such as the head or torso. We define in this situation the human body as a *monogenic commutative group* (A/N). In other cases, adjustment is the consequence of the action of two segments - paired or not. This is the case of the *stereogenic commutative group* (A/N).

In relation to the types of movements, *the dynamic commutative group* can be a *cyclic-repetitive commutative group* (when the powertrain is composed of cyclic movements), or an *acyclic-non-repetitive commutative group* (when the powertrain is composed of acyclic movements) (Fig. 12).

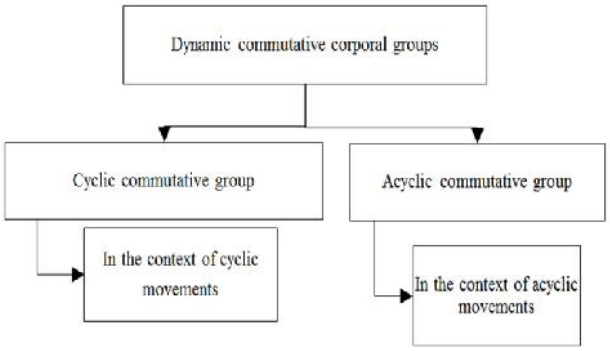


Fig. 12 – The taxonomy of commutative corporal groups depending on the typology of operand movements.

Conclusions

1. We believe that the terminological developments of the presented study, taken and adapted from mathematics, converge on the idea of an interdisciplinary approach, outlined in the introduction.

2. Given the growing demands related to achieving high performance in sports, any action that could have a favorable influence is desirable. For now, our approach was within the virtual field of concepts. We estimate, however, that an extension of the studies and applied research could lead to the generation of operational elements in sports practice.

3. An early identification of possible limiting morphostructural factors, which in turn will negatively affect other factors in achieving athletic performance, will allow streamlining the training process based on the biomechanical analysis of various motor structures specific to different sports categories and events.

4. Starting with anthropometric analysis elements, continuing with biomechanical analyses, the road to high performance will be somewhat less difficult. Anthropokinetics, proposed by us as a new approach in the study of human corporality in motion, could be one solution. We hope that our proposal will be evaluated critically and objectively.

References

Clementini E, Sharma J, Egenhofer MJ. Modeling Topological Spatial Relations: Strategies for Query Processing. Computers and Graphics, 1994;18(6):815-822.

D'Alembert Jean Le Rond. Force of Inertia. In: The Encyclopedia of Diderot & d'Alembert Collaborative Translation Project, Michigan Publishing, University of Michigan Library, 2006.
Fomenko AT, Fuchs DB, Gutenmacher VL. Homotopic topology. Akademiai Kiado, Budapest, 1986,13.
Gagea A. Biomecanică teoretică. Ed. Scrisul Gorjean, Tîrgu Jiu, 2002, 36-37.
Hazewinkel M, Abelian group. Encyclopedia of Mathematics. Springer, 2001.
Egenhofer MJ, Franzosa RD. Point-set topologicalspatial relations. Int J Geograph Inf Syst. 1991,5:2, 161-174.
Neagu N. Biometrie umană. Vol.1, Antropometria. Ed. University Press, 2014, Tîrgu Mureș.
Schubert H. Topology. Allyn and Bacon, 1968,13.
Vialar T. Handbook of mathematics. Ed. Books on Demand, Paris, 2015.
Wilde J. Rolling Resistance Measurements at the MnROAD Facility. Round 2. Published by Minnesota Depart Transport Res Serv & Library, 2014,13-17.
Zamansky M. Linear Algebra and Analysis. Lecture Notes in Computer Sciences, Vol. 367; 1989,457-472.

Websites

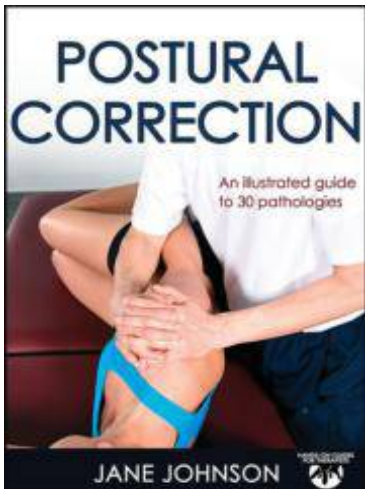
(1) https://en.wikipedia.org/wiki/Niels_Henrik_Abel Accessed in July, 2015
(2) https://en.wikipedia.org/wiki/Topology Accessed in July, 2015
(3) https://en.wikipedia.org/wiki/Johann_Benedict_Listing Accessed in July, 2015
(4) https://en.wikipedia.org/wiki/General_topology Accessed in July, 2015
(5) https://en.wikipedia.org/wiki/ Topological_space Accessed in July, 2015
(6) https://en.wiktionary.org/wiki/homotype Accessed in July, 2015

Palestrica Mileniului III – Civilizaţie şi Sport
Vol. 16, no. 4, Octombrie-Decembrie 2015, 366–367

RECENT PUBLICATIONS
ACTUALITĂŢI EDITORIALE

Book reviews
Recenzii cărţi

Postural Correction
(Corecţia posturală)
Autor: Jane Johnson
Editura: Human Kinetics, 2016
232 pagini; Preţ: £ 25.99 (tipărită), £ 10.83 (eBook = PDF)



Lucrarea pe care o semnalăm de data aceasta urmează să apară efectiv abia la începutul lui 2016, dar convingerea că un număr important de medici specialişti în ortopedie, balneofizioterapie şi medicină sportivă, antrenori, precum şi practicieni de alte nivele profesionale din domeniul recuperării şi kinetoterapiei, şi-ar dori-o cât mai repede, pentru că ar beneficia mult de conţinutul său, ne-a determinat să o prezentăm deja, în avans, astfel încât aceştia să poată să şi-o procure şi să se folosească de ea, cât mai curând cu putinţă.

Cartea este editată în seria specială *„Ghiduri practice pentru terapeuţi”,* se ocupă de 30 de probleme de postură, foarte frecvent întâlnite, şi conţine cunoştinţele cele mai noi, mai verificate şi mai eficiente, cu ajutorul cărora se ajunge la rezolvarea cazurilor, din perspectivă mai curând anatomică şi funcţională, decât d.p.d.v. estetic. Preocupată prioritar de alungirea/întinderea ţesuturilor şi formaţiunilor moi (scurtate în cele mai multe dintre cazurile respective), în scopul de a obţine realinierea segmentelor corporale, lucrarea ne oferă o abordare globală şi unitară, prin care se ţinteşte, şi în cele mai multe cazuri se şi obţine, remodelarea posturilor patologice. Tehnicile recomandate variază în funcţie de postura ce trebuie corectată, şi includ: masajul tisular, stretching-ul pasiv simplu, relaxarea ţesuturilor moi, stimularea punctelor „trigger” şi tracţiunea blândă, continuă a extremităţilor. Dat fiind faptul că muşchii hipotrofiaţi, sau greşit „utilizaţi” (recte muşchii care ajung să acţioneze pe direcţii incorecte), pot contribui şi ei, în bună măsură, la problemele de postură, autoarea ne semnalează, în fiecare caz, care muşchi se impune a fi întăriţi, făcând totodată şi recomandările tehnice necesare. Sugestii indiscutabil utile sunt şi cele care vizează posturile cunoscute a fi extrem de dificil de corectat, prin tehnicile uzuale: ne referim aici atât la scolioze, cât şi la atât de rezistentele (la corectare) deviaţii de ax ale genunchilor: *genu varum, valgum* şi *recurvatum.*

Ca o noutate-originalitate: neminimalizând prin aceasta în nici un fel rolul – indiscutabil esenţial – al specialistului, lucrarea acordă o binevenită atenţie şi recomandărilor ce se adresează, cumva direct, pacientului; oferindu-i informaţii şi programe cu ajutorul cărora el poate continua, la domiciliu, lucrul independent, între şedinţele de la terapeut şi/sau prin care urmează să prezerveze şi să stabilizeze rezultatele obţinute în cadrul sedinţelor efectuate sub supravegherea specializată a acestuia. Desigur, este greu de crezut că, din proprie iniţiativă şi pe cont propriu, pacienţii vor lectura, vor înţelege perfect şi vor încerca să aplice acasă aceste cunoştinţe, dar ele le vor fi realmente utile terapeuţilor, atunci când vor considera că este cazul să-i sfătuiască/instruiască, sau să-i supervizeze „de la distanţă” pe clienţii lor. În sfârşit, multă, dar pe deplin îndreptăţită atenţie, i se acordă stilului de viaţă şi activitate, pe care este recomandat să-l adopte şi să-l menţină, a la longue, pacientul, precum şi modalităţilor şi poziţiilor în care el trebuie să plaseze segmentul sau segmentele afectate, atunci când se află în repaus.

Structurat pe regiunile anatomice ale corpului, astfel încât informaţiile să poată fi accesate rapid, cu uşurinţă, materialul tratează problemele posturale frecvent întâlnite la nivelul coloanei vertebrale, al pelvisului, al membrelor superioare (umeri şi coate) şi al celor inferioare, incluzând şoldurile, genunchii, gleznele şi labele picioarelor. De real interes şi utilitate sunt şi informaţiile specifice, referitoare la cazuri particulare ce ţin de practicarea diferitelor sporturi, sau de categorii populaţionale aparte, cum ar fi populaţia vârstnică; totul, într-un limbaj clar şi concis, care mai are şi calitatea de a evita, pe cât posibil, jargonul biomedical foarte specializat.

În termeni mai concreţi vorbind, acest material, de aproape 250 de pagini, este distribuit în 4 părţi, dintre care doar a doua - „*Corectarea coloanei vertebrale”* - are 4 capitole (dedicate coloanei cervicale, toracice şi lombare, respectiv scoliozelor); celelalte 3 părţi având,

fiecare, câte două. Debutul îl face cap. 1 – „Introducere în corecţia posturală" – care abordează pentru început cauzele, respectiv consecinţele deficienţelor posturale. După care urmează două subcapitole extrem de necesare şi importante pentru orice specialist care se respectă: „Cine poate beneficia de corecţia posturală" şi „Contraindicaţii şi precauţii în corecţia posturală". Importanţa deosebită a acestor teme vine din faptul că, pe de o parte, un adevărat profesionist trebuie să nu-şi facă, dar nici să nu „vândă", pacienţilor şi/sau aparţinătorilor, iluzii, iar pe de altă parte, să respecte cu sfinţenie preceptul „*primum non nocere...*". Celălalt capitol introductiv – „Modificarea/corectarea posturii" – creionează aspectele şi paşii obligatorii, pe care recuperaţionistul trebuie să-i parcurgă, cu fiecare caz care i se adresează, de la debutul colaborării lor şi până la momentul când, dintr-un motiv sau altul, se impune îndrumarea pacientului către alt specialist. Corectarea problemelor de postură ale pelvisului (cap. 7), respectiv membrului inferior (cap. 8) intră în partea a III-a, restul – umărul (cap. 9) şi cotul (cap. 10) alcătuind partea ultimă, a IV-a.

În virtutea bunului obicei al editurii Human Kinetics, ne sunt oferite, şi de data aceasta, sub regimul accesului liber, câteva secvenţe relevante ale lucrării. Este vorba mai întâi de primul capitol în întregime şi începutul celui de-al doilea, care pot fi lecturate aici: http://www.humankinetics.com/ProductSearchInside?Login=Done&isbn=9781492507123. O altă ofertă este reprezentată de secvenţa intitulată „Postura văzută prin lentilele obişnuinţelor: identificarea şi evitarea obiceiurilor ce cauzează deficienţele posturale" (http://www.humankinetics.com/excerpts/excerpts/posture-through-the-habituation-lens). Ea ne vine din subcapitolul „Tehnici de corectare posturală", pendinte de cap. 2 şi merită citită, întrucât beneficiile fiziologice aduse de corecţia posturală se vor pierde repede, dacă pacienţii revin la acele comportamente şi atitudini care au avut un rol semnificativ în apariţia şi stabilizarea deficienţei în cauză. Ultima secvenţă, „Particularităţi ale *genu flexum*-ului" poate fi lecturată accesând link-ul http://www.humankinetics.com/excerpts/excerpts/the-ins-and-outs-of-genu-flexum.

În încheiere, câteva cuvinte despre autoare. Jane Johnson nu este, ca în cazul altor apariţii editoriale, o universitară, dar deţine un masterat în fizioterapie, este o practiciană de vârf în Anglia, iar pe lângă lucrarea aceasta, pe care o prezentăm acum, mai are încă 4 cărţi, publicate toate la Human Kinetics, ceea ce spune suficient despre valoarea lor: „Relaxarea ţesuturilor moi" (2009), „Masajul tisular profund" (2011), „Evaluarea posturală" (2012) şi „Stretching-ul terapeutic" (2012).

Gheorghe Dumitru
gdumitru@seanet.ro

Palestrica of the third millennium – Civilization and Sport
Vol. 16, no. 4, October-December 2015, 368–369

EVENTS
EVENIMENTE

Two autumn school cross country races on the road of tradition
Două crosuri şcolare de toamnă, pe drumul tradiţiei

The 2015/2016 competition calendar of Cluj county started with two autumn running events in Răchiţele and Frata, held on Saturday 24 October and Saturday 5 November. While in Răchiţele the cross country race reached its 5th edition, Frata organized the 1st edition of the event this year. We mentioned in previous reports that the declared aim of these cross country running events is to attract the participation of large numbers of children from rural schools, aged between 11-16 years, in sports activities. With this respect, the calendar includes two autumn cross country races (Răchiţele and Frata) and two spring cross country races (Dăbâca and Borşa). Two of these - Frata, which already took place, and Borşa, which will be held in the spring of 2016 - reach their 1st edition.

In what follows, we mention the results and rankings of the two autumn cross country events, as well as the officials who ensured their success:

Răchiţele

Number of participants - 153 pupils. *Participating centers*: Răchiţele, Mărişel, Izvorul Crişului, Călăţele, Mănăstireni, Râşca, Beliş, Sâncrai and Rogojel. *General ranking*: I - Răchiţele, II - Sâncrai, III - Rogojel. *First place in each age category*: girls grades III-IV (Szocs Imola) - Sâncrai; boys grades III-IV (Todoruţ Paul) - Răchiţele; girls grades V-VI (Bibere Ana-Maria) - Răchiţele; boys grades V-VI (Bălaş Gheorghe) - Răchiţele; girls grades VII-VIII (Abrudan Teodora) - Răchiţele; boys grades VII-VIII (Potra Ioan) - Răchiţele. *Team leading teachers*: Middle School of Răchiţele - Roşu Claudiu Ilie; Middle School of Mănăstireni - Todoran Rareş; Middle School of Călăţele - Mateş Rareş; ”Ady Endre” Middle School of Sâncraiu - Csudom Norbert; ”Avram Iancu” Middle School of Beliş - Todea Anghel; Middle School of Râşca - Ilea Ardelean; ”Pelaghia Roşu” Middle School of Mărişel - Bîlc Maria Iulian; ”Kos Karoly” Middle School of Izvorul Crişului - Török Annamaria; Middle School of Rogojel - Crişan Aurel. *Local officials*: Şaitiş Cristina Florentina - director; Petru Ungur - mayor; Purcel Viorel - deputy mayor.

Frata

Number of participants - 48 pupils. We mention that the lower number of participants was due to the fact that grades I-IV (11-12 years) were on holidays. *Participating centers*: Frata, Luna, Luncani, Viişoara, Tritenii de Jos, Mociu, Cămăraşu. *General ranking*: I Frata, II Cămăraşu, III Mociu. *First place in each age category*: girls gr. V-VI b. 2003-2004 (Leoca Diana) - Frata; boys gr. V-VI b. 2003-2004 (Mocian Marian) - Cămăraşu; girls gr. VII-VIII b. 2001-2002 (Mocian Andrada) - Cămăraşu; boys gr. VII-VIII b. 2001-2002 (Ciungan Daniel) - Viişoara; team ranking b. 2001-2002 - Cămăraşu; team ranking b. 2003-2004 - Frata. *Team leading teachers*: Middle School of Frata - Popa Sebastian; Middle School of Cămăraşu - Prunean Felician, Chira Ovidiu; Middle School of Mociu - Ciuciui Adrian; Middle School of Viişoara - Mocean Gabriel; ”Pavel Dan” Middle School of Tritenii de Jos - Raica Silviu; Middle School of Luna - Olar Maria; Middle School of Luncani - Zadic Alexandru. *Local officials*: Bara Teodor - director; Trif Vasile - mayor; Pop Grigore - deputy mayor.

* * *

Calendarul competiţional şcolar al judeţului Cluj pe anul 2015/2016, a debutat cu crosurile de toamnă desfăşurate la Răchiţele şi Frata, organizate în zilele de sîmbătă 24 octombrie, respectiv sîmbătă 5 noiembrie. În timp ce Răchiţele se află deja la ediţia a V-a, Frata a organizat în anul acesta ediţia I. Am menţionat în reportajele precedente că scopul declarat al organizării acestor crosuri, este cel al angrenării unui număr cît mai mare de copii de la şcolile din mediul rural, de vârsta 11-16 ani, în activitatea sportivă. În această idee calendarul prevede două crosuri de toamnă (Răchiţele şi Frata) şi două crosuri de primăvară (Dăbâca şi Borşa). Două dintre acestea - Frata care s-a desfăşurat deja şi Borşa - care se va desfăşura în primăvara lui 2016 sunt la ediţia I.

Menţionăm în continuare rezultatele şi clasamentele celor două crosuri de toamnă şi oficialii care au garantat reuşita acestora:

Răchiţele

Numărul participanţilor - 153 elevi. *Centrele participante*: Răchiţele, Mărişel, Izvorul Crişului, Călăţele, Mănăstireni, Râşca, Beliş, Sâncrai şi Rogojel. *Clasamentul general*: I - Răchiţele, II - Sâncrai, III - Rogojel. *Locul I la fiecare categorie de vârstă*: fete clasele III-IV (Szocs Imola) - Sâncrai; băieţi clasele III-IV (Todoruţ Paul) - Răchiţele; fete clasele V-VI (Bibere Ana-Maria) - Răchiţele; băieţi clasele V-VI (Bălaş Gheorghe) - Răchiţele; fete clasele VII-VIII (Abrudan Teodora) - Răchiţele; băieţi clasele VII-VIII (Potra Ioan) - Răchiţele. *Profesorii conducători de delegaţii*: Şcoala Gimnazială Răchiţele - Roşu Claudiu Ilie; Şcoala Gimnazială Mănăstireni - Todoran Rareş; Şcoala Gimnazială Călăţele - Mateş Rareş;

Şcoala Gimnazială ”Ady Endre” Sâncraiu - Csudom Norbert; Şcoala Gimnazială ”Avram Iancu” Beliş - Todea Anghel; Şcoala Gimnazială Râşca - Ilea Ardelean; Şcoala Pelaghia ”Roşu Mărişel” - Bîlc Maria Iulian; Şcoala Gimnazială ”Kos Karoly” Izvorul Crişului - Török Annamaria; Şcoala Gimnazială Rogojel - Crişan Aurel. *Oficialităţile locale*: Şaitiş Cristina Florentina - directoare; Petru Ungur - primar; Purcel Viorel - viceprimar.

Frata

Numărul participanţilor - 48 elevi. Menţionăm că numărul mai redus de participanţi se datoreşte vacanţei la clasele I-IV (11-12 ani). *Centrele participante*: Frata, Luna, Luncani, Viişoara, Tritenii de Jos, Mociu, Cămăraşu. *Clasamentul general*: I Frata, II Cămăraşu, III Mociu. *Locul I la fiecare categorie de vârstă*: fete cl.V-VI n. 2003-2004 (Leoca Diana) - Frata; băieţi cl.V-VI n. 2003-2004 (Mocian Marian) - Cămăraşu; fete cl.VII-VIII n. 2001-2002 (Mocian Andrada) - Cămăraşu; băieţi VII-VIII n. 2001-2002 (Ciungan Daniel) - Viişoara; clasament echipe n. 2001-2002 - Cămăraşu; clasament echipe n. 2003-2004 - Frata. *Profesorii conducători de delegaţii*: Şcoala Gimnazială Frata - Popa Sebastian; Şcoala Gimnazială Cămăraşu - Prunean Felician, Chira Ovidiu; Şcoala Gimnazială Mociu - Ciuciui Adrian; Şcoala Gimnazială Viişoara - Mocean Gabriel; Şcoala Gimnazială Pavel Dan Tritenii de Jos - Raica Silviu.

Şcoala Gimnazială Luna - Olar Maria; Scoala Gimnazială Luncani - Zadic Alexandru. *Oficialităţile locale*: Bara Teodor - director; Trif Vasile - primar; Pop Grigore - viceprimar.

Cristian Potora
cristianpotora@gmail.com

Image from the opening ceremony of the cross country race in Răchiţele.

Arrival of girls, the 12-13 years category, at the cross country race in Răchiţele.

Cristina Florentina Şaitiş, director of the School of Răchiţele, conducting the prize award ceremony for one of the girls' age categories.

Prize awarding to training teachers at the cross country race in Răchiţele, conducted by the mayor Petru Ungur: 1st place - Prof. Claudiu Roşu, School of Răchiţele, organizer of the 5th edition of the running race in Răchiţele; 2nd place - Prof. Csudom Norbert, ”Ady Endre” Middle School of Sâncraiu; 3rd place - Prof. Crişan Aurel, Middle School of Rogojel.

Checking the route, before the start of the cross country race in Frata, with Prof. Mircea Elecheş.

Prize award ceremony for one of the boys' categories at the cross country race in Frata, conducted by School Inspector Laura Ionescu.

Deputy General School Inspector Török Zoltan, in the company of the winners of one of the girls' categories at the cross country race in Frata.

School Inspector Cristian Potora, after the girls' prize award ceremony at the cross country race in Frata.

Officials at the end of the prize award ceremonies: Vasile Trif - mayor of Frata commune, Teodor Bara - director of the Middle School of Frata and Prof. Sebastian Popa, Middle School of Frata - *de facto* organizer of the 1st edition of the cross country race in Frata.

Palestrica of the third millennium – Civilization and sport
Vol. 16, no. 4, October-December 2015, 370–372

FOR THE ATTENTION OF CONTRIBUTORS

The subject of the Journal

The journal has a multidisciplinary nature oriented toward biomedical, health, exercise, social sciences fields, applicable in activities of physical training and sport, so that the dealt subjects and the authors belong to several disciplines in these fields. The main rubrics are: "Original studies" and "Reviews".

Regarding "Reviews" the main subjects that are presented are: oxidative stress in physical effort; mental training; psychoneuroendocrinology of sport effort; physical culture in the practice of the family doctor; extreme sports and risks; emotional determinatives of performance; the recovery of patients with spinal column disorders; stress syndromes and psychosomatics; olympic education, legal aspects of sport; physical effort in the elderly; psychomotricity disorders; high altitude sportive training; fitness; biomechanics of movements; EUROFIT tests and other evaluation methods of physical effort; adverse reactions of physical effort; sport endocrinology; depression in sportsmen/women; classical and genetic drug usage; Olympic Games etc.

Among articles devoted to original studies and researches we are particularly interested in the following: the methodology in physical education and sport; influence of some ions on effort capacity; psychological profiles of students regarding physical education; methodology in sport gymnastics; the selection of performance sportsmen.

Other articles approach particular subjects regarding different sports: swimming, rhythmic and artistic gymnastics, handball, volleyball, basketball, athletics, ski, football, field and table tennis, wrestling, sumo.

The authors of the two rubrics are doctors, professors and educators, from universities and preuniversity education, trainers, scientific researchers etc.

Other rubrics of the journal are: the editorial, editorial news, reviews of the latest books in the field and others that are presented rarely (inventions and innovations, universitaria, preuniversitaria, forum, memories, competition calendar, portraits, scientific events).

We highlight the rubric "The memory of the photographic eye", where photos, some very rare, of sportsmen in the past and present are presented.

Articles signed by authors from the Republic of Moldova regarding the organization of sport education, variability of the cardiac rhythm, the stages of effort adaptability and articles by some authors from France, Portugal, Canada must also be mentioned.

The main objective of the journal is highlighting the results of research activities as well as the permanent and actual dissemination of information for specialists in the field. The journal assumes an important role regarding the achievement of necessary scores of the teaching staff in the university and preuniversity education as well as of doctors in the medical network (by recognizing the journal by the Romanian College of Physicians), regarding didactic and professional promotion.

Another merit of the journal is the obligatory publication of the table of contents and an English summary for all articles. Frequently articles are published in extenso in a language with international circulation (English, French).

The journal is published quarterly and the works are accepted for publication in the Romanian and English language. The journal is sent by e-mail or on a floppy disk (or CD-ROM) and printed, by mail at the address of the editorial staff. The works of contributors that are resident abroad and of Romanian authors must be mailed to the Editorial staff at the following address:

„Palestrica of the third millennium – Civilization and sport"
Chief Editor: Prof. dr. Traian Bocu
Contact address: palestrica@gmail.com or traian_bocu@yahoo.com
Mail address: Clinicilor street no. 1 postal code 400006, Cluj-Napoca, România
Telephone:0264-598575
Website: www.pm3.ro

Objectives

Our intention is that the journal continues to be a route to highlight the research results of its contributors, especially by stimulating their participation in project competitions. Articles that are published in this journal are considered as part of the process of promotion in one's university career (accreditation that is obtained after consultation with the National Council for Attestation of Universitary Titles and Diplomas).

We also intend to encourage the publication of studies and research, that include original relevant elements especially from young people. All articles must bring a minimum of personal contribution (theoretical or practical), that will be highlighted in the article.

In the future we propose to accomplish criteria that would allow the promotion of the journal to superior levels according international recognition.

THE STRUCTURE AND SUBMISSION OF ARTICLES

The manuscript must be prepared according to the stipulations of the International Committee of Medical Journal Editors (http://www.icmjee.org).

The number of words for the electronic format:

– 4000 words for original articles;

– 2000 words for case studies;
– 5000-6000 words for review articles.

Format of the page: edited in WORD format, A4. Printed pages of the article will be numbered successively from 1 to the final page.

Font: Times New Roman, size 11 pt.; it should be edited on a full page, with diacritical marks, double spaced, respecting equal margins of 2 cm.

Illustrations:

The images (graphics, photos etc.) should be numbered consecutively in the text, with arabic numbers. They should be edited with EXCEL or SPSS programs, and sent as distinct files: „figure 1.tif", „figure 2. jpg", and at the editors demanding in original also. Every graphic should have a legend, written **under** the image.

The tables should be numbered consecutively in the text, with roman numbers, and sent as distinct files, accompanied by a legend that will be put **above** the table.

PREPARATION OF THE ARTICLES

1. Title page: – includes the title of article (maximum 45 characters), the name of authors followed by surname, work place, mail address of the institute and mail adress and e-mail address of the first author. It will follow the name of article in the English language.

2. Summary: For original articles a summary structured like this is necessary: (Premize-Background, Obiective-Aims, Metode-Methods, Resultate-Results, Concluzii-Conclusions), in the Romanian language, of maximum 250 words, followed by 3-8 key words (if its possible from the list of established terms). All articles will have a summary in the English language. Within the summary (abstract) abbreviations, footnotes or bibliographic references should not be used.

Premises and objectives. Description of the importance of the study and explanation of premises and research objectives.

Methods. Include the following aspects of the study:

Description of the basic category of the study: of orientation and applicative.

Localization and the period of study. Description and size of groups, sex (gender), age and other socio-demographic variables should be given.

Methods and instruments of investigation that are used.

Results. The descriptive and inferential statistical data (with specification of the used statistical tests): the differences between the initial and the final measurement, for the investigated parameters, the significance of correlation coefficients are necessary. The specification of the level of significance (the value ***p*** or the dimension of effect ***d***) and the type of the used statistical test etc are obligatory.

Conclusions. Conclusions that have a direct link with the presented study should be given.

Orientation articles and case studies should have an unstructured summary (without respecting the structure of experimental articles) to a limit of 150 words.

3. Text

Original articles should include the following chapters which will not be identical with the summary titles: Introduction (General considerations), Hypothesis, Materials and methods (including ethical and statistical informations), Results, Discussing results, Conclusions and suggestions. Other type of articles, as orientation articles, case studies, Editorials, do not have an obligatory format. Excessive abbreviations are not recommended. The first abbreviation in the text is represented first *in extenso*, having its abbreviation in parenthesis, and thereafter the short form should be used.

Authors must undertake the responsibility for the correctness of published materials.

4. Bibliography

The bibliography should include the following data:

For articles from journals or other periodical publications the international Vancouver Reference Style should be used: the name of all authors as initials and the surname, the year of publication, the title of the article in its original language, the title of the journal in its international abbreviation (italic characters), number of volume, pages.

Articles: Pop M, Albu VR, Vişan D et al. Probleme de pedagogie în sport. Educaţie Fizică şi Sport 2000; 25(4):2-8.

Books: Drăgan I (coord.). Medicina sportivă, Editura Medicală, 2002, Bucureşti, 2002, 272-275.

Chapters from books: Hăulică I, Bălţatu O. Fiziologia senescenţei. In: Hăulică I. (sub red.) Fiziologia umană, Ed. Medicală, Bucureşti, 1996, 931-947.

Starting with issue 4/2010, every article should include a minimum of 15 bibliographic references and a maximum of 100, mostly journals articles published in the last 10 years. Only a limited number of references (1-3) older than 10 years will be allowed. At least 20% of the cited resources should be from recent international literature (not older than 10 years).

Peer-review process

In the final stage all materials will be closely reviewed by at least two competent referees in the field (Professors, and Docent doctors) so as to correspond in content and form with the requirements of an international journal. After this stage, the materials will be sent to the journal's referees, according to their profiles. After receiving the observations from the referees, the editorial staff shall inform the authors of necessary corrections and the publishing requirements of the journal. This process (from receiving the article to transmitting the observations) should last about 4 weeks. The author will be informed if the article was accepted for publication or not. If it is accepted, the period of correction by the author will follow in order to correspond to the publishing requirements.

Conflict of interest

The authors must mention all possible conflicts of interest including financial and other types. If you are sure that there is no conflict of interest we ask you to mention this. The financing sources should be mentioned in your work too.

Specifications

The specifications must be made only linked to the people outside the study but which have had a substantial contribution, such as some statistical processing or review of the text in the English language. The authors have the responsibility to obtain the written permission from the mentioned persons with the name written within the respective chapter, in case the readers refer to the interpretation of results and conclusions of these persons. Also it should be specified if the article uses some partial results from certain projects or if these are based on master or doctoral theses sustained by the author.

Ethical criteria

The Editors will notify authors in due time, whether their article is accepted or not or whether there is a need to modify texts. Also the Editors reserve the right to edit articles accordingly. Papers that have been printed or sent for publication to other journals will not be accepted. All authors should send a separate letter containing a written statement proposing the article for submission, pledging to observe the ethics of citation of sources used (bibliographic references, figures, tables, questionnaires).

For original papers, according to the requirements of the Helsinki Declaration, the Amsterdam Protocol, Directive 86/609/EEC, and the regulations of the Bioethical Committees from the locations where the studies were performed, the authors must provide the following:

- the informed consent of the family, for studies in children and juniors;
- the informed consent of adult subjects, patients and athletes, for their participation;
- malpractice insurance certificate for doctors, for studies in human subjects;
- certificate from the Bioethical Committees, for human study protocols;
- certificate from the Bioethical Committees, for animal study protocols.

The data will be mentioned in the paper, in the section Materials and Methods. The documents will be obtained before the beginning of the study. Will be mentioned also the registration number of the certificate from the Bioethical Committees.

Editorial submissions will be not returned to authors, whether published or not.

FOR THE ATTENTION OF THE SPONSORS

Requests for advertising space should be sent to the Editors of the "Palestrica of the Third Millennium" journal, 1, Clinicilor St., 400006, Cluj-Napoca, Romania. The price of an A4 full colour page of advertising for 2012 will be EUR 250 and EUR 800 for an advert in all 4 issues. The costs of publication of a logo on the cover will be determined according to its size. Payment should be made to the Romanian Medical Society of Physical Education and Sports, CIF 26198743. Banca Transilvania, Cluj branch, IBAN: RO32 BTRL 0130 1205 S623 12XX (RON).

SUBSCRIPTION COSTS

The "Palestrica of the Third Millennium" journal is printed quarterly. The subscription price is 100 EUR for institutions abroad and 50 EUR for individual subscribers outside Romania. For Romanian institutions, the subscription price is 120 RON, and for individual subscribers the price is 100 RON. Note that distribution fees are included in the postal costs.

Payment of subscriptions should be made by bank transfer to the Romanian Medical Society of Physical Education and Sports, CIF 26198743. Banca Transilvania, Cluj branch, IBAN: RO32 BTRL 0130 1205 S623 12XX (RON), RO07 BTRL 01,304,205 S623 12XX (EUR), RO56 BTRL 01,302,205 S623 12XX (USD). SWIFT: BTRLRO 22

Please note that in 2010 a tax for each article submitted was introduced. Consequently, all authors of articles will pay the sum of 150 RON to the Romanian Medical Society of Physical Education and Sport published above. Authors who have paid the subscription fee will be exempt from this tax. Other information can be obtained online at www.pm3.ro "Instructions for Authors", at our e-mail address palestrica@gmail.com or at the postal address: 1, Clinicilor St., 400006, Cluj-Napoca, Romania, phone: +40264-598575.

INDEXING

Title of the journal: Palestrica of the third millennium – Civilization and sport

pISSN: 1582-1943; eISSN: 2247-7322; ISSN-L: 1582-1943

Profile: a Journal of Study and interdisciplinary research

Editor: "Iuliu Haţieganu" University of Medicine and Pharmacy of Cluj-Napoca and The Romanian Medical Society of Physical Education and Sports in collaboration with the Cluj County School Inspectorate

The level and attestation of the journal: a journal rated B+ by CNCSIS in the period 2007-2011 and certified by CMR since 2003

Journal indexed into International Data Bases (IDB): EBSCO, Academic Search Complete, USA and Index Copernicus, Journals Master List, Poland; DOAJ (Directory of Open Access Journals), Sweden.

Year of first publication: 2000

Issue: quarterly

The table of contents, the summaries and the instructions for authors can be found on the internet page: http://www.pm3.ro. Access to the table of contents and full text articles (in .pdf format) is free.

ÎN ATENŢIA COLABORATORILOR

Tematica revistei

Ca tematică, revista are un caracter multidisciplinar orientat pe domeniile biomedical, sănătate, efort fizic, ştiinţe sociale, aplicate la activităţile de educaţie fizică şi sport, astfel încât subiectele tratate şi autorii aparţin mai multor specialităţi din aceste domenii. Principalele rubrici sunt: „Articole originale" şi „Articole de sinteză".

Exemplificăm rubrica „Articole de sinteză" prin temele importante expuse: stresul oxidativ în efortul fizic; antrenamentul mintal; psihoneuroendocrinologia efortului sportiv; cultura fizică în practica medicului de familie; sporturi extreme şi riscuri; determinanţi emoţionali ai performanţei; recuperarea pacienţilor cu suferinţe ale coloanei vertebrale; sindroame de stres şi psihosomatică; educaţia olimpică, aspecte juridice ale sportului; efortul fizic la vârstnici; tulburări ale psihomotricităţii; pregătirea sportivă la altitudine; fitness; biomecanica mişcărilor; testele EUROFIT şi alte metode de evaluare a efortului fizic; reacţii adverse ale eforturilor; endocrinologie sportivă; depresia la sportivi; dopajul clasic şi genetic; Jocurile Olimpice etc.

Dintre articolele consacrate studiilor şi cercetărilor experimentale notăm pe cele care vizează: metodica educaţiei fizice şi sportului; influenţa unor ioni asupra capacităţii de efort; profilul psihologic al studentului la educaţie fizică; metodica în gimnastica sportivă; selecţia sportivilor de performanţă.

Alte articole tratează teme particulare vizând diferite sporturi: înotul, gimnastica ritmică şi artistică, handbalul, voleiul, baschetul, atletismul, schiul, fotbalul, tenisul de masă şi câmp, luptele libere, sumo.

Autorii celor două rubrici de mai sus sunt medici, profesori şi educatori din învăţământul universitar şi preuniversitar, antrenori, cercetători ştiinţifici etc.

Alte rubrici ale revistei sunt: editorialul, actualităţile editoriale, recenziile unor cărţi - ultimele publicate în domeniu, la care se adaugă şi altele prezentate mai rar (invenţii şi inovaţii, universitaria, preuniversitaria, forum, remember, calendar competiţional, portrete, evenimente ştiinţifice).

Subliniem rubrica "Memoria ochiului fotografic", unde se prezintă fotografii, unele foarte rare, ale sportivilor din trecut şi prezent.

De menţionat articolele semnate de autori din Republica Moldova privind organizarea învăţământului sportiv, variabilitatea ritmului cardiac, etapele adaptării la efort, articole ale unor autori din Franţa, Portugalia, Canada.

Scopul principal al revistei îl constituie valorificarea rezultatelor activităţilor de cercetare precum şi informarea permanentă şi actuală a specialiştilor din domeniile amintite. Revista îşi asumă şi un rol important în îndeplinirea punctajelor necesare cadrelor didactice din învăţământul universitar şi preuniversitar precum şi medicilor din reţeaua medicală (prin recunoaşterea revistei de către Colegiul Medicilor din România), în avansarea didactică şi profesională.

Un alt merit al revistei este publicarea obligatorie a cuprinsului şi a câte unui rezumat în limba engleză, pentru toate articolele. Frecvent sunt publicate articole în extenso într-o limbă de circulaţie internaţională (engleză, franceză).

Revista este publicată trimestrial iar lucrările sunt acceptate pentru publicare în limba română şi engleză. Articolele vor fi redactate în format WORD (nu se acceptă articole în format PDF). Expedierea se face prin e-mail sau pe dischetă (sau CD-ROM) şi listate, prin poştă pe adresa redacţiei. Lucrările colaboratorilor rezidenţi în străinătate şi ale autorilor români trebuie expediate pe adresa redacţiei:

Revista «Palestrica Mileniului III»
Redactor şef: Prof. dr. Traian Bocu
Adresa de contact: palestrica@gmail.com sau traian_bocu@yahoo.com
Adresa poştală: Str. Clinicilor nr.1 cod 400006, Cluj-Napoca, România
Telefon:0264-598575
Website: www.pm3.ro

Obiective

Ne propunem ca revista să continue a fi o formă de valorificare a rezultatelor activităţii de cercetare a colaboratorilor săi, în special prin stimularea participării acestora la competiţii de proiecte. Menţionăm că articolele publicate în cadrul revistei sunt luate în considerare în procesul de promovare în cariera universitară (acreditare obţinută în urma consultării Consiliului Naţional de Atestare a Titlurilor şi Diplomelor Universitare).

Ne propunem de asemenea să încurajăm publicarea de studii şi cercetări, care să cuprindă elemente originale relevante mai ales de către tineri. Toate articolele vor trebui să aducă un minimum de contribuţie personală (teoretică sau practică), care să fie evidenţiată în cadrul articolului.

În perspectivă ne propunem îndeplinirea criteriilor care să permită promovarea revistei la niveluri superioare cu recunoaştere internaţională.

STRUCTURA ŞI TRIMITEREA ARTICOLELOR

Manuscrisul trebuie pregătit în acord cu prevederile Comitetului Internaţional al Editurilor Revistelor Medicale (http://www.icmjee.org).

Numărul cuvintelor pentru formatul electronic:

– 4000 cuvinte pentru articolele originale,
– 2000 de cuvinte pentru studiile de caz,
– 5000–6000 cuvinte pentru articolele de sinteză.

Format pagină: redactarea va fi realizată în format A4. Paginile listate ale articolului vor fi numerotate succesiv de la 1 până la pagina finală.

Font: Times New Roman, mărime 11 pt.; redactarea se va face pe pagina întreagă, cu diacritice, la două rânduri, respectând margini egale de 2 cm pe toate laturile.

Ilustraţiile:

Figurile (grafice, fotografii etc.) vor fi numerotate consecutiv în text, cu cifre arabe. Vor fi editate cu programul EXCEL sau SPSS, şi vor fi trimise ca fişiere separate: „figura 1.tif", „figura 2. jpg", iar la solicitarea redacţiei şi în original. Fiecare grafic va avea o legendă care se trece **sub** figura respectivă.

Tabelele vor fi numerotate consecutiv în text, cu cifre romane, şi vor fi trimise ca fişiere separate, însoţite de o legendă ce se plasează **deasupra** tabelului.

PREGĂTIREA ARTICOLELOR

1. Pagina de titlu: – cuprinde titlul articolului (maxim 45 caractere), numele autorilor urmat de prenume, locul de muncă, adresa postală a instituţiei, adresa poştală şi adresa e-mail a primului autor. Va fi urmat de titlul articolului în limba engleză.

2. Rezumatul: Pentru articolele experimentale este necesar un rezumat structurat (Premize-Background, Obiective-Aims, Metode-Methods, Rezultate-Results, Concluzii-Conclusions), în limba română, de maxim 250 cuvinte (20 de rânduri, font Times New Roman, font size 11), urmat de 3–5 cuvinte cheie (dacă este posibil din lista de termeni consacraţi). Toate articolele vor avea un rezumat în limba engleză. Nu se vor folosi prescurtări, note de subsol sau referinţe.

Premize şi obiective: descrierea importanţei studiului şi precizarea premizelor şi obiectivelor cercetării.

Metodele: includ următoarele aspecte ale studiului:

Descrierea categoriei de bază a studiului: de orientare sau aplicativ.

Localizarea şi perioada de desfăşurare a studiului. Colaboratorii vor prezenta descrierea şi mărimea loturilor, sexul (genul), vârsta şi alte variabile socio-demografice.

Metodele şi instrumentele de investigaţie folosite.

Rezultatele vor prezenta datele statistice descriptive şi inferenţiale obţinute (cu precizarea testelor statistice folosite): diferenţele dintre măsurătoarea iniţială şi cea finală, pentru parametri investigaţi, semnificaţia coeficienţilor de corelaţie. Este obligatorie precizarea nivelului de semnificaţie (valoarea ***p*** sau mărimea efectului ***d***) şi a testului statistic folosit etc.

Concluziile care au directă legătură cu studiul prezentat.

Articolele de orientare şi studiile de caz vor avea un rezumat nestructurat (fără a respecta structura articolelor experimentale) în limita a 150 cuvinte (maxim 12 rânduri, font Times New Roman, font size 11).

3. Textul

Articolele experimentale vor cuprinde următoarele capitole: Introducere, Ipoteză, Materiale şi Metode (inclusiv informaţiile etice şi statistice), Rezultate, Discutarea rezultatelor, Concluzii (şi propuneri). Celelalte tipuri de articole, cum ar fi articolele de orientare, studiile de caz, editorialele, nu au un format impus.

Răspunderea pentru corectitudinea materialelor publicate revine în întregime autorilor.

4. Bibliografia

Bibliografia va cuprinde:

Pentru articole din reviste sau alte periodice se va menţiona: numele tuturor autorilor şi iniţialele prenumelui, anul apariţiei, titlul articolului în limba originală, titlul revistei în prescurtare internaţională (caractere italice), numărul volumului, paginile

Articole: Pop M, Albu VR, Vişan D et al. Probleme de pedagogie în sport. Educaţia Fizică şi Sportul 2000; 25(4):2-8.

Cărţi: Drăgan I (coord.). Medicina sportivă aplicată. Ed. Editis, Bucureşti 1994, 372-375.

Capitole din cărţi: Hăulică I, Bălţatu O. Fiziologia senescenţei. În: Hăulică I. (sub red.) Fiziologia umană. Ed. Medicală, Bucureşti 1996, 931-947.

Începând cu revista 4/2010, fiecare articol va trebui să se bazeze pe un minimum de 15 şi un maximum de 100 referinţe bibliografice, în majoritate articole nu mai vechi de 10 ani. Sunt admise un număr limitat de cărţi şi articole de referinţă (1-3), cu o vechime mai mare de 10 ani. Un procent de 20% din referinţele bibliografice citate trebuie să menţioneze literatură străină studiată, cu respectarea criteriului actualităţii acesteia (nu mai vechi de 10 ani).

Procesul de recenzare (peer-review)

Într-o primă etapă toate materialele sunt revizuite riguros de cel puţin doi referenţi competenţi în domeniu respectiv (profesori universitari doctori şi doctori docenţi) pentru ca textele să corespundă ca fond şi formă de prezentare cerinţelor unei reviste serioase. După această etapă materialele sunt expediate referenţilor revistei, în funcţie de profilul materialelor. În urma observaţiilor primite din partea referenţilor, redacţia comunică observaţiile autorilor în vederea corectării acestora şi încadrării în cerinţele de publicare impuse de revistă. Acest proces (de la primirea articolului până la transmiterea observaţiilor) durează aproximativ 4 săptămâni. Cu această ocazie se comunică autorului daca articolul a fost acceptat spre publicare sau nu. În situaţia acceptării, urmează perioada de corectare a articolului de către autor în vederea încadrării în criteriile de publicare.

Conflicte de interese

Se cere autorilor să menţioneze toate posibilele conflicte de interese incluzând relaţiile financiare şi de alte tipuri. Dacă sunteţi siguri că nu există nici un conflict de interese vă rugăm să menţionaţi acest lucru. Sursele de finanţare ar trebui să

fie menţionate în lucrarea dumneavoastră.

Precizări

Precizările trebuie făcute doar în legătură cu persoanele din afara studiului, care au avut o contribuţie substanţială la studiul respectiv, cum ar fi anumite prelucrări statistice sau revizuirea textului în limba engleză. Autorii au responsabilitatea de a obţine permisiunea scrisă din partea persoanelor menţionate cu numele în cadrul acestui capitol, în caz că cititorii se referă la interpretarea rezultatelor şi concluziilor acestor persoane. De asemenea, la acest capitol se vor face precizări în cazul în care articolul valorifică rezultate parţiale din anumite proiecte sau dacă acesta se bazează pe teze de masterat sau doctorat susţinute de autor, alte precizări.

Criterii deontologice

Redacţia va răspunde în timp util autorilor privind acceptarea, neacceptarea sau necesitatea modificării textului şi îşi rezervă dreptul de a opera modificări care vizează forma lucrărilor.

Nu se acceptă lucrări care au mai fost tipărite sau trimise spre publicare la alte reviste. Autorii vor trimite redacţiei odată cu articolul propus spre publicare, într-un fişier word separat, o declaraţie scrisă în acest sens, cu angajamentul respectării normelor deontologice referitoare la citarea surselor pentru materialele folosite (referinţe bibliografice, figuri, tabele, chestionare).

Pentru articolele originale, în conformitate cu îndeplinirea condiţiilor Declaraţiei de la Helsinki, a Protocolului de la Amsterdam, a Directivei 86/609/EEC şi a reglementărilor Comisiilor de Bioetică din locaţiile unde s-au efectuat studiile, autorii trebuie să prezinte:

- acordul informat din partea familiei, pentru studiile pe copii şi juniori;
- acordul informat din partea subiecţilor adulţi, pacienţi şi sportivi, pentru participare;
- adeverinţă de Malpraxis pentru medici, pentru cercetările/studiile pe subiecţi umani;
- adeverinţă din partea Comisiilor de Etică, pentru protocolul de studiu pe subiecţi umani;
- adeverinţă din partea Comisiilor de Bioetică, pentru protocolul de studiu pe animale.

Datele vor fi menţionate în articol la secţiunea Material şi metodă. Documentele vot fi obţinute înainte de începerea studiului. Se va menţiona şi numărul de înregistrare al adeverinţei din partea Comisiilor de Etică.

Materialele trimise la redacţie nu se restituie autorilor, indiferent dacă sunt publicate sau nu.

ÎN ATENŢIA SPONSORILOR

Solicitările pentru spaţiile de reclamă, vor fi adresate redacţiei revistei "Palestrica Mileniului III", Str. Clinicilor nr. 1, cod 400006 Cluj-Napoca, România. Preţul unei pagini de reclamă full color A4 pentru anul 2012 va fi de 250 EURO pentru o apariţie şi 800 EURO pentru 4 apariţii. Costurile publicării unui Logo pe coperţile revistei, vor fi stabilite în funcţie de spaţiul ocupat. Plata se va face în contul Societăţii Medicale Române de Educaţie Fizică şi Sport, CIF 26198743. Banca Transilvania, sucursala Cluj Cod IBAN: RO32 BTRL 0130 1205 S623 12XX (LEI).

ÎN ATENŢIA ABONAŢILOR

Revista "Palestrica Mileniului III" este tipărită trimestrial, preţul unui abonament fiind pentru străinătate de 100 Euro pentru instituţii, şi 50 Euro individual. Pentru intern, preţul unui abonament instituţional este de 120 lei, al unui abonament individual de 100 lei. Menţionăm că taxele de difuzare poştală sunt incluse în costuri.

Plata abonamentelor se va face prin mandat poştal în contul Societăţii Medicale Române de Educaţie Fizică şi Sport, CIF 26198743. Banca Transilvania, sucursala Cluj Cod IBAN: RO32 BTRL 0130 1205 S623 12XX (LEI); RO07 BTRL 01304205 S623 12XX (EURO); RO56 BTRL 01302205 S623 12XX (USD). SWIFT: BTRLRO 22

Precizăm că începând cu anul 2010 a fost introdusă taxa de articol. Ca urmare, toţi autorii semnatari ai unui articol vor achita împreună suma de 150 Lei, în contul Societăţii Medicale Române de Educaţie Fizică şi Sport publicat mai sus.

Autorii care au abonament vor fi scutiţi de această taxă de articol.

Alte informaţii se pot obţine online de pe www.pm3.ro „Pentru autori" sau pe adresa de mail a redacţiei palestrica@gmail.com sau pe adresa poştală: Str. Clinicilor nr.1 cod 400006, Cluj-Napoca, România, Telefon:0264-598575.

INDEXAREA

Titlul revistei: Palestrica Mileniului III – Civilizaţie şi sport

pISSN: 1582-1943; eISSN: 2247-7322; ISSN-L: 1582-1943

Profil: revistă de studii şi cercetări interdisciplinare

Editor: Universitatea de Medicină şi Farmacie „Iuliu Haţieganu" din Cluj-Napoca şi Societatea Medicală Română de Educaţie Fizică şi Sport, în colaborare cu Inspectoratul Şcolar al Judeţului Cluj

Nivelul de atestare al revistei: revistă acreditată în categoria B+ de CNCS în perioadele 2007-2011 şi atestată CMR din anul 2003 şi în prezent

Revistă indexată în Bazele de Date Internaţionale (BDI): EBSCO, Academic Search Complete, USA şi Index Copernicus, Journals Master List, Polonia, DOAJ (Directory of Open Access Journals), Sweden

Anul primei apariţii: 2000

Periodicitate: trimestrială

Cuprinsul, rezumatele şi instrucţiunile pentru autori se găsesc pe pagina de Internet: http://www.pm3.ro Accesul la cuprins şi articole in extenso (în format .pdf) este gratuit.

INDEX ALFABETIC AL AUTORILOR
care au publicat în anul 2015, în revista „Palestrica Mileniului III” – vol. 16, nr. 1; 2, 3; 4*

AUTHORS' ALPHABETICAL INDEX
who published during 2015, in "Palestrica of the Third Millennium" journal – vol. 16, nr. 1; 2, 3; 4*

* Interpretare: 16-2015/1:1 = Volumul - Anul apariţiei / Numărul revistei : Pagina

PALESTRICA MILENIULUI III – CIVILIZAŢIE ŞI SPORT
Redacţia revistei «Palestrica Mileniului III»
Str. Clinicilor nr.1, cod 400006, Cluj-Napoca, România,
Tel.: 0264-598575, e-mail: palestrica@gmail.com
Universitatea de Medicină și Farmacie „Iuliu Haţieganu” Cluj-Napoca,
Catedra de Fiziologie, str. Clinicilor 1, cod 400006 Tel. 0264 / 598575

TALON DE INDIVIDUAL DE ABONAMENT 2016

„PALESTRICA MILENIULUI III – CIVILIZAŢIE ŞI SPORT”
4 NUMERE / 2016 – 100 lei

NUMELE (INSTITUŢIA).....
ADRESA: Strada..... Nr..... Bloc..... Scara..... Etaj..... Ap.....
Sector..... Localitatea..... Judeţ.....
Cod poştal..... Tel. fix..... Tel Mobil.....
Fax..... E-mail.....

Plata se va face în contul Societăţii Medicale Române de Educaţie Fizică şi Sport, CIF 26198743, Banca Transilvania, Cluj, IBAN: RO32 BTRL 0130 1205 S623 12XX (LEI), SWIFT: BTRLRO 22, cu specificaţia „Abonament la revista Palestrica Mileniului III”.
Vă rugăm anexaţi xerocopia dovezii de achitare a abonamentului, de talonul de abonament şi expediaţi-le pe adresa redacţiei, în vederea difuzării revistelor cuvenite.

„PALESTRICA MILENIULUI III – CIVILIZAŢIE ŞI SPORT”
este o revistă recunoscută de CNCSIS şi este luată în considerare în vederea avansării didactice. De asemenea, revista este acreditată de către Colegiul Medicilor din România. Un abonament anual beneficiază de 5 credite.

PALESTRICA MILENIULUI III – CIVILIZAŢIE ŞI SPORT
Redacţia revistei «Palestrica Mileniului III»
Str. Clinicilor nr.1, cod 400006, Cluj-Napoca, România,
Tel.: 0264-598575, e-mail: palestrica@gmail.com
Universitatea de Medicină și Farmacie „Iuliu Haţieganu” Cluj-Napoca,
Catedra de Fiziologie, str. Clinicilor 1, cod 400006 Tel. 0264 / 598575

TALON DE ABONAMENT 2016

„PALESTRICA MILENIULUI III – CIVILIZAŢIE ŞI SPORT”
4 NUMERE / 2016 – 100 lei

NUMELE (INSTITUŢIA).....
ADRESA: Strada..... Nr..... Bloc..... Scara..... Etaj..... Ap.....
Sector..... Localitatea..... Judeţ.....
Cod poştal..... Tel. fix..... Tel Mobil.....
Fax..... E-mail.....

Plata se va face în contul Societăţii Medicale Române de Educaţie Fizică şi Sport, CIF 26198743, Banca Transilvania, Cluj, IBAN: RO32 BTRL 0130 1205 S623 12XX (LEI), SWIFT: BTRLRO 22, cu specificaţia „Abonament la revista Palestrica Mileniului III”.
Vă rugăm anexaţi xerocopia dovezii de achitare a abonamentului, de talonul de abonament şi expediaţi-le pe adresa redacţiei, în vederea difuzării revistelor cuvenite.

„PALESTRICA MILENIULUI III – CIVILIZAŢIE ŞI SPORT”
este o revistă recunoscută de CNCSIS şi este luată în considerare în vederea avansării didactice. De asemenea, revista este acreditată de către Colegiul Medicilor din România. Un abonament anual beneficiază de 5 credite.