

PALESTRICA OF THE THIRD MILLENNIUM - CIVILIZATION AND SPORT

A quarterly of multidisciplinary study and research

© Published by The "Iuliu Haieganu" 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 (Romanian College of Pharmacists) since 2015

A journal with a multidisciplinary approach in the fields of biomedical science,
health, medical rehabilitation, 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
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Vol. 18, No. 4, October-December 2017

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Telephone: 0264-598575
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pISSN 1582-1943
eISSN 2247-7322
ISSN-L 1582-1943
www.pm3.ro

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ORIGINAL STUDIES

Rehabilitation in elderly patients with parkinsonism

Reabilitarea complex a vârstnicilor cu parkinsonism

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Abstract

Background. Parkinsonism is an umbrella term which covers a group of neurological disorders that cause movement problems (slow movement, abnormal gait and balance problems, rigidity, tremor); only 80-85% of all cases are due to Parkinson's disease (PD); other 15-20% are defined as atypical parkinsonism.

Aims. We evaluated in our study the efficacy of a complex rehabilitation program, based on 6 weeks of aerobic training, for reducing symptoms and improving the quality of life in elderly patients with vascular parkinsonism.

Methods. The study was a randomized controlled trial comprising two groups of patients (E-study group and C-control group), homogeneous in terms of biographical, clinical and functional features. All patients underwent a full clinical, imaging and functional assessment.

Results. All parameters had a significant modification (Up and Go test, Berg scale, 2 MWD and NEADL scale) in patients that performed the rehabilitation program.

Conclusions. The rehabilitation program mainly aimed at maximizing functional ability and quality of life in patients with vascular parkinsonism. Our study is a beginning for the development of an evidence-based practice in the rehabilitation of older patients with parkinsonism.

Keywords: vascular parkinsonism, rehabilitation program.

Rezumat

Premize. Parkinsonismul este un termen umbrel, care acoperă un grup de tulburări neurologice care cauzează probleme de mișcare (mișcare lentă, probleme anormale de mers și echilibru, rigiditate, tremor); numai 80-85% din toate cazurile se datorează bolii Parkinson (PD); altele 15-20% sunt definite ca parkinsonism atipic.

Obiective. S-a evaluat în studiul nostru eficacitatea unui program complex de reabilitare bazat pe formarea aerobă de 6 săptămâni pentru reducerea simptomelor și îmbunătățirea calității vieții la pacienții vârstnici cu parkinsonism vascular.

Metode. Studiul a fost un studiu controlat, randomizat, care a cuprins două grupuri de pacienți (lotul de studiu E și lotul de control C), omogene în ceea ce privește caracteristicile biografice, clinice și funcționale. Toți pacienții au fost evaluați complet - clinic, imagistic și funcțional.

Rezultate. Toți parametrii au avut o modificare semnificativă (testul Up and Go, scara Berg, 2 MWD și scara NEADL) la pacienții care au efectuat un program de reabilitare.

Concluzii. Programul de reabilitare vizează în principal maximizarea capacității funcționale și a calității vieții la pacienții cu parkinsonism vascular. Studiul nostru este un început pentru dezvoltarea unei practici bazate pe dovezi în reabilitarea pacienților vârstnici cu parkinsonism.

Cuvinte cheie: parkinsonism vascular, program de reabilitare.

Received: 2017, September 6; *Accepted for publication:* 2017, September 20

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<https://doi.org/10.26659/pm3.2017.18.4.185>

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Introduction

Over the last 10 years there have been various medical studies about the importance of rehabilitation programs in the management of patients with chronic neurological diseases, especially in elderly persons with complex deconditioned status (Cheng et al., 2012). Parkinsonism is an umbrella term covering a group of neurological disorders that cause movement problems (slow movement, abnormal gait and balance problems, rigidity, tremor); only 80-85% of all cases are due to Parkinson's disease (PD); other 15-20% are defined as atypical parkinsonism that includes disorders characterized by parkinsonism but not caused by PD (1).

The category of atypical parkinsonism comprises a number of disorders (progressive supranuclear palsy, multiple system atrophy, Lewy body dementia, corticobasal degeneration), some of which have yet to be clearly defined - vascular parkinsonism, drug-induced parkinsonism, and parkinsonism secondary to infection and other causes (Hohler et al., 2012). These disorders tend to progress more rapidly than PD, are defined through additional symptoms such as early falling, dementia or hallucinations, and do not respond or respond only for a short time to levodopa therapy (1).

Vascular parkinsonism (VP), a controversial clinical concept, is a form of secondary parkinsonism resulting from cerebrovascular disease. Worldwide, VP represents 2.5% to 5.0% of all cases of parkinsonism in various population-based studies and clinical researches.

In Europe, VP is estimated at 3% of all cases of parkinsonism (Vale et al., 2012). Based on diagnostic criteria for VP, 4% to 12% of patients with Parkinson's syndrome are estimated to have a vascular etiology that occurs more frequently in the older population (da Silva et al., 2012).

Despite the progress made in the medical understanding of other parkinsonism syndromes, the concept of VP is still unclear and clinical diagnosis is often difficult (Benamer & Grosset, 2009); it is defined by the following features (Hohler et al., 2012; Chadwick & Aminoff, 2004; Zijlmans et al., 2004):

- an abrupt bilateral and symmetrical onset with stepwise evolution of bradykinesia and rigidity;
- evidence of the presence of risk factors (systemic arterial hypertension, atherosclerotic disease) for neurovascular disease, lacunar infarcts in the basal ganglia or more widespread subcortical white matter lesions obvious on neuroimaging (in elderly patients these alterations in the white matter are often correlated with parkinsonian symptoms);
- focal signs or symptoms consistent with stroke such as pyramidal damage with symmetrical involvement, pseudobulbar paralysis and spontaneous improvement of the symptoms;
- prominent postural instability and gait disorder;
- no rest tremor;
- unresponsive to levodopa treatment (2).

For positive VP diagnosis, a few clinical and imaging exclusion aspects should be taken into consideration: a history of craniocerebral trauma, defined encephalitis,

computed tomography (CT) and magnetic resonance imaging (MRI) evidencing a cerebral tumor or suggesting hydrocephaly (da Silva et al., 2012). VP is characterized by symptom heterogeneity, with the mention that postural instability and falls are more frequent than bradykinesia and upper limb rest tremor (Gupta et al., 2012).

The most important clinical complaint of VP, with the development of a complex dysfunction, is gait impairment (Thanvi et al., 2012). This gait disturbance develops early and has a significant impact on the severity of the patient's status and quality of life (Pokhobov, 2014). VP does not respond well to the typical medications used to treat Parkinson's disease. Treatment of symptomatic vascular parkinsonism involves trying to minimize stroke risk factors as outlined above and a trial of levodopa and other anti-parkinsonian medications. Rehabilitation programs (kinetic and physical measures, using ambulatory devices and development of compensatory strategies) may also play an important role in preventing falling, training to improve balance, gait and postural status (Benamer & Grosset, 2009).

Hypothesis

Taking into consideration the previous recommendations for VP management, we evaluated in our study the efficacy of a complex rehabilitation program, based on 6 weeks of aerobic training, for reducing symptoms and improving the quality of life in elderly patients with VP.

Material and methods

We mention that we obtained the approval of the Ethics Committee of the University of Medicine and Pharmacy of Craiova No 129/16.05.2017 and a signed informed consent from all the subjects participating in the study. Our research was performed on 27 patients, all diagnosed with vascular parkinsonism (VP).

Research protocol

a) Period and place of the research.

We conducted our study during the period May 2017 - October 2017 in the Rehabilitation Department of the "Filantropia" Hospital Craiova.

b) Subjects and groups.

The study was a randomized controlled trial including two groups of patients (E - study group and C - control group), homogeneous in terms of biographical, clinical and functional features (Table I).

All patients underwent a full clinical, imaging and functional assessment.

Clinical evaluation of the studied patients was carefully made and permitted to evidence the defined signs and symptoms of VP - gait difficulties, postural instability and falls, symmetrical predominant lower-body rigidity and bradykinesia. None of them had seriously disabling lower limb osteoarthritis. All patients were diagnosed with arterial hypertension, well controlled by drugs during our study. A comprehensive geriatric assessment was performed, in order to exclude moderate or severe dementia, to diagnose cognitive impairment (impairment of attention, verbal fluency, apathy) and to accurately identify possible risks and benefits of dopaminergic treatment. Diagnosis was made on clinical grounds based on patient history and physical examination, and was supported by neuroimaging

assessment (cerebral MRI showed the minimal infarcts of subcortical gray matter nuclei and diffuse white matter ischemic lesions – all patients reported that they had been previously diagnosed with transient ischemic stroke).

c) Tests applied.

Functional assessment was performed with the following scales and tests:

- The Timed Up and Go test was used to determine how quickly (seconds) some daily activities could be performed at a comfortable speed: rise from a chair; walk as quickly as possible at a comfortable and safe pace to a line on the floor, three meters; turn round; walk back to the chair and sit down. In the starting position the patient is sitting in a chair (seat height approximately 45 centimeters) with his feet resting on the floor. The patient's arms rest on the arms of the chair. If necessary, the patient may use a walking aid. The patient has to be able to walk without the help of others. Two test trials were performed 1 min apart and we used the shortest time in the study. All these aspects are mentioned in the medical literature (Silva-Batista et al., 2017).

- The Berg Balance Scale is a 14-item validated scale that evaluates balance abilities during sitting, standing and positional changes (turning, reaching forward). Items are rated from 0 to 4, with 0 meaning the subject needs assistance, is unable to perform the task; 4 meaning the subject can perform the task safely and independently. Total scores are indicative of overall balance abilities, with a score of 0 to 20 indicating wheelchair bound; a score of 21 to 40 indicating walking with assistance, and 41 to 56 indicating independent. It is easy to administer in approximately 20 minutes (Qutubuddin et al., 2005; Conradsson et al., 2007). Minimal detectable change (MCD) was found to be ± 6 points among patients who suffered a stroke and ± 5 points in patients with parkinsonism, especially with PD (Steffen & Seney, 2008).

- The 2 MWD (two-minute walking distance) test. This test assesses the walking capacity during a 2 minute period; the patient is instructed to walk back and forth along a 20-m corridor and to cover the maximum distance possible in 2 minutes, taking rests as needed. The maximum distance covered is recorded. Examiners provide standardized encouragement every 30 seconds, by telling the patient "you're doing well, keep up the good work." Two trials should be performed at baseline, approximately 20 minutes apart. During the rest interval, participants can sit down. If an assistive device is used, the type of device is recorded (Falvo & Earhart, 2009; Hohler et al., 2012). We chose this short form of test (usually the 6 MWD – six-minute walking distance test is employed) because our patients were old and had gait disturbance, so they had to walk only 2 minutes in order to evaluate and monitor the walking capacity.

- The NEADL (Nottingham Extended Activities of Daily Living) scale was used as a single assessment of independence, to review the progress of a patient over time; it contains 22 items grouped in four sections of daily life (items 1-6 in Section 1 Mobility; items 7-11 in Section 2 Kitchen; items 12-16 in Section 3 Domestic; items 17-22 in Section 4 Leisure); each item is quantified on a 4-point scale (0 - unable, 1 - with help, 2 - possible with difficulty,

3 - able); the maximum possible score is 22, and a higher score means greater independence (Wu et al., 2011). This scale is used in clinical trials to quantify the effects of rehabilitation programs on the quality of life of elderly people with various disorders.

After complete evaluation, all study group patients were trained for 6 weeks. We applied a complex rehabilitation program that covered the following compartments: hygienic-dietary and educational (for risk factors), medication, physical (procedures of electrotherapy - TENS and ultrasound), kinetic, massage, adapted for each patient.

We designed a *kinetic program*, defining the following:

- assistance rehabilitation constituent;
- optimal exercises in the kinetic program applied in relation to the evolution of the condition and global clinical-functional status;
- optimal period of treatment after obtaining the amelioration of neuromotor status, with recovery of motor control, within possible limits;
- optimal number of rehabilitation sessions and also their periodicity for the complete recovery of the patient.

The *objectives of the kinetic program* applied to our patients were:

- body posture correction;
- muscle strengthening;
- decreasing bradykinesia;
- improving functional abilities (especially gait) and decreasing the risk of falling;
- improving quality of life.

Patients were trained 3 days a week, for 6 weeks. Each patient attended two kinetic sessions per day (*a.m.* - strength and physical conditioning training programs and *p.m.* - coordination exercises). Both training sessions were conducted as individual treatment in an outpatient setting with the same duration and frequency as follows: 18 treatment sessions of 30-40 minutes each, 3 days a week, for 6 consecutive weeks.

A.m. exercises. In the first week, all patients performed lower limb and upper limb joint mobilization, 2 sets of 8 repetitions, followed by conventional resistance exercises (for gluteus maximus and medius, half-squat, plantar flexion, and leg-press, trunk extension, in this order). A rest interval of three minutes was allowed between exercises and sets. In the second week, patients performed the same exercises, but 3 sets of 10 repetitions, and in the last week 4 sets of 12 repetitions. We respected a linear progression of training because we tried to maximize training adaptations during our rehabilitation program. We used exercises based on eccentric contraction and progressive resistance training. At the end of the *a.m.* program, each patient performed walking and stepping activities for 10-15 minutes. Heart rate was monitored.

P.m. exercises. The coordination exercises applied *p.m.* were represented by the following sequences:

- exercises for axial mobility (head extension, shoulder flexion, trunk extension, in this order) associated with muscle relaxation and diaphragmatic breathing to increase the range of motion of the neck and trunk. The exercises for active mobilization were represented through the Kabat diagonals (flexion and extension first diagonals, flexion and extension second diagonals for each side and

both sides); each patient performed 10 exercises without resistance in the first two sessions and then with resistance; breathing was synchronized with the Kabat diagonal. In the sitting position the patient performed exercises for the scapulohumeral joint and the elbow joint, for the trunk and upper limbs, and finally, for the trunk and lower limbs.

- stretching tight extensor muscles;
- exercises for balance improvement, using compensatory strategies such as the hip strategy and the step strategy, including corrective walking;
- gait training, using external cues (visual and auditory cues) and specific tasks; appropriate assistive devices for ambulation were suggested for all studied patients.

Exercises for corrective walking with visual step cues were necessary for the promotion of balance movements (the upper limbs along the trunk associated with the twisting motion of the trunk). In the first stage, we applied lower limb joint mobilizations; for example:

- walking in a straight line, with the foot placed in the previously marked traces (established through the normal walking scheme); after 3-4 sessions of walking training, we placed sticks and cardboard boxes with a height of 10-15 cm, in order to train patients to walk with small steps and to break through fear of obstacles;
- command during gait (we alternated low and high tones during gait training to stimulate leg drops and lifts) and sudden change of the walking direction;
- stepping front and back;
- making a sudden stop and beginning the walking scheme;
- zigzag walking on tiptoes.
- specific training in standing position, such as activities involving clothing and hygiene, and coordination of movements in order to shift the center of mass inside the body base.

After the rehabilitation program, all patients could perform the exercises on their own at home. A properly designed daily home exercise program included stretching and aerobic training and postural exercises with permanent self-control.

d) Statistical processing.

We used statistical methods to process our results in accordance with the design of our study - χ^2 Chi square and two nonparametric tests (Mann-Whitney test and Wilcoxon test) because our data did not have a Gaussian distribution.

Results

The two groups (control and study) were compatible in structure. In both cases, the percent differences had no

statistical significance when comparing the distribution by sex and residence ($p^2=0.686$ for sex, respectively $p^2=0.148$ for residence) (Table I).

By comparing the age distributions of the two patient groups with the Mann-Whitney test, no statistically significant differences were obtained ($p_{MW}=0.102$), but there was a tendency for a younger age in the E group.

The analysis of the UP & GO test scores showed that in the study group there were very significant differences between the initial and the final values ($p_W = 0.0009$), while in the control group the differences were not significant, $p_W = 0.059 > 0.05$. A comparison at baseline of the control and study groups indicated that differences were almost non-existent ($p_{MW} = 0.941$). Finally, the differences between the groups became significant, with a Mann-Whitney test result $p_{MW} = 0.011 > 0.001$ (Table II).

By analyzing the BERG scores, significant differences (close to the high significance limit) between the initial values and the final values were found in the study group ($p_W = 0.0010$), while there was a significant difference in the control group, $p_W = 0.020 < 0.05$. By comparing the control and study groups at baseline, no significant difference was obtained ($p_{MW} = 0.679$). Finally, the differences between the groups became significant, with a Mann-Whitney test result $p_{MW} = 0.015 < 0.05$ (Table II).

The analysis of the 2MWD scores evidenced significant differences (close to the high significance limit) between the initial and the final values in the study group ($p_W = 0.0011 > 0.001$), while there was a significant difference in the control group, $p_W = 0.0024 < 0.05$. A comparison at the initial time between the control and study groups showed no significant difference ($p_{MW} = 0.846$). Finally, the differences between the groups became significant, with a Mann-Whitney test result $p_{MW} = 0.003 < 0.05$ (Table II).

By analyzing the NEADL scores, very significant differences between the initial and the final values were found in the study group, $p_W = 0.0009$, while there was a difference at the limit of significance in the control group, the Wilcoxon test result being $p_W = 0.049 < 0.05$. By comparing at baseline the control and study groups, no significant difference was obtained ($p_{MW} = 0.138$). Finally, the differences between the groups became even smaller ($p = 0.355 > 0.05$) (Table II). This could be explained by the fact that if at the beginning the values in the study group were lower than those in the control group, the situation was finally reversed and the values in the study group became slightly higher than those in the control group.

Table I

The biographical data of our patients

Group	Men	Women	Urban	Rural	Age (years)	
C Control group 13 patients	11 (84.62%)	2 (15.38%)	10 (76.92%)	3 (23.08%)	Minimum	70
					Quartile 1	76
					Median	77
					Quartile 3	78
					Maximum	80
E Study group 14 patients	11 (78.57%)	3 (21.43%)	7 (50.00%)	7 (50.00%)	Minimum	70
					Quartile 1	73.25
					Median	75
					Quartile 3	76
					Maximum	79

Discussions

The signs and symptoms of parkinsonism, particularly of VP, have a high prevalence in older persons, like in our studied patients (Lauretani et al., 2010).

Despite the progress made in the understanding of other parkinsonian syndromes and significant developments in neuroimaging techniques, the concept of VP is still unclear and clinical diagnosis is often difficult. There are no widely agreed upon diagnostic criteria. Patients with VP might have the same symptoms as those with idiopathic Parkinson’s disease, although it often affects the lower rather than the upper part of the body (Benamer & Grosset, 2009). Our patients did not present residual deficits from previous strokes because they only had a history of transient ischemic stroke. Vascular parkinsonism (VP) is a poorly defined condition which has clinical, and perhaps pathological, overlap with other diagnoses. Although classical VP involves lesions of the basal ganglia, the majority of the cases actually show diffuse subcortical white matter changes on imaging. The exact pathologies of these white matter changes are debated and likely heterogeneous, but are generally thought to represent areas of chronic or recurrent partial ischemia, a number of small strokes that results in damage to several brain vessels. While this disorder rarely exhibits the symptoms of tremors, patients are likely to lose their mental skills and abilities (Pokhobov, 2014; Gupta & Kuruvilla, 2011). These aspects were evidenced in our study patients after imaging assessment.

A clear correlation between clinical presentation and radiological features was not observed in our study, similarly to other studies (Kalra et al., 2010).

In the assessment of our patients, we used valid and reliable instruments. The Timed Up and Go test is a short practical test by which gait and balance are tested (Keus et al., 2004). Our results for BBS, 2MWD and NEADL scales were less obvious than in other studies (Conradsson et al., 2007; Wu et al., 2011), but changes in the study patients were significant, which suggests the efficiency of the rehabilitation program for the patients’ functional gait and balance status.

The rehabilitation program in our study was established and applied after a careful examination of the patients. Also, it is known that parkinsonism is associated with negative outcomes in the elderly and there is still uncertainty about when and how to start the treatment (Lauretani et al., 2010).

The treatment approach for VP can be problematic,

and clinicians should emphasize control of comorbidities and vascular risks, and it also involves a multidisciplinary team with a physical therapist, a speech pathologist and an occupational therapist, in order to achieve the best functional performance and quality of life for each patient (Cardoso et al., 2012).

We applied a complex rehabilitation program to our patients because we took into consideration that VP does not respond well to the typical medications used to treat Parkinson’s disease. First, we focused on the control of stroke risk factors - a sedentary lifestyle, smoking, high blood pressure and high cholesterol. We considered that physical therapy plays an important role in preventing falling, through training to improve gait, balance and development of compensatory strategies, as mentioned in the literature data (Lauretani et al., 2016; Benamer & Grosset, 2009).

The first rehabilitation measure – control of stroke risk factors in VP patients – was followed by the kinetic program. We structured the kinetic program depending on the dysfunctional aspects of our patients – postural instability, gait and balance difficulties, rigidity, mobility and strengthening impairments.

The control of posture in patients with VP is very important. Due to postural instability and balance impairment, patients lean forward, are prone to falls, have drooping shoulders and a bowed head; to compensate for this, they develop a disturbance of gait, stop mid-walk, and take small and rapid steps to keep their balance. Because of gradual loss of movement, patients are unable to perform ordinary motions and normal activities such as various ADLs (Chang et al., 2008; Factor, 2008).

All these impairments play a decisive role in determining the severity of the patients’ status and quality of life (Pokhobov, 2014). So, we considered it very important to perform a complete kinetic program. Perhaps, like in fundamental research for Parkinson’s disease (recent animal studies have suggested that exercise rehabilitation may stimulate the production of brain-derived neurotrophic factors, normalize dopamine production, and protect nigrostriatal neurons that usually deteriorate in PD), it is plausible that effective non-pharmacological treatment strategies might lead to lower therapeutic levels of dopaminergic medications for some patients (Johnson & Almeida, 2007).

People with disabilities are less physically active than those without disabilities. Otherwise, there is

Table II
The studied parameter values

Studied parameter	Study group		P	Control group		p
	Initial (M ± SD)	Final (M ± SD)		Initial (M ± SD)	Final (M ± SD)	
UPGO (seconds)	92.07 ± 3.47	83.85 ± 4.84	0.0009	91.69 ± 2.89	91.15 ± 2.96	0.059
BBS	27.92 ± 5.44	34.35 ± 4.30	0.0001	28.23 ± 5.67	29.00 ± 5.88	0,020
2MWD (meters)	48.35 ± 5.44	60.64 ± 7.46	0.0011	48.84 ± 4.45	52 ± 3.26	0.0024
NEADL scale	25.14 ± 5.62	31.28 ± 4.41	0.0009	27.53 ± 4.31	29.46 ± 3.84	0.049

UPGO = Timed Up and Go test, BBS = Berg Balance Scale, 2MWD = 2-minute walking distance, NEADL scale = Nottingham Extended Activities of Daily Living scale

consensus in the literature that regular exercise practice improves physical and functional performance in different populations (Nelson et al., 2007; Dalgas et al., 2009).

The important role of a kinetic program in patients with parkinsonism is mentioned in the medical literature. For example, normalizing the body posture and exercises to improve balance are important components of a rehabilitation program for stimulating the balance of patients with parkinsonism (Toole et al., 2000). It has been demonstrated that in healthy elderly persons, an exercise program focused on walking, mobility of the joints and muscle strength decreases the number of falls, an important aspect for the quality of life of these patients (Gillespie et al., 2003). We obtained the same good results with our patients after combining strength and balance exercises as in other studies, where the authors examined the relationship between muscle strength, power and balance performance in healthy older adults (Orr, 2010; Hess et al., 2006).

Rhythmic recurring cues are frequently used in the assessment and the kinetic program of patients with PD and VP. The assessment of step variability allows to objectively differentiate gait, and the method of tempo-rhythmic correction of gait with sound stimulation allows to significantly improve the patient's gait parameters and quality of life without changing the dose of antiparkinsonian drugs (Pokhobov et al., 2009). It is suggested that cues allow a movement to be directly controlled by the cortex, with little or no involvement of basal ganglia. So-called cues are used to complete or replace this reduced or even absent internal control. Rhythmic recurring cues are given as a continuous rhythmic stimulus, which can serve as a control mechanism for walking.

Various aerobic exercise programs have shown an improvement in gait and quality of life for individuals with parkinsonism. The study conducted by Rodrigues-de-Paula et al. demonstrated a significant improvement in quality of life after a strength training program and aerobic exercises using walking and stepping activities with heart rate monitoring. The advantage of this training program is that it can be applied clinically, since it does not require complex or expensive equipment (Toole et al., 2005). The tempo and difficulty of the kinetic exercises must be adjusted, because fatigue has a negative effect on the performance of activities.

The literature data correlated with clinical trials in the rehabilitation of VP patients is more limited compared to clinical trials for Parkinson's disease. So, the training period recommended for the rehabilitation of patients with parkinsonism is unknown. It could be optimal between 6 and 12 weeks.

Probably, kinetic programs in parkinsonism patients can improve brain performance, and the therapeutic impact on gait and balance could be more significant (Guerini et al., 2004). In our study, we did not apply behavioral therapy because we did not have the support of a psychologist in our rehabilitation team, but we are aware that behavioral therapy may help patients limited by fear of falling.

Conclusions

1. Clinical management is essential before the rehabilitation program.
2. The kinetic program includes active exercises that involve both the somatosensory and musculoskeletal systems, so that patients will be able to respond optimally and improve their postural control, gait and balance.
3. The rehabilitation program is mainly aimed at maximizing functional ability and quality of life in patients with vascular parkinsonism.
4. Our study is a beginning for the development of an evidence-based practice in the rehabilitation of older patients with parkinsonism.
5. Further research on larger samples is needed to validate our results.

Conf icts of interest

No conf icts of interests

References

- Benamer HTS, Grosset DG. Vascular Parkinsonism: A Clinical Review. *Eur Neurol.* 2009;61(1):11-15 DOI: 10.1159/000165343.
- Cardoso T, Barbosa MT, Caramelli P, Cardoso F. Vascular Parkinsonism and cognitive impairment. Literature review, Brazilian studies and case vignettes, *Dement Neuropsychol.* 2012;6(3):137-144.
- Chadwick CW, Aminoff MJ. Clinical differentiation of parkinsonian syndromes: prognostic and therapeutic relevance. *Am J Med.* 2004;117(6):412-419.
- Chang WH, Kim MS, Cho JW, Youn J, Kim YK, Kim SW, Lee A, Kim YH. Effect of cumulative repetitive transcranial magnetic stimulation on freezing of gait in patients with atypical parkinsonism: a pilot study. *J Rehabil Med.* 2016;48(9):824-828. doi: 10.2340/16501977-2140.
- Cheng Y-Y, Hsieh W-L, Kao C-L, Chan R-C. Principles of rehabilitation for common chronic neurologic diseases in the elderly. *J Clin Gerontol Geriatr.* 2012;3(1):5-13. <https://doi.org/10.1016/j.jcgg.2011.11.003>.
- Conradsson M, Lundin-Olsson L, Littbrand H, Malmqvist L, Gustafson Y, Rosendahl E. Berg Balance Scale: Intrarater Test- Retest Reliability Among Older People Dependent in Activities of Daily Living and Living in Residential Care Facilities. *Phys Ther.* 2007;87(9):1155-1163.
- da Silva EG, Viana MA, Barasnevicus Quagliato EMA. Vascular parkinsonism, Analysis of seven cases. *Arq Neuropsiquiatr.* 2006;64 (3A):568-571.
- Dalgas U, Stenager E, Jakobsen J, Petersen T, Hansen HJ, Knudsen C, Overgaard K, Ingemann-Hansen T. Resistance training improves muscle strength and functional capacity in multiple sclerosis. *Neurol.* 2009;3;73(18):1478-1484. doi: 10.1212/WNL.0b013e3181bf98b4.
- Factor SA. The clinical spectrum of freezing of gait in atypical parkinsonism. *Mov Disord.* 2008;23 (2 Suppl): S431-S438.
- Falvo MJ, Earhart GM. Six-minute walk distance in persons with Parkinson disease: a hierarchical regression model. *Arch Phys Med Rehabil.* 2009;90(6):1004-1008.
- Gillespie LD, Gillespie WJ, Robertson MC, Lamb SE, Cumming RG, Rowe BH. Interventions for preventing falls in elderly people. *Cochrane Database Syst Rev.* 2003;(4):CD000340. DOI:10.1002/14651858.CD000340.
- Guerini F, Frisoni GB, Bellwald C, Bellelli G, Trabucchi M. Subcortical vascular lesions predict functional recovery after

- rehabilitation inpatients with L-dopa refractory parkinsonism. *J. Am. Geriatr. Soc.* 2004;52(2):252-256.
- Gupta D, Kuruvilla A. Vascular parkinsonism: what makes it different?. *Postgrad Med J.* 2011;87(1034):829-836. doi: 10.1136/postgradmedj-2011-130051.
- Hess JA, Woollacott M, Shivitz N. Ankle force and rate of force production increase following high intensity strength training in frail older adults. *Aging Clin Experim Res.* 2006;18(2):107-115.
- Hohler AD, Tsao JM, Katz DI, T. DiPiero J, Hehl CL, Leonard A, Allen V, Gardner M, Phenix H, Saint-Hilaire M, Ellis T. Effectiveness of an Inpatient Movement Disorders Program for Patients with Atypical Parkinsonism. *Parkinson's Disease.* Volume 2012;Article ID 871974, 6 pages, doi:10.1155/2012/871974.
- Johnson AM, Almeida QJ. The Impact of Exercise Rehabilitation and Physical Activity on the Management of Parkinson's Disease. *Geriatrics and Aging.* 2007;10(5):318-321.
- Kalra S, Grosset DG, Benamer HT. Differentiating vascular parkinsonism from idiopathic Parkinson's disease: a systematic review. *Mov Disord.* 2010;25(2):149-156. doi: 10.1002/mds.22937.
- Keus SHJ, Hendriks HJM, Bloem BR, Bredero-Cohen AB, de Goede CJT, van Haaren M, Jaspers M, Kamsma YPT, Westra J, de Wolff BY, M. Munneke M. KNGF Guidelines for physical therapy in patients with Parkinson's disease. *Dutch J Physiother.* 2004;114(3,Suppl):1-92.
- Lauretani F, Ceda GP, Pelliccioni P. Approaching neurological diseases to reduce mobility limitations in older persons. *Curr Pharm Des.* 2010;20:149-164.
- Lauretani F, Ticinesi A, Meschi T, Maggio M. The key points for treatment of Parkinsonism in older persons. *Geriatric Care.* 2016;2(6156):54-55.
- Nelson ME, Rejeski WJ, Blair SN, Duncan PW, Judge JO, King AC, Macera CA, Castaneda-Sceppa C. Physical activity and public health in older adults: recommendation from the American College of Sports Medicine and the American Heart Association. *Med Sci Sports Exerc.* 2007;39(8):1435-1445. DOI:10.1249/mss.0b013e3180616aa2.
- Orr R. Contribution of muscle weakness to postural instability in the elderly. A systematic review. *Eur J Phys Rehabil Med.* 2010;46(2):183-220.
- Pokhabov DV. Rehabilitation of Patients with Gait Impairment in Parkinsonism. *Neurosci Behav Physiol.* 2014;44(1):64-68. doi:10.1007/s11055-013-9874-1.
- Pokhabov DV, Abramov VG, Nesterova IuV. Rehabilitation of gait disorders in patients with Parkinson's disease and vascular parkinsonism. *Zh Nevrol Psikhiatr Im S Korsakova.* 2009;109(2):20-25.
- Qutubuddin AA, Pegg PO, Cifu DX, Brown R., McNamee S., Carne W, Validating the Berg Balance Scale for patients with Parkinson's disease: a key to rehabilitation evaluation, *Arch Phys Med Rehabil.* 2005;86 (4):789-792. DOI: <http://dx.doi.org/10.1016/j.apmr.2004.11.005>.
- Silva-Batista C, Corcos DM, Barroso R, David FJ, Kanegusuku H, Forjaz C, De Mello MT, Roschel H, Tricoli V. Instability Resistance Training Improves Neuromuscular Outcome in Parkinson's Disease. *Med Sci Sports Exerc.* 2017;49(4): 652-660.
- Steffen T, Seney M. Test-retest reliability and minimal detectable change on balance and ambulation tests, the 36- item short-form health survey, and the unified Parkinson disease rating scale in people with parkinsonism. *Phys Ther.* 2008;88 (6):733-746.
- Thanvi B, Lo N, Robinson T. Vascular parkinsonism: an important cause of parkinsonism in older people. *Age Ageing.* 2005;34(2):114-119. DOI:10.1093/ageing/af 025
- Toole T, Hirsch MA, Forkink A, Lehman DA, Maitland CG. The effects of a balance and strength training program on equilibrium in Parkinsonism: A preliminary study. *NeuroRehabil.* 2000;14(3):165-174.
- Toole T, Maitland CG, Warren E, Hubmann MF, Panton L. The effects of loading and unloading treadmill walking on balance, gait, fall risk and daily function in Parkinsonism. *NeuroRehabil.* 2005;20(4):307-322.
- Wu C-Y, Chuang L-L, Lin K-C, Lee S-D, Hong W-H. Responsiveness, minimal detectable change, and minimal clinically important difference of the Nottingham Extended Activities of Daily Living scale in patients with improved performance after stroke rehabilitation. *Arch Phys Med Rehabil.* 2011;92(8):1281-1287. doi: 10.1016/j.apmr.2011.03.008.
- Zijlmans JCM, Daniel Se, Hughes AJ, Révész T, Lees AJ. Clinicopathological investigation of vascular parkinsonism, including clinical criteria for diagnosis. *Mov Disord.* 2004; 19(6):630-640. DOI:10.1002/mds.20083.

Websites

- (1) Available online at www.parkinson.org (1-800-4PD-INFO (473-4636)). Accessed in 2017, August 16.
- (2) Available online at www.wemove.org (www.movementdisorders.org). Accessed in 2017, August 16.

Promotion of an active lifestyle among children with hearing deficiencies - presentation of an educational program

Promovarea unui stil de viață activ în rândul elevilor cu deficiențe de auz - prezentarea unui program educațional

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Abstract

Background. Promotion of an active lifestyle has important short-term and long-term effects on the health and well-being of children. The World Health Organization recommends a minimum of 1 hour of physical activity every day for children and adolescents.

Aims. The objective of this paper is the presentation of the activities developed in the school year 2016-2017 in order to stimulate an active lifestyle among school children with hearing deficiencies from Romania.

Methods. The activities are part of a comprehensive program for the promotion of a healthy lifestyle - nutrition, involvement in physical activity, smoking prevention - among children with hearing disabilities, which was implemented in two schools from Cluj-Napoca and Sibiu in the school year 2016-2017.

Results. The educational activities targeted both children and their parents. In order to stimulate the involvement of school children in physical activity, they participated in one lesson which presented several issues related to the importance of physical activity, types of physical activities, and examples of exercises they might perform at school or at home in order to be involved in at least one hour of physical activity every day. The lesson used a special video which was created using sign language for people with hearing deficiencies, books with cartoons for children, posters. Moreover, children were encouraged to participate in different physical activities and sport competitions developed at school and out of school. Parents were informed about the educational messages transmitted to children and the way they could help their children through the receipt of letters and newsletters and informative materials found on the web page of the program.

Conclusions. The paper presented the program and offered recommendations for future activities for active lifestyle promotion among children with hearing deficiencies from Romania.

Keywords: physical activity, children with hearing deficiencies.

Rezumat

Premize. Promovarea unui stil de viață sănătos are importante efecte pe termen scurt și termen lung asupra sănătății și stării de bine a copiilor. Organizația Mondială a Sănătății recomandă cel puțin o oră de activitate fizică în fiecare zi, pentru copiii și adolescenții.

Obiective. Obiectivul acestui articol este prezentarea activităților realizate în anul școlar 2016-2017, pentru stimularea unui stil de viață activ în rândul elevilor cu deficiențe de auz din România.

Metode. Activitățile sunt parte componentă a unui program de promovare a unui stil de viață sănătos - nutriție, activitate fizică, prevenirea fumatului - în rândul copiilor cu deficiențe de auz, care a fost implementat în anul școlar 2016-2017 în 2 școli din Cluj-Napoca și Sibiu.

Rezultate. Activitățile educaționale s-au adresat copiilor, părinților. Pentru stimularea participării copiilor în activități fizice, aceștia au participat la o lecție care a prezentat diferite aspecte privind importanța activității fizice, tipurile de activități fizice și exemple de exerciții fizice pe care le pot face la coală sau acasă, pentru o oră de activitate fizică în fiecare zi. Lecția a utilizat materiale video, create special pentru grupul țintă folosind limbajul mimico-gestual, cărți cu desene pentru copii, postere. De asemenea, copiii au fost încurajați să participe la activități fizice și competiții sportive realizate la coală sau în afara colii. Părinții au fost informați despre mesajele educaționale transmise copiilor și asupra modului în care îi pot ajuta prin scrisori, buletine informative și materiale afișate pe pagina web a proiectului.

Concluzii. Articolul prezintă programul educațional și face recomandări pentru viitoare activități de promovare a unui stil de viață activ, în rândul copiilor cu deficiențe de auz din România.

Cuvinte cheie: activitate fizică, copii cu deficiențe de auz.

Received: 2017, August 11; *Accepted for publication:* 2017, September 10
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<https://doi.org/10.26659/pm3.2017.18.4.192>

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Introduction

Physical activity plays an important role in the prevention of chronic diseases such as cardiovascular diseases, diabetes, different forms of cancer, as well as in the management of body weight, prevention of depression and promotion of well-being (***, 2002; Newton et al., 2008; ***, 2010; Lotrean et al., 2011). The physical activity of children and adolescents has short-term and long-term effects on their development and health. Moreover, the habits developed during this period of time have a high chance to continue into adulthood, being very important at this age for building attitudes, skills and actions that promote an active lifestyle (Currie et al., 2008; ***, 2010; Lotrean et al., 2011).

The World Health Organization recommends a minimum of 1 hour of physical activity every day for children and adolescents (***, 2010). Nevertheless, studies from several countries underline the fact that there are varying proportions of children and adolescents who do not respect this recommendation, while promoting an active lifestyle among groups such as children and adolescents with hearing deficiencies is an important challenge (***, 2002; ***, 2010; ***, 2006; Candeias et al., 2010; Lotrean et al., 2011). The health behavior of school aged children was assessed by means of questionnaires regarding the involvement in physical activity of children aged 11, 13 and 15 from several European countries, including Romania. It appeared that in 2014, the proportions of Romanian children fulfilling the recommendations for participation in physical activity were: among 11-year-old children, 39% for boys and 23% for girls (European mean 30% and 21%, respectively), among 13-year-old children, 28% for boys and 16% for girls (European mean 29% and 15%, respectively), and among 15-year-old children, 21% for boys and 11% for girls (European mean 21% and 11%, respectively) (Inchley, 2016).

Several studies underline the need to develop appropriate health education activities for people with hearing deficiencies (Munoz-Baell et al., 2008; Smith et al., 2012; Sadler et al., 2001).

With respect to promotion of an active lifestyle among Romanian children and adolescents, here are several examples (Lotrean, 2015); (1); (2); (3):

a) School based sport activities, competitions and educational programs

There are mandatory curricular hours of sport education for primary, secondary and high school students, while schools and county school inspectorates organize a number of sport activities and competitions.

Health education is also performed in schools, but it is not mandatory, depending on the school directorate and teachers and the possibility to cooperate with several governmental and non-governmental organizations in order to promote a healthy lifestyle, including promotion of appropriate physical activity and sedentary behavior prevention. One example is the program "I do live healthy, too" ("Si eu traiesc sanatos") (2).

b) Mass-media awareness campaigns

There are short messages on TV regarding the importance of performing a minimum of 30 minutes

of physical activity every day, but no comprehensive mass-media campaigns focusing on building motivation and commitment are in place for promotion of an active lifestyle.

c) Health information, education and counseling for some groups of adults

Health professionals are entitled to perform education and counseling with regard to active lifestyle promotion among different groups of patients, but the extent of putting this into place is not documented in Romania. Overloading of the medical staff with clinical activities seriously limits their availability for counseling their patients regarding healthy lifestyle promotion.

d) Technical measures

- Development of sport facilities in parks from different cities, but this is generally found in big cities in Romania

- Building and improving the infrastructure of sport facilities in both urban and rural areas, but there are still gaps between different regions and areas of the country, with rural areas lagging behind urban areas

- Walking facilities in the cities, while in some cities a bicycle line system is in the process of being developed, which is still in the beginning phase.

Hypothesis

It is very important to develop, implement and evaluate messages and activities which promote appropriate involvement in physical activity among different groups of children and adolescents, as an important component of health promotion among these. This paper focuses on developing and implementing activities for active lifestyle promotion among children with hearing deficiencies in Romania. The paper aims to answer the challenges posed by the type of materials and activities that could be developed and implemented in order to shape the knowledge, attitudes, motivation and behavior of children with hearing deficiencies in Romania with regard to their involvement in physical activity, a subject that has been understudied until now.

Material and methods

a) *Period and place of the research*

The activities for the promotion of physical activities are part of a comprehensive program for promotion of a healthy lifestyle - nutrition, involvement in physical activity, smoking prevention - among children with hearing disabilities from Romania. It was implemented in the school year 2016-2017 in 2 schools for children with hearing deficiencies from Cluj-Napoca and Sibiu.

b) *Subjects and groups*

The program was implemented among school children with hearing deficiencies, grades I-VIII, in two schools from Cluj-Napoca and Sibiu. These schools accommodate pupils with hearing deficiencies from the North-Western region of Romania, who spend in school all their time during weekdays and go home for weekends (sometimes) and holidays.

c) *Tests applied*

The paper presented a program for active lifestyle promotion among school children with hearing deficiencies

from Romania and offered recommendations for future activities in the field.

Results

Activities for children with hearing deficiencies

The educational activities targeted both children and their parents.

The activities for children included one lesson, which was aimed at stimulating involvement of school children in physical activity.

The themes presented in the lesson comprised issues related to the importance of physical activity, types of physical activities, and examples of exercises they might perform at school or at home in order to be involved in at least one hour of physical activity every day.

Since a big challenge encountered during activities for children with hearing deficiencies is the creation of educational materials they can understand and find attractive, the lesson used a special video which was created using sign language for people with hearing deficiencies, books with cartoons for children, posters (Fig. 1).

The lesson had the following structure:

- Video presentation using sign language for people with hearing deficiencies
- Activities performed by children alone or in groups
- Video presentation
- Activities performed by children alone or in groups, including performance of several physical activities indicated in the video.

The video included explanations about the importance and the way of performing several types of physical activity. All the explanations were presented by a medical doctor and translated into sign language for people with hearing deficiencies by an adolescent, and were illustrated with pictures. Moreover, the video incorporated several demonstrations of different types of physical exercise that could be performed at school or at home, as well as indications for performing several activities promoting an active lifestyle among pupils. The main message was the necessity of performing one hour of physical activity every day, and the video also offered examples and recommendations aimed at helping pupils to monitor their physical activity (including the use of pedometers) and to build confidence and skills needed for this.

Books for children were also used, synthesizing the main messages transmitted by the video and presenting activities children should perform during the lesson (e.g. activities for analyzing the physical activities performed in the last days, performing physical exercise based on the models presented in the video), as well as suggestions for future activities in order to have an active lifestyle.

Moreover, children were encouraged to participate in different physical activities and sport competitions organized at school and out of school. One example is the participation of pupils from the School for children with hearing deficiencies in Cluj-Napoca in a sport competition organized in May 2017, which involved children both with and without hearing impairment from Cluj-Napoca, as a way to increase their commitment to and appreciation of an active lifestyle.

Activities for parents of children with hearing deficiencies

Parents were informed about the educational messages transmitted to children and the way they could help their children through the receipt of letters and newsletters and informative materials found on the web page of the program. They were informed about the main message of the program regarding the necessity for children to perform at least one hour of physical activity every day and the ways to stimulate this.

At least one hour of physical activity every day!



Fig. 1 – Poster for promoting physical activity

Discussions

National plans for health promotion and chronic disease prevention should comprise actions and strategies for promotion of a healthy lifestyle, including appropriate physical activity among different population groups (***, 2010; ***, 2009). There are several ways to promote an active lifestyle. These should start with a correct evaluation of the knowledge, attitudes and behaviors of different population groups with regard to involvement in physical activity, and continue with educational measures (e.g. educational programs and sport competitions at school, mass-media campaigns), as well as legislative and technical measures (e.g. appropriate infrastructure and equipment for performing sport), allowing and encouraging involvement in physical activity (***, 2010; Lotrean & Mejia-Torres, 2011; ***, 2011; ***, 2009).

The strength of active lifestyle promotion in Romania relies on the presence of several measures and activities performed at different levels in order to promote physical activity, the existence of different bodies responsible for physical activity and health promotion, the cooperation between different governmental and non-governmental organizations. Weaknesses and threats are represented by the fact that many times, educational programs and activities are performed only in some settings and for limited periods of time, while different logistic and funding constraints are noticed in several situations and technical measures are implemented unequally in rural and urban areas.

This paper focuses on educational activities developed for children with hearing deficiencies in Romania for the promotion of physical activity. They are part of a compre-

hensive program for healthy lifestyle promotion among this target group.

The results presented by the paper have two main strengths. First, they present a program aiming to impact upon the awareness, knowledge and skills of both children with hearing deficiencies and their parents with regard to an active lifestyle. These types of activities might have important short-term and long-term consequences on their health, social development and well-being.

Second, the program allowed the development of easy-to-use educational materials using images and sign language for children with hearing deficiencies. The program, its structure and materials represent important resources that might be used in activities for healthy lifestyle promotion among children with hearing deficiencies from different regions of Romania.

Hence, there are two main recommendations for future activities in this field. First, the continuation and dissemination of the program among children with hearing deficiencies from different regions of Romania would be very important and, due to the structure and educational materials that were created, this is also feasible. Second, future in-school and out-of-school activities should be developed in order to maintain and enhance the potential of the program to cultivate a culture and skills promoting an active lifestyle.

Conclusions

1. The paper presents the development and implementation of activities targeting active lifestyle promotion among children with hearing deficiencies from two cities of Romania, in order to build confidence and skills in children with regard to performance of physical activity for at least one hour daily.

2. Educational materials were developed, which included video materials using sign language for people with hearing deficiencies, books with clear messages and drawings for children, which are resources that might also be useful in the future.

3. It is necessary to further intensify the efforts for active lifestyle promotion among children with hearing deficiencies from Romania, building on the existing infrastructure, networking and educational materials.

Acknowledgement

This work was supported by a grant of the Romanian National Authority for Scientific Research and Innovation, CNCS - UEFISCDI, project number PN-II-RU-TE-2014-4-2631.

References

Candeias V, Armstrong TP, Xuereb GC. Diet and physical activity in schools: perspectives from the implementation of the

WHO global strategy on diet, physical activity and health. *Can J Public Health*. 2010;101(Suppl 2):S28-S30.

Currie C, Gabhainn SN, Godeau E, Roberts C, Smith R, Currie D, Pickett W, Richter M, Morgan A, Barnekow V. Inequalities in young people's health: HBSC international report from the 2005/06 Survey. Copenhagen, WHO Regional Office for Europe; Health policy for children and adolescents, 2008(5).

Inchley J, Currie D, Young T, Samdal O, Torsheim T, Augustson L, Mathison F, Aleman-Diaz A, Molcho M, Weber M and Barnekow V. Growing up unequal – gender and socioeconomic differences in health and well being of young people. Copenhagen, WHO Regional Office for Europe; Health Policy for Children and Adolescents, 2016(7).

Lotrean LM. Promovarea sănătății în rândul copiilor, adolescenților și tinerilor. Risoprint, Cluj-Napoca, 2015.

Lotrean L, Laza V, Ionut C, De Vries H. An assessment of physical activity among school students from Transylvania. *Palestrica of the Third Millennium*, 2008;9(1):34-39.

Lotrean LM, Mejia-Torres G. Assessment of physical activity and food intake in order to promote a healthy lifestyle. *Palestrica of the Third Millennium*, 2011;12(4):380-387.

Munoz-Baell IM, Alvarez-Dardet C, Ruiz MT, Ortiz R, Esteban ML, Ferreira E. Preventing disability through understanding international megatrends in Deaf bilingual education. *J Epid Com Health*. 2008;62:131-137.

Newton RU, Galvão DA. Exercise in prevention and management of cancer. *Curr Treat Options Oncol*. 2008;9(2-3):135-146.

Sadler GR, Huang JT, Padden CA, Elion L, Galey TA, Gunsauls DC, Brauer B. Bringing health care information to the deaf community. *J Cancer Educ*. 2001;16(2):105-108.

Smith CE, Massey-Stokes M, Lieberth A. Health information needs of Deaf adolescent females: A call to action. *Am Ann Deaf*. 2012;157(1):41-47.

***. Centers for Disease Control and Prevention (CDC). Environmental barriers to health care among persons with disabilities - Los Angeles County, California, 2002-2003. *Morbidity and Mortality Weekly Reports*, 2006;55(48):1300-1303.

***. Centers for Disease Control and Prevention. School Health Guidelines to Promote Healthy Eating and Physical Activity. USA: CDC, 2011.

***. World Cancer Research Fund/American Institute for Cancer Research. Policy and action for cancer prevention. Food, nutrition, and physical activity: a global perspective. Washington DC: AICR, 2009.

***. World Health Organization. World Health Assembly global strategy on diet, physical activity and health. Resolution WHA55.23. Geneva: WHO, 2002.

***. World Health Organization. Global Recommendations on Physical Activity for Health. Geneva: WHO, 2010.

Websites

(1) Eurostat. How much do Europeans exercise? Available from: <http://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20170302-1?inheritRedirect=true&redirect=%2Feurosstat%2F> Accessed in May 2017.

(2) Programul de Educație Școlară. Available from: <http://www.sets.ro/ro/home/> Accessed in October 2015.

(3) Ministerul Sănătății. Comunicat de presă. Available from: <http://www.aspilfov.ro/comunicat.doc> Accessed in September 2015.

Children's nutrition specificity related to general sporting activities practiced in kindergartens

Particularitățile alimentare ale copiilor în funcție de activitatea fizică desfășurată în grădinițe

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Abstract

Background. Physical activity is fundamental to ensuring child and adult health. Regular sport activities can reduce the risk of cardiovascular and metabolic disease, increasing the immune function in both adults and children.

Aim. The aim of the study was to analyze the characteristics of physical activity from kindergartens with an extended program and the menu plan adaptation according to the type of sport activity carried out and its duration, intensity and frequency.

Methods. A retrospective observational study was conducted in Târgu Mureș, Romania, between June - July 2016. Within the study we included subjects enrolled in 11 kindergartens with an extended program from the city. We had a sample of 1856 subjects, aged between 2.5 and 6 years. The data considered of interest were related to the sport duration (min), frequency (number of classes per week), type of activity, food plan and nutritional values of the menu.

Results. Thirty minutes of mandatory physical activity were scheduled during a day, consisting of gymnastics. For optional sports activities, the children attended dance, swimming, zumba or gymnastics classes under the guidance of a qualified coach. The duration of an optional activity was between 30-60 min/week. During the days with the dance program there was a significant increase in fat consumption. In the case of other macronutrients, no significant differences were observed.

Conclusions. It is necessary to improve sport activities, both mandatory and optional, and to adapt the food plan within the institutions according to the sustained activity and its characteristics.

Keywords: children, sport, nutrition, kindergarten.

Rezumat

Premize. Activitatea fizică este un element esențial în asigurarea sănătății de sine în sine. Activitățile sportive uzuale, de intensitate medie, pot reduce riscul de patologii cardiovasculare sau metabolice, îmbunătățind funcția imună atât la adult, cât și la copil.

Obiective. Scopul lucrării a fost de a analiza caracteristicile activităților fizice desfășurate în grădinițe cu program prelungit și nivelul de adaptare al planului alimentar la tipul de activitate susținută, durata, intensitatea și frecvența acesteia.

Metode. A fost desfășurat un studiu de tip observational, retrospectiv, în Târgu Mureș, România, în perioada iunie-iulie 2016. În studiu au fost incluși subiecți înscriși în 11 grădinițe cu program prelungit din oraș. Lotul de studiu a fost alcătuit din 1856 de subiecți, cu vârsta cuprinsă între 2,5 și 6 ani. Datele considerate de interes au fost relaționate cu durata activității fizice (minute), frecvența (numărul de ore dintr-o săptămână), tipul de activitate, planul alimentar și valorile nutriționale ale meniului.

Rezultate. Treizeci de minute de activitate fizică obligatorie erau programate în decursul unei zile. Pentru sportul opțional, copiii au urmat cursuri de dans, înot, Zumba sau gimnastică, sub supravegherea unui antrenor calificat. Durata unei activități opționale era de 30-60 min/săptămână. În timpul zilelor cu antrenament de dans, a fost observată o creștere semnificativă a consumului de grăsimi. În cazul altor macronutrienți nu au fost observate diferențe semnificative.

Concluzii. Este nevoie de o îmbunătățire a activităților sportive a copilului, atât activitate obligatorie, cât și opțională, și de o adaptare a planului alimentar din cadrul instituțiilor în funcție de activitatea susținută și caracteristicile acesteia.

Cuvinte cheie: copiii, sport, nutriție, grădinițe.

Received: 2017, August 20; Accepted for publication: 2017, September 5

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<https://doi.org/10.26659/pm3.2017.18.4.196>

Introduction

Physical activity is fundamental to ensuring child and adult health (Felfe et al., 2016). Regular sport activities can reduce the risk of cardiovascular and metabolic disease, increasing the immune function in both adults and children (Timmons, 2007). Due to these benefits, recreational sport is practiced in schools since early ages (kindergarten), being divided into two categories: mandatory and optional physical activity. In optional sport activities, children can choose from gymnastics, dance, swimming or other classes depending on the range provided by the educational institution (Leoni et al., 2008). However, being optional means involving additional costs for parents. Apart from the educational program, preschool children can practice other types of sporting activities, without being involved in organized sports structures, represented by sports clubs (Merkel, 2013).

At the same time, nutrition is the basis of a healthy lifestyle (Purcel et al., 2013). Thereby, preschool educational institutions are bound to provide 75% of the child's nutritional needs, through energy, macronutrient and micronutrient needs (Hirschman et al., 2013). Although these regulations are mentioned in the legislation, in the case of regular physical activity practice, the child's food plan should be adapted and individualized according to the daily scheduled activity (Lucas et al., 2017).

Hypothesis

The aim of the study was to analyze the characteristics of physical activity from kindergartens with an extended program and the menu plan adaptation according to the type of sport activity carried out and its duration, intensity and frequency. The periodization of physical activity in the educational curriculum can generate important changes in the nutritional needs of the child. The hypothesis is that food intake is not adjusted according to the type of effort and total effort time.

Material and method

Research protocol

A retrospective observational study was conducted after obtaining the institutional approval and parental consent to include the children in the study group. The study inclusion criteria were: kindergartens with an extended program from Târgu Mureș, Romania, along with healthy subjects, suitable for involvement in an organized sports program. The exclusion criteria were related to chronic or acute diseases with an impact on physical activity.

a) Period and place of the research

The study was conducted during June - July 2016 in Târgu Mureș. Within the study we included subjects enrolled in 11 kindergartens with an extended program from the city.

b) Subjects and groups

The study included a sample of 1856 subjects, aged between 2.5 and 6 years. To preserve institutional confidentiality, we assigned a number from K1 to K11 to all kindergartens.

c) Tests applied

The level of optional and mandatory physical activity in each institution was analyzed based on data provided by the administrative department. The data considered of interest regarding physical activity were related to the effort duration (min), frequency (number of classes per week), type of optional and mandatory sport activities provided for the child, along with the number of children enrolled in the two mentioned types of activity. Food data were made available by the administrative department using the exact food product amount/day/child. Dietary data were collected over a period of 10 working days, 2 consecutive weeks, respectively. Based on the collected data, the amount of protein (kcal/g), fat (kcal/g) and carbohydrates (kcal/g) was calculated, as well as the caloric value (kcal) of the menu. In order to calculate the nutritional value of the menu (macronutrients and caloric value), the national food database, approved by the Romanian Ministry of Health was used.

d) Statistical processing

Statistical evaluation was performed using GraphPad Prism 7.0. software. The confidence level was set at 95%, *p* 0.05 being considered statistically significant. The descriptive data of interest were represented by mean, median, minimum and maximum values, standard deviation (SD), coefficient of variation (CV) and standard error (SE). For inferential statistics, Spearman's test, D'Agostino & Pearson omnibus normality test, and one-way ANOVA were applied in data analysis.

Results

Of the total number of subjects, the participation level in the mandatory physical activity was 100% (n=1856), with a reduced level of the optional physical activity at 67.88% (n=1260). The detailed analysis of K1-K11 daily menus showed significant differences compared to World Health Organization's recommendations. Thus, Table I shows the average nutritional values proposed by the educational

Table I

Descriptive statistics regarding energy intake distribution in macronutrients.

Kindergartens	75% of the daily energy needs	Calories (Kcal)			%		
		Carbohydrates	Lipids	Proteins	Carbohydrates	Lipids	Proteins
K1	1692	811.3	613.9	229.4	47.95	36.28	13.56
K2	1662	855.1	496.2	195.5	51.45	29.86	11.76
K3	1390	825.2	427.2	159.7	59.37	30.73	11.49
K4	1545	1015	484.2	199	65.70	31.34	12.88
K5	1445	745.5	493.6	188.2	51.59	34.16	13.02
K6	1452	840.6	418.1	206	57.89	28.79	14.19
K7	1593	850.3	595.8	199.6	53.38	37.40	12.53
K8	1498	661.5	515.4	210.7	44.16	34.41	14.07
K9	1355	858.8	375.6	197.9	63.38	27.72	14.61
K10	1529	754.2	615.7	221.2	49.33	40.27	14.47
K11	1496	784.4	499.1	200.4	52.43	33.36	13.40

institutions. The nutritional value of the menus is expressed in calories (kcal), and those for Carbohydrates, Proteins and Fat are expressed in calories (kcal) and percentage (%) from the total energy intake.

Regarding the total energy value, differences from international recommendations are significant ($p < 0.0001$). A mean difference of 454.0 kcal was recorded between the main recommendations and the actual practice in the kindergartens (95% CI: 383.2 to 524.7). For carbohydrates, a mean difference of 390.4 kcal (95% CI: 330.9 to 449.9) was calculated (Figure 1), the result being statistically significant different compared to recommendations ($p < 0.0001$). The mean difference in protein intake was 148.1 kcal (95% CI: 136.0 to 160.2 CI) and in fat intake 215.6 kcal (95% CI: 162.1 to 269.1), the difference being significant in both cases ($p < 0.0001$).

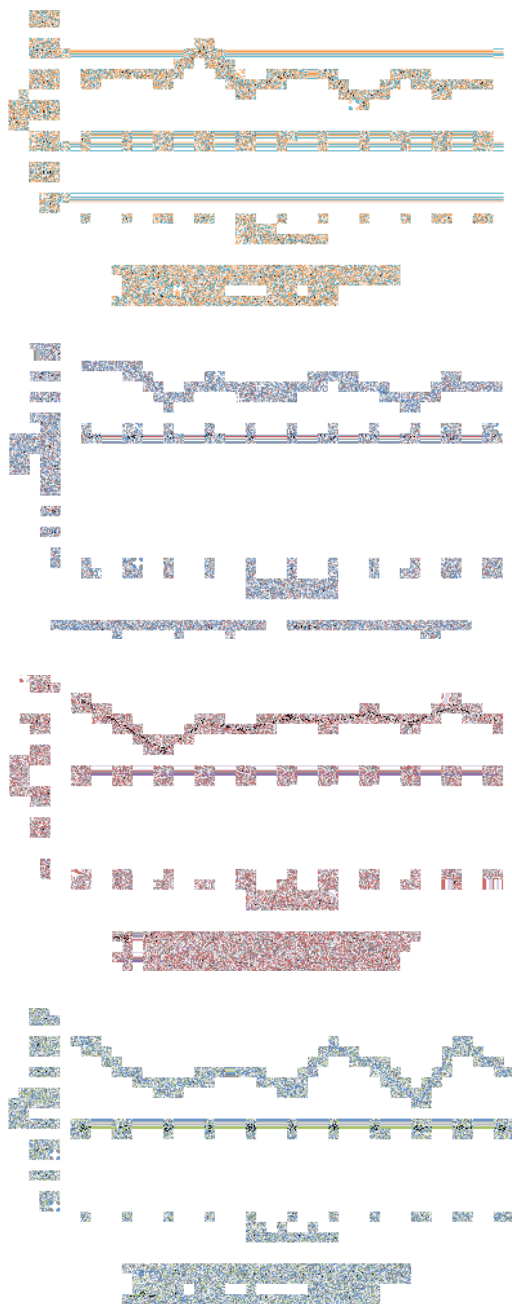


Fig. 1 - The evolution of energy consumption recommended by WHO and the energy density provided in kindergartens (75%) through carbohydrates, proteins, fats

Thirty minutes of mandatory physical activity were scheduled during a day, consisting of gymnastics. For optional sports activities, children attended dance, swimming, Zumba or gymnastics classes under the guidance of a qualified coach. The duration of an optional activity was between 30-60 min/week, being scheduled in all the studied kindergartens according to the following data: 150 min dance/week, 60 min swimming/week, 150 min Zumba/week and 210 min gymnastics/week. Thus, important differences were identified regarding the international recommendations and the activity proposed at national level, as shown in Figure 2.

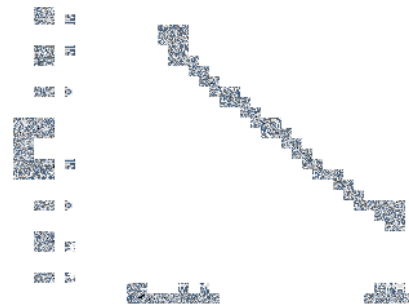


Fig. 2 - Differences between the minimum activity recommendation/day and the proposed physical activity program over a 5-day period in the kindergartens.

Table II shows the number of children enrolled in optional recreational sports activities. Data are expressed as percentage of the total number of subjects.

Table II

Type of activity and number of participants enrolled in optional recreational sports activities

Subjects	Dance	Swimming	Zumba	Gymnastics	No activity
No. of enrolled children	178	87	496	499	596
% of the study group	9.59	4.69	26.72	26.89	32.11

Following the association of nutrition with the physical activity performed along with its duration and frequency, it was observed that the food plan was not adapted to the level of activity, either in terms of energy value or in terms of macronutrient distribution, as shown in Table III.

Table III

Association of the physical activity performed and food ingestion adaptation.

Energy intake	Zumba		Swimming		Gymnastics	
	p	r	p	r	p	r
Calories	0.0757	-0.6587	0.2678	-0.5409	0.7342	0.1437
Carbohydrates	0.444	-0.3172	0.7984	0.1352	0.9327	0.03593
Lipids	0.5604	-0.244	0.0687	-0.7775	0.6915	0.1677
Proteins	0.8182	0.09759	0.6042	0.2704	0.6287	0.2036

A significant statistical association was observed in the case of dance classes. During the days with a dance program, there was a significant increase in fat consumption ($p = 0.0048$, $r = 0.974$). In the case of other macronutrients,

no significant differences were observed (calories: $p = 0.088$, carbohydrates: $p = 0.492$, proteins: $p = 0.321$).

Insignificant statistical data were obtained when the food plan was associated with the total number of minutes spent in organized optional or mandatory sports during a day. Thus, energy consumption was not adapted to recommendations and the physical activity level, as shown in Table IV.

Table IV
Association of total physical activity and food ingestion adaptation during a day

Data		Statistical results			
Parameter 1	Parameter 2	p	r	95% confidence interval	
				Lower	Upper
Effort	Calories	0.4495	-0.2548	-0.7505	0.4244
	Carbohydrates	0.5998	0.1784	-0.4879	0.7133
	Lipids	0.1559	-0.4587	-0.8365	0.2146
	Proteins	0.246	-0.3822	-0.8063	0.3013

Discussions

The level of physical activity carried out in kindergartens is variable according to the existing data. The main studies suggest 160 minutes of physical activity over a week. This amount of effort is distributed on 3 different training days over the week, depending on the child's development. Recent discussions have highlighted that the reported total effort time is not sufficient for kindergarten groups and primary school children groups. Thus, Strong et al. (2005) proposed an increased level of moderate activity (60 minutes) over a day. The main characteristics of the effort must be developed for children so that the program will be enjoyable, involving a variety of activities. Zumba fitness, mentioned in our study as an option for the program, is described as a difficult sport which can cause injuries, according to Inouye et al. (2013), but carried out at a reduced intensity it can meet the daily activity needs (Vendramin et al., 2016).

Keeping a sports activity program is also a priority on non-educational days. Caroli et al. (2011) reported a significant increase in physical activity over the weekend, but with differences between countries and cultures.

From a functional point of view, increasing the level of activity can generate an increase in energy requirements. Thus, meeting energy needs becomes a priority. Based on the fact that these educational structures should meet 75% out of 100% daily energy needs and based on the results obtained, we can suggest a menu adaptation, according to the educational and physical program of the child. The main changes regarding the menu can result in a qualitative improvement in the body's dietary and hydration status, according to specific age requirements. Based on the results obtained, the child's energy needs are exceeded by increasing the total intake of simple carbohydrates and fats (Welker et al., 2016). According to Dubois et al. (2007), increasing carbohydrate intake between meals can expose children to weight and inactive mass gain. Protein consumption seems to be important based on the protein sources consumed by children. Often, increasing protein intake can generate a significant increase in fat

consumption (Weker et al., 2011).

Thus, establishing a direct link between the 60 minute sports activity within a day and increasing energy input by qualitative sources becomes a priority. This priority can be controlled by the two main served meals (Briefel et al., 2009) and the two snacks offered during the day, in kindergartens. At the same time, food consumption in the family for the remaining 25% should establish an appropriate balance and complement the menu (Weker, 2006). Nutritional education can be performed through nutrition lessons and practical culinary experiences in kindergartens, relating to the physical activity program recommended for each age (Lynch, 2015).

Conclusions

1. The meals served in preschool kindergartens in relation to the scheduled sport activity indicate that food intake and the menu structure do not change depending on the physical activity performed by the children.
2. Total energy intake through carbohydrates, fats and proteins exceeds the child's energy needs and the official international recommendation.
3. A proportion of 32.12% of the sample subjects do not perform optional physical activities.
4. The duration and frequency of sports activities do not comply with the official recommendations.
5. It is necessary to improve both mandatory and optional sport activity and to adapt the food plan within institutions to the activity performed and its characteristics.

Conflicts of interest

There are no conflicts of interest concerning the results or methodology of the study.

Acknowledgments

Partial results of this paper were presented at the National Conference of Sports Nutrition held in Târgu Mureș, Romania, in October 2016.

References

- Briefel RR, Wilson A, Gleason PM. Consumption of low-nutrient, energy-dense foods and beverages at school, home, and other locations among school lunch participants and nonparticipants. *J Am Diet Assoc.* 2009;109(2 Suppl):S79-S90. doi: 10.1016/j.jada.2008.10.064.
- Caroli M, Malecka-Tendera E, Epifani S, Rollo R, Sansolios S, Matusik P, Mikkelsen BE. Physical activity and play in kindergarten age children. *Int J Pediatr Obes.* 2011;6(Suppl 2):47-53. doi: 10.3109/17477166.2011.613671.
- Dubois L, Farmer A, Girard M, Peterson K. Regular sugar-sweetened beverage consumption between meals increases risk of overweight among preschool-aged children. *J Am Diet Assoc.* 2007;107(6):924-934.
- Felfe C, Lechner M, Steinmayr A. Sports and Child Development, *PLoS ONE*, 2016;11(5):e0151729. <http://doi.org/10.1371/journal.pone.0151729>.
- Hirschman J, Chiqui JF. School food and nutrition policy, monitoring and evaluation in the USA. *Public Health Nutr.* 2013;16(6):982-988. doi: 10.1017/S1368980012004144.
- Inouye J, Nichols A, Maskarinec G, Tseng C-W. A Survey of Musculoskeletal Injuries Associated with Zumba. *Hawai'i*

- Journal of Medicine & Public Health. 2013;72(12):433-436.
- Leoni E, Beltrami P, Poletti G, Baldi E, Sacchetti R, Garulli A, Masotti A, Bianco L, Ventura FA, Pandolf P, Guberti E. Survey on sports practice and physical activity of primary school children living in the area of Bologna Local Health Unit in relation with some individual and environmental variables. *Ann Ig.* 2008;20(5):441-453.
- Lucas PJ, Patterson E, Sacks G, Billich N, Evans CEL. Preschool and School Meal Policies: An Overview of What We Know about Regulation, Implementation, and Impact on Diet in the UK, Sweden, and Australia. *Nutrients.* 2017;9(7):E736. doi:10.3390/nu9070736.
- Lynch M. Kindergarten food familiarization. An exploratory study of teachers' perspectives on food and nutrition in kindergartens. *Appetite.* 2015;87:46-55. doi: 10.1016/j.appet.2014.12.200.
- Merkel DL. Youth sport: positive and negative impact on young athletes. *Open Access J Sports Med.* 2013;4:151-160. doi:10.2147/OAJSM.S33556.
- Purcel LK, Canadian Paediatric Society, Paediatric Sports and Exercise Medicine Section. Sport nutrition for young athletes. *Paediatrics & Child Health.* 2013;18(4):200-202.
- Strong WB, Malina RM, Blimkie CJ, Daniels SR, Dishman RK, Gutin B, Hergenroeder AC, Must A, Nixon PA, Pivarnik JM, Rowland T, Trost S, Trudeau F. Evidence based physical activity for school-age youth. *J Pediatr.* 2005;146(6):732-737.
- Timmons WB. Exercise and Immune Function in Children. *Am J Lifestyle Med* 2007;1(1):59-66.
- Vendramin B, Bergamin M, Gobbo S, Cugusi L, Duregon F, Bullo V, Zaccaria M, Neunhaeuserer D, Ermolao A. Health Benefits of Zumba Fitness Training: A Systematic Review. *PM R.* 2016;8(12):1181-1200. doi: 10.1016/j.pmrj.2016.06.010.
- Weker H, Barańska M, Dyląg H, Riahi A, Wiśniewski M, Strucińska M, Kurpińska P, Rowicka G, Klemarczyk W. Analysis of nutrition of children aged 13-36 months in Poland: a nationwide study. *Med Wieku Rozwoj.* 2011;15(3):224-231.
- Weker H. Simple obesity in children. A study on the role of nutritional factors. *Med Wieku Rozwoj.* 2006;10(1):3-191.
- Welker E, Lott M, Story M. The School Food Environment and Obesity Prevention: Progress over the Last Decade. *Curr Obes Rep.* 2016;5(2):145-155. doi: 10.1007/s13679-016-0204-0.

Effect of Manuka honey administration on malondialdehyde, in intense exercise

Efectul administrării de miere de Manuka asupra malondialdehidei, în efort fizic intens

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Abstract

Background. Honey is known for its many beneficial effects on health, including its antioxidant benefits.

Aims. The objective of the study was to evaluate the effect of Manuka honey (MKH) on malondialdehyde (MDA) in intense exercise.

Methods. 32 healthy volunteer men were randomly assigned to four groups: control (C), who did not receive therapy; and the therapy groups who received MKH before exercise, for: one week (1E=8), two weeks (2E=8), and three weeks (3E=8). For all groups the protocol was the same: short-term intense exercise on a Monark Ergomedic 839E cycle ergometer. MDA was analyzed: 10 min before (T1) and 30 min (T2) and 4h (T3) after the exercise. Statistical evaluation was done using the Student test.

Results. MDA was significantly increased at T2 compared to T1, the most in C and the least in 3E. MDA was significantly reduced in 3E compared to 2E and 1E, at T2 and T3. The biggest difference was between C and 3E, both at T2 and T3.

Conclusions. 1) MKH administration had the same type of effects on MDA, regardless of the administration period. 2) The effects of MKH administered for 3W, 2W and 1W on MDA differed in their intensity at T2 and T3. 3) The MKH action on MDA was most important at T2. 4) Because 3E administration had the most intense and persistent effect on MDA, we recommend it as a modulator of oxidative stress in short-term intense exercise, in sedentary subjects.

Keywords: Manuka honey, malondialdehyde, intense exercise.

Rezumat

Premize. Mierea este cunoscută pentru numeroasele sale efecte benefice asupra sănătății, inclusiv pentru cele antioxidante.

Obiective. Obiectivul studiului a fost de a evalua efectul mierei Manuka (MKH) asupra malondialdehidei (MDA) în efort fizic intens.

Metodă. 32 de voluntari sănătoși au fost repartizați aleatoriu în patru grupuri: control (C), care nu au primit terapie; și grupurile de terapie care au primit MKH înainte de efortul fizic, timp de: o săptămână (1E=8), două săptămâni (2E=8) și trei săptămâni (3E=8). Pentru toate grupurile, protocolul a fost același: efort fizic intens și de scurtă durată, efectuat pe bicicleta Monark Ergomedic 839E. MDA a fost analizat: cu 10 minute înainte de efort (T1); la 30 min (T2) și 4h (T3) după efortul fizic. Evaluarea statistică a fost efectuată utilizând testul Student.

Rezultate. MDA a fost semnificativ crescut la T2 în comparație cu T1, cel mai mult la C și cel mai puțin la 3E. MDA a fost redus semnificativ la 3E comparativ cu 2E și 1E, la T2 și T3. Cea mai mare diferență a fost între C și 3E, atât la T2, cât și la T3.

Concluzii. 1) Administrarea MKH a avut același efect asupra MDA, indiferent de perioada de administrare. 2) Efectele MKH administrate timp de 3S, 2S și 1S asupra MDA au diferit ca intensitate la T2 și T3. 3) Acțiunea MKH asupra MDA a fost cea mai importantă la T2. 4) Deoarece administrarea 3E a avut cel mai intens și persistent efect asupra MDA, o recomandăm ca un modulator al stresului oxidativ în efortul fizic intens și de scurtă durată, la subiecții sedentari.

Cuvinte cheie: miere de manuka, malondialdehidă, efort fizic intens.

Received: 2017, August 30; Accepted for publication: 2017, September 12

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<https://doi.org/10.26659/pm3.2017.18.4.201>

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Introduction

Among various supplements, honey and honey-derived products have been more recently used, being demonstrated to have immunomodulatory, anti-inflammatory, antibacterial, antiviral and antioxidant properties (Tartibian & Maleki, 2012). Honey contains a number of components known to act as antioxidants; these include vitamin C, vitamin E, enzymes such as catalase, peroxidase, and phenolic compounds (Aljadi & Kamaruddin, 2004). Phenolic antioxidants from processed honey are bioavailable, and they increase plasma antioxidant activity, so they may augment defenses against oxidative stress and might be able to protect humans from oxidative stress (Schramm et al., 2003).

Many studies indicate that the antioxidant activity of honey varies widely, depending on the floral source (Bertoncelj et al., 2007). It has been shown that Manuka honey (MKH) has the highest content of polyphenols, (899.09 mg gallic acid/kg), whereas lavender honey has the lowest polyphenol content (111.42 mg gallic acid/kg) (Alzahrani et al., 2012).

Athletes are exposed to oxidative stress during physical activity, physical injury, or emotional stress (Bloomer et al., 2005). An increase in exercise intensity is one of the many ways in which oxidative stress and free radical production have been shown to increase inside cells (Kerksick, Willoughby, 2005). MDA increased immediately after aerobic exercise (treadmill running) in subjects working at high percentages of VO_{2max} (Alessio et al., 1997).

Hypothesis

The influence of polyphenols, including those of honey, on the oxidative process has been a growing concern in recent years. The use of polyphenols in exercise is also a point of interest in research. The comparative influence of different amounts of honey consumed on stress-induced acute short-term exercise has been less explored.

Objective

The objective of the study was to evaluate the effect of MKH on malondialdehyde (MDA) in short-term intense exercise.

Material and methods

Research protocol

a) Period and place of the research

The study was approved by the Ethics Committee of the College of Physicians. An informed consent was obtained from each participant, according to the Declaration of Helsinki. The measurements were carried out in May 2017, in the Family Medical Practice 122 in Cluj-Napoca.

b) Subjects and groups

Participation of all subjects in the study was voluntary. The selected subjects were sedentary. Persons with mental disorders, any type of cortisone therapy and toxic addiction - alcohol, tobacco, drugs, coffee - were excluded from the study. Four groups were explored: the control group (C), which received no therapy, and the experimental groups

(E), which were administered MKH for 1 week (1E), 2 weeks (2E), and 3 weeks (3E). All four groups were subjected to the same type of physical exercise.

The number and the gender of the subjects in all groups were the same (8, male). The mean age for each group was: 28.2 ± 3 (C), 30.3 ± 4 (1E), 24.9 ± 1 (2E), 24.4 ± 3 (3E). Participants were asked not to consume alcohol, coffee, not to smoke and not to use any medication or antioxidant during the study.

c) Tests applied

- Study design

For stress caused by physical exercise, short-term heavy exercise on the cycle ergometer was chosen as a model. Before physical testing, the participants performed a 4-min muscle warm-up on the ergonomic bike adjusted to 40 watts. After an 8-min break, the testing proper followed, which was carried out on a MONARK ERGOMEDIC 839E cycle ergometer. The exercise test was performed at a pedaling rate of 60 rotations/min, starting with a power of 30 watts for three minutes, followed by a gradual increase of power until fatigue was felt by each subject.

The selected apitherapy product was Manuka honey MGO™ 100+ (MKH), marketed by Apiland (1,2). It was administered to 1E, 2E and 3E daily, for one, two and three weeks, respectively, at a dose of 1g/kg body weight. In all E groups, MKH was administered before physical exercise on the cycle ergometer.

- Determination of indicators

It was the same for C and E groups, performed at the end of the MKH administration period, as follows: time 1 = first determination, basal (T1), 10 min before exercise; time 2 = second determination (T2), and time 3 = third determination (T3), 30 min and 4 hours, respectively, after exercise.

- Explorations

The examinations consisted of measuring venous blood malondialdehyde (MDA) levels at the Synevo laboratory in Cluj-Napoca, using the high-pressure liquid chromatography method (HPLC) with fluorescence detection (3).

d) Statistical processing

The results obtained were analyzed using the SPSS 13.0. statistical package.
- For continuous data examination, Student's t test was used.
- The differences were considered significant at a $p < 0.05$.

Results

Note that the *reference values* were those of C and the *reference time* was considered to be T2.

A. Intra-group analysis (Tables I, II, III, IV)

The dynamics of MDA values were similar for all groups (Fig. 1).

MDA values significantly increased from T1 to T2 for: C ($p < 0.00001$), 1E ($p < 0.00001$), 2E ($p < 0.00001$) and 3E ($p < 0.00001$). MDA values decreased from T2 to T3: insignificantly for C and 1E and significantly for 2E ($p = 0.042$) and 3E ($p = 0.031$).

Table I
Comparison of MDA values for C

C	T1	T2	T3
Mean	0.51625	3.88625	3.734
SD	0.46816	1.3656	0.40673
P	T2-T1 = 0.00001 T3-T1 = 0.00001		T2-T3 = Ns

Table II
Comparison of MDA values for 1E

1E	T1	T2	T3
Mean	0.40125	3.44	3.20875
SD	0.1715	0.34496	0.34382
P	T2-T1 = 0.00001 T3-T1 = 0.00001		T2-T3 = Ns

Table III
Comparison of MDA values for 2E

2E	T1	T2	T3
Mean	0.42625	3.025	2.7425
SD	0.16151	0.303926	0.30165
P	T2-T1 = 0.00001 T3-T1 = 0.00001		T2-T3 = 0.042

Table IV
Comparison of MDA values for 3E

3E	T1	T2	T3
Mean	0.43625	2.43125	2.13375
SD	0.18547	0.30012	0.28908
P	T2-T1 = 0.00001 T3-T1 = 0.00001		T2-T3 = 0.031

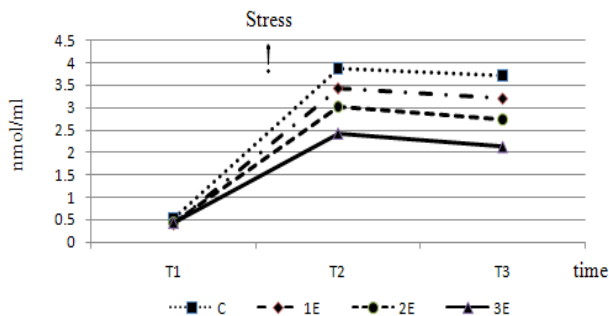


Fig. 1 – Changes in MDA under the influence of MKH, in intense exercise «Stress» = the time of acute short-term exercise.

B. Inter-group analysis (Tables V, VI)

Compared with C, MDA values decreased in all MKH-treated groups at: a) T2 - 1E (p = 0.017), 2E (p = 0.00015) and E3 (p = 0.00001); and b) T3 - 1E (p = 0.0071), 2E (p = 0.00004) and E3 (p = 0.00001).

Table V
Comparison of MDA inter-group values versus C

Moments	MDA	C	1E	2E	3E
T2	Mean	3.88625	3.44	3.025	2.43125
	p		0.017	0.00015	0.00001
T3	Mean	3.734	3.20875	2.7425	2.13375
	p		0.0071	0.00004	0.00001

Table VI
Comparison of MDA inter-group values versus 3E

Moments	MDA	1E	2E	3E
T2	Mean	3.44	3.025	2.43125
	p	0.00001	0.0007	
T3	Mean	3.20875	2.7425	2.13375
	p	0.00001	0.0005	

C. Analysis of the MDA value ratio by moments and between groups (Figs. 2, 3)

The greatest difference between the groups was between C and 3E, both at T2 (1.6) and T3 (1.7).

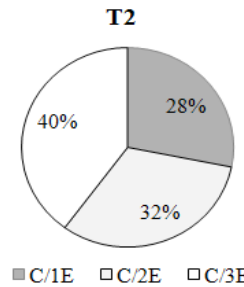


Fig. 2 - Inter-group MDA value ratio at T2.

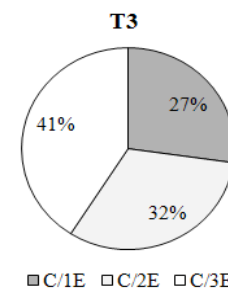


Fig. 3 - Inter-group MDA value ratio at T3.

Discussion

This article is a continuation of previous research of the authors regarding the relationship between sport and stress (Jurcu et al., 2012), sport and polyphenols (Jurcu, 2012), and sport and oxidative stress (Jurcu & Jurcu, 2013).

a) Manuka honey

In the present study, a comparative analysis of the impact of different MKH administration periods on MDA in sedentary persons subjected to short-term intense exercise was carried out.

Chronological Pubmed evidence

MKH (*Leptospermum scoparium*) in New Zealand contains a high amount of phenolic compounds such as flavonoids, methyl syringate and a methoxylated benzoic acid, a structural isomer of syringic acid (Stephens et al., 2010). Methyl syringate in MKH was identified as a potent superoxide scavenger that could be expected to reduce free radical activity (Jubri et al., 2013). MKH was positively correlated with the unique manuka factor (UMF) value, which is expressed as phenol equivalents of its bactericidal activity (Kato et al., 2012). MKH reduces oxidative damage in young and middle-aged rats, and this effect could be mediated through the modulation of its antioxidant enzyme

activities and its high total phenolic content, so it can be used as an alternative supplement from an early age, in order to improve oxidative status (Jubri et al., 2013). MKH proved to be superior in its phenolic content (899.09 mg gallic acid/kg) to acacia honey of Germany and wild carrot honey, and to have significantly higher levels of polyphenols and antioxidant activity than portobello honey (made in Edinburgh, UK) (Patel & Cichello, 2013). Thus, oral administration of MKH, interfering with the oxidative process, reduces the free radical level (MDA) (Almasaudi et al., 2017).

b) The relationship of oxidative stress and MDA with exercise

Short-term intense physical exercise may result in oxidative phenomena, which can be evidenced by changes in MDA, a known marker of oxidative stress. This idea is supported, in this study, by MDA dynamics in C, the post-exercise values of this parameter being highly significantly increased at T2 and significantly increased at T3.

Chronological Pubmed evidence

Exhaustive maximal exercise induces free radical generation, while short periods of submaximal exercise (i.e. less than 70% VO₂max) may inhibit it and lipid peroxidation; the tendency to an increase in MDA with exercise intensity was obvious (Lovlin et al., 1987). Physical exercise in healthy individuals induced transient lipid peroxidation, which could be reversed by some products during recovery (Leaf et al., 1997). For example, following a downhill run for 45 min at 75% VO₂max, young and older men experienced similar increases in serum MDA, and vitamin E administration influenced, even if only modestly, oxidative stress induced by this intense exercise (Sacheck et al., 2003). Thus, athletes are at risk of constant exposure to oxidative stress, which is why the consumption of antioxidant-rich food may be necessary in order to meet their dietary antioxidant requirements (Ahmad et al., 2017).

c) The antioxidant effect of honey and the relationship of honey with exercise

Intra-group analysis showed that T2-T1 differences of MDA values were highly significant for all groups, while T2-T3 differences were significant only for 2E and 3E. This proves that MKH administration for a longer time period resulted in a higher anti-oxidative stress protection.

Inter-group analysis showed that for all the groups receiving MKH, there was a significant reduction in MDA values in the post-exercise period compared to the control group. Of the three variants, the 3-week treatment had the most intense effect.

The analysis of the ratio between groups showed that the greatest difference was between C and 3E groups, both at T2 and T3, which demonstrates, once again, that the longer administration of MKH achieved a more effective protection against oxidative stress induced by short-term intense exercise.

The antioxidant effect of honey - chronological Pubmed evidence

Honey has great potential to be used as a natural source of antioxidants to reduce the negative effects of fruit and vegetable processing (Chen et al., 2000) and its use in some foods, instead of traditional sweeteners, could result

in an enhanced antioxidant defense system in healthy adults (Schramm et al., 2003). Processing, handling and storage affect honey antioxidant activity only to a minor degree, while the botanical origin of honey has the greatest influence on its antioxidant activity (Bertoncelj et al., 2007). Although honey has gained interest as a source of antioxidants, the exact dose of honey that is optimal for protection against oxidative damage is still debatable and more studies are required (Ahmad et al., 2017).

The relationship of honey with exercise - chronological Pubmed evidence

The influence of honey consumption on exercise has been studied in various stress models. Thus, after consumption of 1.5 g/kg body weight of buckwheat honey by healthy human adults, plasma total phenolic and antioxidant content increased (Schramm et al., 2003). Consumption of 70 g/day of unprocessed honey by male cyclists, after 8 weeks of cycling, determined suppression of MDA in seminal plasma and increased antioxidant activity (Tartibian & Maleki, 2012). Honey was also recommended to be consumed by athletes before exercise, as a carbohydrate source for energy (Ahmad et al., 2017).

The results obtained by MDA testing under the action of the MKH used are consistent with data from recent studies related to changes in this parameter, under the action of honey. This study also confirms the antioxidant effect of MKH. The difference from the cited studies is that our study shows that the longer the administration of MKH (three weeks), the more intense and persistent is the modulation of oxidative stress induced by short-term intense exercise in sedentary subjects.

Conclusions

1. MKH administration had the same type of effects on MDA, regardless of the administration period.
2. The effects of MKH on MDA in 3E, 2E and 1E were different in intensity at T2 and T3.
3. The MKH action on MDA was most important at T2.
4. Because 3E administration had the most intense and persistent effect on MDA, we recommend it as a modulator of oxidative stress in short-term intense physical exercise.

Conflicts of interest

Nothing to declare.

Acknowledgement

The study was funded from sponsorships. We address our thanks to Dr. Alexandrina Frig u, for kindly hosting this study in the medical practice that she runs, and Dr. Nicolae Colceriu, for specialized botanical counseling and for contributing to statistical data processing.

References

Ahmad NS, Abdul Aziz A, Kong KE, Hamid MSA, Cheong JPG, Hamzah SH. Dose-Response Effect of Tualang Honey on Postprandial Antioxidant Activity and Oxidative Stress in Female Athletes: A Pilot Study. *J Altern Complement Med.*

2017. doi: 10.1089/acm.2017.0129. [Epub ahead of print].
- Alessio HM, Goldfarb AH, Cao G. Exercise-induced oxidative stress before and after vitamin C supplementation. *Int J Sport Nutr.* 1997;7(1):1-9.
- Aljadi A, Kamaruddin M. Evaluation of the phenolic contents and antioxidant capacities of two Malaysian floral honeys. *Food Chem.* 2004;85(4):513-518. [https://doi.org/10.1016/S0308-8146\(02\)00596-4](https://doi.org/10.1016/S0308-8146(02)00596-4).
- Almasaudi SB, Abbas AT, Al-Hindi RR, El-Shitany NA., Abdel-dayem UA, Ali SS, Saleh RM, Al Jaouni SK, Kamal MA, Harakeh SM. Manuka Honey Exerts Antioxidant and Anti-Inflammatory Activities That Promote Healing of Acetic Acid-Induced Gastric Ulcer in Rats. *Evid Based Complement Alternat Med.* 2017(2017):5413917. DOI: 10.1155/2017/5413917.
- Alzahrani HA, Alsabehi R, Boukraâ L, Abdellah F, Bellik Y, Bakhotmah BA. Antibacterial and antioxidant potency of floral honeys from different botanical and geographical origins. *Molecules.* 2012;17(9):10540-10549. doi: 10.3390/molecules170910540.
- Bertoncelj J, Dobersek U, Jamnik M, Golob T. Evaluation of the phenolic content, antioxidant activity and colour of Slovenian honey. *Food Chem.* 2007;105:822-828. <http://dx.doi.org/10.1016/j.foodchem.2007.01.060>.
- Bloomer RJ, Goldfarb AH, Eideman J, McKenzie MJ, Consitt LA. Effects of acute aerobic and anaerobic exercise on blood markers of oxidative stress. *J Strength Cond Res* 2005;19(2):276-285. doi:10.1519/14823.1.
- Chen L, Mehta A, Berenbaum M, Zangerl AR, Engeseth NJ. Honeys from different floral sources as inhibitors of enzymatic browning in fruit and vegetable homogenates. *J Agric Food Chem.* 2000;48(10):4997-5000.
- Jubri Z, Rahim NB, Aan GJ. Manuka honey protects middle-aged rats from oxidative damage. *Clinics (Sao Paulo).* 2013;68(11):1446-1454. doi: 10.6061/clinics/2013(11)11.
- Jurcu R, Jurcu I, Bodescu C. Anxiety and salivary cortisol modulation, in stress sports, by the help of a phytotherapeutic product that contains *Rhodiola Rosea*. *Palestrica of the Third Millennium-Civilization and Sport.* 2012;13(3):213-218.
- Jurcu R, Jurcu I. Influence of a green tea extract product on oxidative stress and muscle fatigue sensation in sedentary people subjected to physical exercise. *Palestrica of the Third Millennium-Civilization and Sport.* 2013;14(2):90-95.
- Jurcu R. The relationship between sports and polyphenols, retrospective analysis of PubMed publications of the last 52 years. *Palestrica of the Third Millennium-Civilization and Sport.* 2012;13(3):339-347.
- Kato Y, Umeda N, Maeda A, Matsumoto D, Kitamoto N, Kikuzaki H. Identification of a novel glycoside, leptosin, as a chemical marker of manuka honey. *J Agric Food Chem.* 2012;60(13):3418-3423. doi: 10.1021/jf300068w.
- Kerksick C, Eilloughby D. The antioxidant role of glutathione and N-acetyl-cysteine supplements and exercise-induced oxidative stress. *J Int Soc Sports Nutr* 2005;2:38-44. doi: 10.1186/1550-2783-2-2-38.
- Leaf DA, Kleinman MT, Hamilton M, BarstoE TJ. The effect of exercise intensity on lipid peroxidation. *Med Sci Sports Exerc.* 1997;29(8):1036-1039.
- Lovlin R, Cottle E, Pyke I, Kavanagh M, Belcastro AN. Are indices of free radical damage related to exercise intensity. *Eur J Appl Physiol Occup Physiol.* 1987;56(3):313-316.
- Patel S, Cichello S. Manuka honey: An emerging natural food with medicinal use. *Nat. Prod. Bioprospect.* 2013;3(4):121-128. doi:10.1007/s13659-013-0018-7.
- Sacheck JM, Milbury PE, Cannon JG, Roubenoff R, Blumberg JB. Effect of vitamin E and eccentric exercise on selected biomarkers of oxidative stress in young and elderly men. *Free Radic Biol Med.* 2003;34(12):1575-1588.
- Schramm DD, Karim M, Schrader HR, Holt RR, Cardetti M, Keen CL. Honey with high levels of antioxidants can provide protection to healthy human subjects. *J Agric Food Chem* 2003;51(6):1732-1735. doi:10.1021/jf025928k.
- Stephens JM, Schlothauer RC, Morris BD, Yang D, Fearnley L, Greenwood DR, Loomes KM. Phenolic compounds and methylglyoxal in some New Zealand manuka and kanuka honeys. *Food Chem.* 2010;120(1):78-86. <https://doi.org/10.1016/j.foodchem.2009.09.074>.
- Tartibian B, Maleki BH. The effects of honey supplementation on seminal plasma cytokines, oxidative stress bio-markers, and antioxidants during 8 weeks of intensive cycling training. *J Androl* 2012;33(3):449-461. doi: 10.2164/jandrol.110.012815.

Websites

- (1) <https://EEE.apiland.ro/gama-manuka-mgo/miere-manuka-mgo-100.html> Accessed: 2017, August 15
- (2) <https://www.apiland.ro/gama-manuka-mgo/> Accessed: 2017, August 15
- (3) www.synevo.ro/malondialdehida Accessed: 2017, August 15

Digit ratio (2D:4D) comparison between competitive age group swimmers and non-athletes

Compararea raportului degetelor (2D:4D) între grupa de vârstă competitivă de înot tineri și nesportivi

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Abstract

Background. The ratio of the second to the fourth digit length (2D:4D) could have an important role in sport performance.

Aims. The aim of the study was to determine the 2D:4D ratio in age group swimmers and to compare them with non-athletes of both genders.

Methods. 30 female and 35 male age group swimmers and 34 females and 40 male non-athlete volunteers participated in the study. Non-athletic volunteers were selected from the healthy volunteer subjects without sport activities. The lengths of the index and ring fingers of both hands from the proximal bend of the metacarpophalangeal joint up to the fingertips were measured with digital calipers, and the index-ring finger ratio was determined. The height, weight and body mass index of the age group swimmers and non-athlete volunteers were evaluated. Results were processed with SPSS 20.0.

Results. There were significant differences between the age group swimmers and the non-athlete volunteers in terms of the right-hand finger ratio. When the right-hand finger ratio of the female swimmer and non-athlete groups were compared, statistically significant differences were found between the groups.

Conclusion. Right hand 2D:4D ratio was an important indicator of success for swimming performance (especially short-distance sprint performance). This could be used as an additional criterion for talent identification in female swimmers.

Keywords: digit ratio, swimming, age group swimmers, talent identification.

Rezumat

Premize. Raportul dintre lungimea degetului arătător și inelar (2D:4D) ar putea avea un rol important în performanța sportivă.

Obiective. Scopul studiului a fost de a determina raportul 2D:4D în cazul grupei de vârstă competitivă de înot tineri și de a realiza o comparație cu nesportivi de ambele sexe.

Metode. 30 de subiecți de sex feminin și 35 de subiecți de sex masculin au format grupa de vârstă a înotătorilor, iar 34 de subiecți de sex feminin și 40 de subiecți de sex masculin au format grupa de voluntari nesportivi care au participat la studiu. Voluntarii nesportivi au fost selectați dintre subiecții sănătoși fără activități sportive. S-a măsurat lungimea degetelor arătător și inelar de la ambele mâini de la baza articulației metacarpofalangiene până la vârful degetelor cu ajutorul caliperelor digitale și s-a determinat raportul arătător-inelar. S-au măsurat înălțimea, greutatea și indicele de masă corporală la grupa de vârstă a înotătorilor și la voluntarii nesportivi. Rezultatele au fost prelucrate cu ajutorul SPSS 20.0.

Rezultate. S-au evidențiat diferențe semnificative între grupa de vârstă a înotătorilor și voluntarii nesportivi în ceea ce privește raportul degetelor de la mâna dreaptă. Când s-a comparat raportul degetelor de la mâna dreaptă la înotători și nesportivi, s-au constatat diferențe semnificative statistice.

Concluzii. Raportul 2D:4D la mâna dreaptă reprezintă un indicator important al succesului în ceea ce privește performanța la înot (în special performanța la sprintul pe distanță scurtă). Acesta poate fi folosit ca un criteriu suplimentar pentru identificarea talentului înotătorilor.

Cuvinte cheie: raportul degetelor, înot, grupa de vârstă de înot tineri, identificare de talente.

Received: 2017, September 2; *Accepted for publication:* 2017, September 15

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<https://doi.org/10.26659/pm3.2017.18.4.206>

Introduction

The second to fourth digit ratio is the ratio of the lengths of the second and fourth digits (2D:4D). This ratio has been proposed to be related to sports performance. The second to fourth digit ratio of the hand (2D:4D ratio) carries a negative correlation with prenatal testosterone levels (Aksu et al., 2009; Barut et al., 2008; Csathó et al., 2003; Hönekopp et al., 2007; Koehler et al., 2004; Lutchmaya et al., 2004; Manning & Bundred, 2000; Manning et al., 2001; Pokrywka et al., 2005; Paul et al., 2006). This polarity appears as early as the 14th week of intrauterine life and remains stable throughout puberty (Burriss et al., 2007; Fink et al., 2003; Loehlin et al., 2006; Manning et al., 2000; Manning et al., 2004).

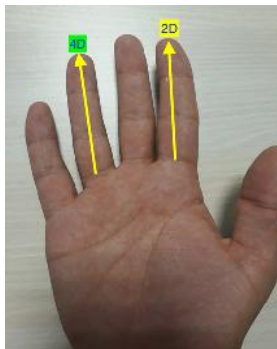


Fig. 1 – Digit ratio (2D/4D).

Moreover, it is claimed that the length of the second digit is related with estrogen, while the length of the fourth digit is related with testosterone (Manning et al., 2002).

Accordingly, the 2D:4D ratio in females is higher than in males (Barut et al., 2008; Fink et al., 2003; Manning et al., 2007; Voracek & Dressler, 2007). Several investigations implied that in humans, males classically have shorter second digits compared with fourth digits; however, these fingers are more equal in length in females (Manning et al., 1998; Zhang et al., 2008). Malas et al. (2006) claimed that the 2D:4D ratio was significantly lower in male than in female human fetuses with ages ranging between 9 and 40 weeks of gestation.

The HOXA and HOXD genes affect the differentiation of fingers, toes and gonads, whose products such as testosterone may be displayed in the morphology of fingers (Manning et al., 2003).

Adult body composition and muscle strength have been reported to determine the effect of intrauterine sex hormones (Gale et al., 2001).

There is a strong relationship between a low second to fourth finger ratio in both hands and high performance in sprint and endurance performance-based sports due to high prenatal exposure to testosterone (Bennett et al., 2010; Manning et al., 2002; Manning, Henzi et al., 2001; Pokrywka et al., 2005; Tester & Campbell, 2007; Manning & Hill, 2009). In female and male athletes, the 2D:4D ratio is negatively correlated with exercise performance levels (running associated with physical fitness, skiing, gymnastics and sports such as football, based on the shuttle, repetitive jump test) (Hönekopp et al., 2006; Manning & Taylor, 2001; Manning, 2002).

Despite studies such as those mentioned above on various sports, there are few literature studies investigating the 2:4 digit ratio in swimmers. The aim of this study was to determine the 2D:4D ratio in competitive age group swimmers (AGS) and to compare them with non-athletes of both genders.

Hypothesis

In the present study it was hypothesized that the 2D:4D finger ratio is a performance marker among swimmers. The relationship between the 2D:4D finger ratio and short-distance swimming performance was determined. Gender as well as left and right hand differences were evaluated.

Material and methods

Research protocol

a) Period and place of the research

The study included 30 female and 35 male swimmers competing in the Turkish National Short Course Swimming Championship organized in December 2013.

b) Subjects and groups

Thirty female and 35 male swimmers (aged between 13-18 years) participated in the study. Thirty-four female and 40 male students matched for age participated in the study as non-athletes. The physical characteristics of the swimmers and non-athletes are presented in Table 1. The swimmers were finalists of the 50 and 100 m races in all swimming techniques during the National Short Course Swimming Championship of Turkey. The non-athlete group had no sports activity or regular exercise. Both the participants and their parents were informed about the study and they signed a written consent. All procedures and written forms were controlled and approved by the Ethics Committee of the Dokuz Eylül University.

c) Tests applied

The digit ratio (2D:4D), body weight, height, and body mass index were evaluated as follows:

1. Digit ratio: The 2D:4D ratio was determined by measuring the index and ring fingers of both hands using a digital compass with a sensitivity of 0.01 mm (Mitutoyo, Japan), starting from the proximal baseline on the palmar side of the metacarpophalangeal joint to the fingertip (on the palmar surface). All measurements were made by the same person. Subjects with osteoarthritis or any structural deformity related to a hand injury, and those with a history of hand trauma were excluded from the study. The digit ratio was calculated by dividing the length of the second digit by that of the fourth digit.

2. Body height, body weight and body mass index: The height and body weight of the participants were measured by the Seca 799 Digital Column Scale (USA). The body mass index was calculated using the formula (kg)/height (m)².

d) Statistical processing

The results were expressed as mean and standard deviation. The data were analyzed using the Student t-test via SPSS for Windows. The difference was considered statistically significant whenever $p < 0.05$.

Results

The physical characteristics of the AGS and non-athletic volunteer groups are shown in Table I. Gender

differences of digit ratios are presented in Table II. There was no significant difference of digit ratios in both hands between females and males in the AGS group. Similarly, no gender difference was observed for digit ratios in non-athletes (Table II).

A comparison between the AGS and non-athletic groups revealed that the 2D:4D ratio in the right hand was significantly lower in the AGS group ($p=0.047$) (Table III). However, no significant difference was found in the digit ratio for the left hand between AGS and the non-athletic group.

The comparison of the right-hand digit ratio between female AGS and the female non-athletic group revealed a statistically significant difference ($p=0.014$), whereas the comparison between male AGS and non-athletes was not statistically significant regarding finger ratios (Table IV).

Table I
Physical and anthropometric characteristics according to gender in competitive age group swimmers and the non-athletic volunteer group.

Groups	AGS group (n=59)		Non-athletic group (n=74)	
	Female (n=24)	Male (n=35)	Female (n=34)	Male (n=40)
Age (years)	14.08±0.78	14.86±1.44	14.60±0.60	14.53±0.65
Height (cm)	161.42±6.00	172.74±8.55	163.78±6.93	174.98±8.27
Weight (kg)	52.29±5.62	61.17±9.84	58.43±12.79	69.68±12.53
BMI (kg/m ²)	20.06±1.88	20.40±2.12	21.73±4.30	22.79±4.03

Table II
Comparison between female and male finger ratios in swimmers and non-athletes.

Groups	AGS group (n=59)			Non-athletic group (n=74)		
	Female (n=24)	Male (n=35)	P	Female (n=34)	Male (n=40)	P
2D:4D left	0.99±0.04	0.99±0.03	N.S.	0.99±0.06	0.98±0.04	N.S.
2D:4D right	0.99±0.03	0.98±0.05	N.S.	0.99±0.05	0.98±0.06	N.S.

N.S: not significant

Table III
Comparison between swimmers and non-athletic volunteers in terms of finger ratios.

Groups	AGS group (n=59)	Non-athletic group (n=74)	P
2D:4D left	1.00±0.03	1.00±0.04	N.S.
2D:4D right	0.97±0.05	0.99±0.04	$p=0.047$

N.S: not significant

Table IV
Comparison between the female and male groups of swimmers and non-athletes in terms of finger ratios

Groups	Female group (n=58)			Male group (n=75)		
	AGS (n=24)	Non-athletic (n=34)	P	AGS (n=35)	Non-athletic (n=40)	P
2D:4D left	0.99±0.03	0.99±0.04	N.S.	0.99±0.03	0.99±0.04	N.S.
2D:4D right	0.96±0.05	0.99±0.03	$p=0.014$	0.97±0.04	0.98±0.05	N.S.

N.S: not significant

Discussions

In the present study, the right-hand finger ratio of

swimmers was significantly lower than that of the control group ($p=0.047$). There are few studies regarding the finger ratios of swimmers. Perciavalle et al. (2014) reported that the 2D:4D ratio of the right hand is associated with the performance of high-level swimmers. Considering other sports, Hsu et al. (2015) stated that elite collegiate tennis athletes have lower 2D:4D values than those of non-athletes, and coaches may use the right-hand 2D:4D ratio as a valid indicator of potential tennis performance when evaluating young tennis players. In their study, all participants had their right-hand second and fourth fingers measured because the right hand may be more sensitive to prenatal testosterone exposure (Hsu et al., 2015; Hönekopp & Watson, 2010). The original finding of this study is that the ratio of the right-hand fingers is significantly different when the groups are compared without considering the gender difference. This result is consistent with the implications of a narrative review about finger ratios and sports performance (Kim & Kim, 2016). Moreover, research suggests that fetal testosterone and fetal estrogen affect the right hand to a greater extent, which also supports this situation (Manning, 2011; Zheng & Cohn, 2011).

According to one of the two literature studies performed on swimmers, Perciavalle et al. (2014) found a relation between right hand 2:4 finger ratios and performance in 21 elite male swimmers. This study reported a significant correlation with performance in the 100-meter race, which is considered a sprint distance. In another important study, Sudakhar et al. (2013) reported that finger ratios in male swimmers were associated with performance, without discriminating sprint from endurance swimmers. The authors argued that low finger ratios in male swimmers may be due to the influence of testosterone in the prenatal period, and 2:4 finger ratios might identify young athletes that could achieve high performance levels. The results of this study are based on research carried out in a single club. Our study was conducted on swimmers finalists in short-distance races at the national championship. The results of the present study show that finger ratios may be an important indicator of sprint performance for female swimmers. Short-distance swimmers have different physiological and anthropometric characteristics (Maglischo, 2003). We also suppose that testosterone may have an impact on some properties in sports that require speed, power and agility, when women are exposed to testosterone during the fetal period.

Some studies in the literature report that finger ratios can also be used to evaluate sports performance in women (Pokrywka et al., 2005; Paul et al., 2006). To support this, there are significant differences in finger ratios between elite female athletes and the control group in the present study. In contrast, not all studies in the literature support these findings. Reports of a recent study evidenced no significant relationship between the 2D:4D digit ratio and the performance level in elite female athletes. In the mentioned study, the lengths of the digits were measured by X-rays only in the left hand, unilaterally (Peeters & Claessens, 2013). In our study and many previous studies, the ratios of the right-hand fingers yielded meaningful results. Measuring 2D:4D finger ratios only in the left hand via X-rays may have led to different results. Probably both hands should be measured in such studies.

Conclusions

1. Right hand 2D:4D ratio was an important indicator of success for swimming performance (especially short-distance sprint performance).

2. This could be used as an additional criterion for talent identification in female swimmers.

Acknowledgements

We offer our endless thanks to the employees of the Turkish Swimming Federation and the Directorate of National Education.

References

- Aksu F, Topaço lu H, Arman C, Ataç A, Tet k S. Neck circumference and 2:4 digit ratio in patients with acute myocardial infarction. *Türkiye Klin Cardiovasc Sci*. 2009;21(2):147-152.
- Barut C, Tan Ü, Dogan A. Association of height and weight with second to fourth digit ratio (2D: 4D) and sex differences. *Percept Mot Skills*. 2008;106(2):627-632.
- Bennett M, Manning JT, Cook CJ, Kilduff LP. Digit ratio (2D: 4D) and performance in elite rugby players. *J Sports Sci*. 2010;28(13):1415-1421.
- Burriss RP, Little AC, Nelson EC. 2D: 4D and sexually dimorphic facial characteristics. *Arch Sex Behav*. 2007;36(3):377-384.
- Csathó Á, Osváth A, Bicsák É, Karádi K, Manning J, Kállai J. Sex role identity related to the ratio of second to fourth digit length in women. *Biol Psychol*. 2003;62(2):147-156.
- Fink B, Neave N, Manning JT. Second to fourth digit ratio, body mass index, waist-to-hip ratio, and waist-to-chest ratio: their relationships in heterosexual men and women. *Ann Hum Biol*. 2003;30(6):728-738.
- Gale CR, Martyn CN, Kellingray S, Eastell R, Cooper C. Intrauterine programming of adult body composition. *J Clin Endocrinol Metab*. 2001;86(1):267-272.
- Hönekopp J, Bartholdt L, Beier L, Liebert A. Second to fourth digit length ratio (2D: 4D) and adult sex hormone levels: new data and a meta-analytic review. *Psychoneuroendocrinology*. 2007;32(4):313-321.
- Hönekopp J, Manning JT, Müller C. Digit ratio (2D: 4D) and physical fitness in males and females: Evidence for effects of prenatal androgens on sexually selected traits. *Horm Behav*. 2006;49(4):545-549.
- Hönekopp J, Watson S. Meta-analysis of digit ratio 2D: 4D shows greater sex difference in the right hand. *Am J Hum Biol*. 2010;22(5):619-630.
- Hsu C-C, Su B, Kan N-W, Lai S-L, Fong T-H, Chi C-P, et al. Elite collegiate tennis athletes have lower 2D: 4D ratios than those of nonathlete controls. *J Strength Cond Res*. 2015;29(3):822-825.
- Kim TB, Kim KH. Why is digit ratio correlated to sports performance? *J Exerc Rehabil*. 2016;12(6):515-519.
- Koehler N, Simmons LW, Rhodes G. How well does second-to-fourth-digit ratio in hands correlate with other indications of masculinity in males? *Proc R Soc Lond B Biol Sci*. 2004;271(Suppl 5):S296-S298.
- Loehlin JC, McFadden D, Medland SE, Martin NG. Population differences in finger-length ratios: Ethnicity or latitude? *Arch Sex Behav*. 2006;35(6):739-742.
- Lutchmaya S, Baron-Cohen S, Raggatt P, Knickmeyer R, Manning JT. 2nd to 4th digit ratios, fetal testosterone and estradiol. *Early Hum Dev*. 2004;77(1):23-28.
- Maglischo EW. Swimming fastest. *Human Kinetics*; 2003, 366-367.
- Malas MA, Dogan S, Evcil EH, Desdicioglu K. Fetal development of the hand, digits and digit ratio (2D: 4D). *Early Hum Dev*. 2006;82(7):469-475.
- Manning JT, Barley L, Walton J, Lewis-Jones DI, Trivers RL, Singh D, Thornhill R, Rohde P, Bereczkei T, Henzi P, Soler M, Szwed A. The 2nd: 4th digit ratio, sexual dimorphism, population differences, and reproductive success: evidence for sexually antagonistic genes? *Evol Hum Behav*. 2000;21(3):163-183.
- Manning JT, Bundred PE. The ratio of 2nd to 4th digit length: a new predictor of disease predisposition? *Med Hypotheses*. 2000;54(5):855-857.
- Manning JT, Callow M, Bundred PE. Finger and toe ratios in humans and mice: implications for the aetiology of diseases influenced by HOX genes. *Med Hypotheses*. 2003;60(3):340-343.
- Manning JT, Henzi P, Bundred PE. The ratio of 2nd to 4th digit length: a proxy for testosterone, and susceptibility to HIV and AIDS? *Med Hypotheses*. 2001;57(6):761-763.
- Manning JT, Hill MR. Digit ratio (2D: 4D) and sprinting speed in boys. *Am J Hum Biol*. 2009;21(2):210-213.
- Manning JT, Martin S, Trivers RL, Soler M. 2nd to 4th digit ratio and offspring sex ratio. *J Theor Biol*. 2002;217(1):93-95.
- Manning JT, Morris L, Caswell N. Endurance running and digit ratio (2D: 4D): implications for fetal testosterone effects on running speed and vascular health. *Am J Hum Biol*. 2007;19(3):416-421.
- Manning JT, Scutt D, Wilson J, Lewis-Jones DI. The ratio of 2nd to 4th digit length: a predictor of sperm numbers and concentrations of testosterone, luteinizing hormone and oestrogen. *Hum Reprod Oxf Engl*. 1998;13(11):3000-3004.
- Manning JT, Stewart A, Bundred PE, Trivers RL. Sex and ethnic differences in 2nd to 4th digit ratio of children. *Early Hum Dev*. 2004;80(2):161-168.
- Manning JT, Taylor RP. Second to fourth digit ratio and male ability in sport: implications for sexual selection in humans. *Evol Hum Behav*. 2001;22(1):61-69.
- Manning JT. Digit ratio: A pointer to fertility, behavior, and health. Rutgers University Press; 2002.
- Manning JT. Resolving the role of prenatal sex steroids in the development of digit ratio. *Proc Natl Acad Sci U S A*. 2011;108(39):16143-16144.
- Paul SN, Kato BS, Hunkin JL, Vivekanandan S, Spector TD. The big finger: the second to fourth digit ratio is a predictor of sporting ability in women. *Br J Sports Med*. 2006;40(12):981-983.
- Peeters MW, Claessens AL. Digit ratio (2D: 4D) and competition level in world-class female gymnasts. *J Sports Sci*. 2013;31(12):1302-1311.
- Perciavalle V, Di Corrado D, Scuto C, Perciavalle V, Coco M. Anthropometrics related to the performance of a sample of male swimmers. *Percept Mot Skills*. 2014;118(3):940-950.
- Pokrywka L, Racho D, Suchecka-Racho K, Bitel L. The second to fourth digit ratio in elite and non-elite female athletes. *Am J Hum Biol*. 2005;17(6):796-800.
- Sudhakar HH, Veena UB, Tejaswi RN. Digit ratio (2D:4D) and performance in Indian swimmers. *Indian J Physiol Pharmacol*. 2013;57(1):72-76.
- Tester N, Campbell A. Sporting achievement: what is the contribution of digit ratio? *J Pers*. 2007;75(4):663-678.
- Voracek M, Dressler SG. Digit ratio (2D: 4D) in twins: heritability estimates and evidence for a masculinized trait expression in women from opposite-sex pairs. *Psychol Rep*. 2007;100(1):115-126.
- Zhang W, Robertson J, Doherty S, Liu JJ, Maciewicz RA, Muir KR, et al. Index to ring finger length ratio and the risk of osteoarthritis. *Arthritis Rheumatol*. 2008;58(1):137-144.
- Zheng Z, Cohn MJ. Developmental basis of sexually dimorphic digit ratios. *Proc Natl Acad Sci U S A*. 2011;108(39):16289-16294.

REVIEWS

Arterial stiffness in athletes

Rigiditatea arterială la sportivii de performanță

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Abstract

Competitive athletes are exposed to intensive and prolonged training which may determine structural and functional adaptations in the arterial system. Arterial stiffness is a characteristic of the aging process and an important predictor of cardiovascular morbidity and mortality. Hemodynamic stress induced by intensive training may influence arterial elastic properties. This article synthesizes the results of studies evaluating arterial stiffness parameters at rest and after acute bouts of exercise in athletes performing various types of intensive training programs.

In predominantly endurance trained subjects, some of the studies indicated reduced arterial stiffness and central pressures, while others showed no differences between the athletes and controls. Acute bouts of exercise increase pulse wave velocity and decrease central pressures. However, in ultra-marathon runners, decreased systemic compliance after the race, compared to basal values, was reported.

The differences between studies may be determined, at least partly, by the type, intensity and duration of physical training. The various methods used to measure arterial parameters in these studies make difficult the comparison between their results.

The mechanisms of vascular distensibility adaptation during intensive training are not yet elucidated, but hemodynamic factors, oxidative stress and systemic inflammation are discussed.

Keywords: arterial stiffness, central arterial pressures, competitive athletes.

Rezumat

Sportivii de performanță sunt expuși unui efort intens și prelungit care poate duce la modificări adaptative structurale și funcționale ale sistemului arterial. Rigiditatea arterială este o caracteristică a procesului de îmbătrânire și un predictor independent al morbidității și mortalității cardiovasculare. Stresul hemodinamic indus de antrenamentul intens poate influența proprietățile elastice ale arterelor.

Acest articol sintetizează rezultatele studiilor care au evaluat parametrii de rigiditate arterială atât în condiții bazale, cât și în urma efortului acut, la subiecți aflați în programe diferite de antrenament.

La sportivii care desfășoară activități în care predomină efortul aerob, unele studii au constatat o reducere a rigidității arteriale și a presiunilor arteriale centrale, în timp ce altele nu au identificat diferențe semnificative între sportivi și lotul de control. Efortul acut a dus la creșterea vitezei unde de puls și la reducerea presiunilor centrale la sportivii de performanță. Cu toate acestea, la ultra-maratonieri, s-a constatat o scădere a complianței arteriale sistemice la sfârșitul cursei, comparativ cu valorile inițiale.

Mecanismele adaptării distensibilității arteriale la sportivii de performanță nu sunt încă elucidate, intrând în discuție rolul factorilor hemodinamici, al stresului oxidativ și al inflamației sistemice.

Cuvinte cheie: rigiditatea arterială, presiuni arteriale centrale, sportivi de performanță.

Received: 2017, July 14; Accepted for publication: 2017, August 20

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<https://doi.org/10.26659/pm3.2017.18.4.210>

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Introduction

It is now accepted that the cardiovascular system undergoes structural and functional changes during athletic adaptation. Athletic heart is characterized by an increase in ventricular mass and chamber dimensions, after prolonged and intense training (Green et al., 2012).

Over the last twenty years, researchers have given increasing importance to the study of arterial structure and function in athletes. It has been shown that both resistance and conduit arteries are enlarged in athletes, possibly due to increased shear stress from chronic hemodynamic overload (Green et al., 2012). A decrease in wall thickness of conduit arteries has also been reported as a remodeling process that accompanies prolonged training (Green et al., 2012; Tijssen et al., 2012). These morphological adaptations may impact upon arterial function (Green et al., 2012).

Arterial stiffness develops with aging as a result of a reduction in arterial distensibility. The increase in aortic pulse wave velocity (PWV), the gold standard measure of arterial stiffness, is an independent predictor of cardiovascular morbidity and all-cause mortality (Laurent & Boutouyrie, 2007).

Great arteries have two major hemodynamic functions: the conduit function, which delivers blood to peripheral organs, and the dampening function, which transforms the intermittent flow produced by left ventricular ejection into a continuous steady flow, which ensures peripheral tissue perfusion. Each ventricular ejection produces a forward pressure pulse wave that travels downward and reflects at the site of arterial bifurcations, producing backward waves that return toward the heart as reflected waves. The pressure wave is the result of the summation of the forward and the reflected wave. In elastic arteries, the reflected wave comes back to the heart during diastole, augmenting diastolic pressure. In stiff arteries, PWV increases and the backward wave arrives faster during ventricular ejection, augmenting central systolic pressure. Aortic stiffness, stroke volume and ejection velocity are the most important determinants of systolic and diastolic aortic pressures. The effects of the reflected wave on pressure wave amplitude are expressed as augmentation pressure or augmentation index (Aix). In peripheral arteries which are closed to the reflected sites, systolic pressure increases, leading to pulse pressure amplification (Avolio et al., 2009). In the presence of tachycardia, the duration of left ventricular ejection is reduced and the reflected wave reaches the ventricle during diastole. In case of bradycardia, the reflected wave comes back towards the ventricle during systole, increasing aortic systolic pressure and pulse pressure (London & Pannier, 2010). Pressure wave morphology and Aix index may also be influenced by the properties of small arteries, such as peripheral resistance and remodeling. It has been suggested that central blood pressures may be more important for patient prognosis than brachial pressures. In fact, central aortic pressure opposes left ventricular ejection and its increase may directly impact left ventricular function (Roman et al., 2007).

A great body of evidence indicates a favorable role of exercise, particularly aerobic exercise, on arterial stiffness.

A recent meta-analysis concluded that aerobic exercise induces a significant improvement in aortic PWV and Aix. The favorable effect was more important in trials with intense and long duration interventions (Ashor et al., 2014).

While the favorable role of habitual exercise on vascular function has been documented, the effect of high intensity training as seen in competitive athletes is less well determined. The aim of this review is to present and analyze the results of studies evaluating the effects of sustained endurance and resistance exercise training on various measures of arterial stiffness.

Effects of various types of physical training on arterial stiffness

A number of studies evaluated arterial stiffness and wave reflection parameters, using various methods, in endurance- and/or resistance-trained subjects, and compared them with measures obtained in recreationally active or sedentary controls.

In one study, which included young healthy endurance-trained subjects and recreationally active controls, the authors determined central pressures (systolic, diastolic and pulse pressure) and pulse pressure amplification using the analysis of the central pulse pressure wave derived from the radial wave. The results indicated that endurance-trained athletes had lower wave reflection and systolic load compared to controls of similar age, with similar anthropometric parameters and peripheral blood pressures. The study also found a decreased tension time-index, which is related to systolic load and heart oxygen consumption, and an increased index of subendocardial viability, which reflects a better subendocardial perfusion, in athletes compared to controls. Athletes had significantly reduced heart rate, but the adjustment of Aix for heart rate did not alter the initial results (Edwards & Lang, 2005).

Another study, which included 212 young endurance athletes, found a reduced aortic PWV in athletes compared to controls. The evolution of aortic stiffness with age showed that PWV in athletes remained inferior to that of controls before the age of 30 years, but after the third decade of life, the progression of arterial stiffness was similar in both groups. The attenuation of vascular stiffness with age, due to aerobic training, seems to disappear after a certain age, probably because of sustained mechanical stress of arterial wall elastic fibers (Maldonado et al., 2006).

An unfavorable vascular hemodynamic profile was found in a study that evaluated endurance athletes aged 24 to 55 years in comparison with sedentary controls matched for age, height, brachial systolic and mean blood pressure. The authors reported significantly reduced heart rate and an increase in carotid systolic pressure and pulse pressure, as well as a reduction in pulse pressure amplification in athletes. The increase in systolic load observed in this study was explained by the reduced heart rate and by a possible increase in stroke volume and ventricular ejection. The authors could not explain the augmentation in central systolic load in the context of the well-known favorable cardiovascular effect of aerobic exercise (Laurent et al., 2011).

Some other studies reported no differences in aortic

PWV between endurance athletes and healthy non-athlete controls (Dulai et al., 2011; Rátgéber et al., 2017).

The effects of intense resistance training on arterial compliance were also evaluated, but the results were contradictory (Miyachi, 2013).

In one study that compared endurance-trained athletes, resistance-trained athletes and sedentary controls, aortic PWV decreased and systemic compliance increased in endurance-trained subjects compared to controls, while in resistance-trained athletes, aortic PWV increased and systemic compliance decreased compared to healthy controls. Vascular changes were accompanied in resistance-trained subjects by an increase in endothelin-1 concentrations. Arterial stiffness was associated with plasma endothelin-1 levels, independently of blood pressure values. Nitric oxide did not change significantly (Otsuki et al., 2007). Endothelin-1 is a potent vasoconstrictor which contributes to basal vascular tone and stimulates proliferation of smooth vascular cells (Miyachi & Masaki, 1999). Increased vascular tone and smooth vascular cell proliferation may increase arterial stiffness. Thus, endothelin-1 may be involved in arterial stiffness alterations during exercise.

Carotid-femoral PWV and carotid-brachial PWV were measured in basketball players (who mainly performed aerobic exercise) and weight lifters (who were resistance-trained). In both groups, the authors reported reduced arterial stiffness compared to controls (Saka et al., 2016). Similar results were found in another study which included resistance-trained participants, endurance runners and healthy controls. Aortic PWV was lower in both endurance and resistance-trained subjects. Long resistance training was accompanied by an increase in pulse pressure amplification and a decrease in central augmentation pressure (Morra et al., 2014).

In ultra-endurance athletes (16.3 ± 3.7 h/week) who may have a greater cardiovascular risk due to prolonged and intense cardiovascular strain, the measurement of central pressures and subendocardial viability index revealed no differences in Aix, brachial and central pressures between athletes and controls. However, athletes had an increased subendocardial perfusion capacity, while the ejection duration was prolonged (Knez et al., 2008). This finding which was also reported by Edwards and Lang in competitive endurance-trained athletes, as mentioned above, suggests a favorable adaptation to increased hemodynamic stress.

In marathon runners, however, an increased baseline aortic stiffness was reported compared to controls (Kröger et al., 2010; Vlachopoulos et al., 2010). A U-shaped relationship between the intensity of aerobic training and arterial stiffness during vascular adaptation was proposed. Arterial stiffness decreased progressively in physically active and endurance-trained subjects, and increased constantly in marathon and ultra-marathon runners (Sardeli & Chacon-Makahil, 2016).

In high-intensity strength- and endurance-trained young elite rowers, examined by high-resolution magnetic resonance imaging, endothelial function and aortic distensibility were normal. Arterial remodeling leads to reduced aortic diameters and increased areas of peripheral

arteries. The authors concluded that the favorable effects of training on vascular function are only temporary (Petersen et al., 2006).

The effects of acute bouts of exercise on vascular stiffness and wave reflection have been evaluated in several studies. Intense acute exercise may be used to test cardiovascular adaptation to the acute increase in hemodynamic strain.

In one study, 16 healthy male endurance-trained subjects (football and water polo players) younger than 25 years underwent a submaximal test, based on cycling during 30 min. Vascular parameters (aortic PWV, central and peripheral blood pressures, Aix adjusted for 75 b/min, pulse pressure amplification, ejection duration, and the subendocardial viability ratio) were measured before and 15 min after the test. The results indicated an increase in pulse pressure amplification and a decrease in the ejection duration. The subendocardial viability ratio was not reduced, suggesting good myocardial vascularization (Staniszewska et al., 2016). While ventricular contraction increases during acute exercise, good endocardial perfusion may represent an adaptation process which ensures an optimal oxygen supply during exercise.

Carotid stiffness was measured in young competitive basketball players and in healthy controls, at rest and after a bout of acute cycling exercise. Basketball players are exposed to both resistance and endurance training. In resting conditions, athletes had decreased stiffness and augmented diameters of the carotid artery. After four bouts of cycling, carotid stiffness in sedentary controls increased, while the vascular parameters of athletes remained unchanged. Moreover, carotid systolic and mean blood pressures increased significantly less in basketball players than in controls. These results suggest an increased elasticity of the carotid artery reflecting an adaptation to intense exercise. In contrast, oscillatory shear stress was increased in athletes under both rest and post-exercise conditions (Liu et al., 2015). The vascular consequences of oscillatory stress are not entirely elucidated. However, some data indicate its possible proatherogenic role (Newcomer et al., 2011).

The effect of acute moderate exercise was evaluated by Dulai et al., who compared endurance-trained with resistance-trained subjects and sedentary controls at rest and after acute exercise. They found no differences in PWV values between the groups at rest, while after exercise, PWV and systolic blood pressures increased in endurance athletes, but not in controls and resistance-trained athletes (Dulai et al., 2011). Very young sportsmen, aged 11-16 years, were compared to sedentary controls at rest and after dynamic and isometric exercise. At rest, the authors found no differences in PWV and Aix between athletes and controls. However, a slight but not statistically significant decrease in Aix was found in sportsmen. After dynamic exercise, a significant increase in aortic PWV was seen in the oldest group (15-16 years). The authors also reported a decrease in Aix in the same age group, which did not reach statistical significance (Rátgéber et al., 2017).

The increase in aortic PWV observed after exercise may be especially explained by the elevation of systolic pressure and heart rate. The decrease in peripheral vascular

resistance may predominantly influence Aix. The values of Aix tend to decrease after aerobic exercise.

The acute effects of ultra-marathon (a mountain trail running ultra-marathon) were also assessed by determining systemic (small and large artery) compliance, before and after the race. The results indicated that aerobic exercise for 20-40 hours induced a post-race reduction in large artery compliance. The increase in large artery stiffness was more important in subjects with more elastic arteries at baseline (Burr et al., 2012).

Increased oxidative stress (Skendery et al., 2008) and systemic inflammation (Kim et al., 2007) reported in ultra-marathon runners may be responsible for the alteration in endothelial function and sympathetic control of vascular tone, both mechanisms being involved in arterial structure and function alteration. It is considered that arterial stiffness may be an important cause of myocardial fibrosis identified in lifelong endurance athletes (Wilson et al., 2011).

Mechanisms involved in arterial stiffness modulation during intensive training

Regular aerobic exercise has been shown to be protective for arteries and to enhance arterial distensibility (Ashor et al., 2014), while the effect of resistance training on arterial structure and function remains controversial (Miyachi, 2013). However, the effects of resistance training on metabolic factors may induce an indirect vascular benefit ().

The mechanism that modulates arterial stiffness in athletes is complex and incompletely elucidated. Changes in hemodynamic parameters of blood flow, blood pressures and pulsatility during exercise may induce local vascular processes that protect against atherosclerosis (Newcomer et al., 2011).

One possible favorable effect may be an increase in the mean shear stress due to the increase in blood flow and augmentation in nitric oxide synthesis associated with the reduction in nitric oxide inactivation. Suppression of local angiotensin-converting enzyme may also contribute to the improvement of endothelial function (Rieder et al., 1997). Plasma endothelin-1, which is decreased in endurance-trained subjects and increased in resistance-trained subjects, may be another contributor to vascular adaptation (Otsuki et al., 2007). Exercise also increases oscillatory shear stress, which may have deleterious vascular effects, inducing a proatherogenic profile. It has been shown that oscillatory shear stress stimulates adhesion molecule expression, decreases nitric oxide synthesis and enhances proliferation of vascular smooth muscle cells. It is considered that different patterns of shear stress appear during exercise, with a possible different impact on endothelial nitric oxide release and vascular adaptation (Newcomer et al., 2011).

The decrease in sympathetic tone which has been documented in athletes may contribute to peripheral vasodilatation and reduce arterial stiffness (Boutouyrie et al., 1994).

Oxidative stress and systemic inflammation are two well-documented mechanisms involved in arterial wall stiffness (Patel et al., 2011; Park & Lakatta, 2012). The anti-inflammatory and anti-oxidative effects of physical

exercise, previously documented (reviewed in Ashor et al., 2014), may also contribute to the favorable vascular profile of athletes. However, in ultra-marathon runners, excessive inflammatory and oxidative reactions may be the cause of the increased arterial stiffness observed in these athletes (Skendery et al., 2008; Kim et al., 2007, Burr et al., 2012).

Conclusions

1. The arterial system engenders a complex adaptation in competitive athletes. In predominantly endurance-trained subjects, some studies indicated reduced arterial stiffness and central pressures, while others showed no differences between athletes and controls.

2. Few data indicated a positive role of resistance training. The discrepancies between studies may be determined, at least partly, by the type, intensity and duration of physical training. Moreover, the various methods used to measure arterial parameters might also have contributed to these differences.

3. The mechanisms involved in vascular stiffness response in competitive athletes are complex and incompletely understood. Hemodynamic stimuli, systemic inflammation and oxidative stress seem to be important contributors to arterial adaptation during competitive training.

References

- Ashor AW, Lara J, Siervo M, Celis-Morales C, Mathers JC. Effects of exercise modalities on arterial stiffness and wave reflection: A systematic review and meta-analysis of randomized controlled trials. *PLoS ONE* 2014;9(10):e110034. doi:10.1371/journal.pone.0110034.
- Avolio AP, Van Bortel LM, Boutouyrie P, Cockcroft JR, McEniery CM, Protogerou AD, Roman MJ, Safar ME, Segers P, Smulyan H. Role of pulse pressure amplification in arterial hypertension. Experts' opinion and review of the data. *Hypertension* 2009;54(2):375-383. doi: 10.1161/HYPERTENSIONAHA.109.134379.
- Boutouyrie P, Lacolley P, Girerd X, Beck L, Safar M, Laurent S. Sympathetic activation decreases medium-sized arterial compliance in humans. *Am J Physiol.* 1994;267(4 Pt 2):H1368-H1376.
- Burr JF, Bredin SSD, Phillips A, Foulds H, Cote A, Charlesworth S, Ivey AC, Drury TC, Fougere R, Warburton DER. Systemic arterial compliance following ultra-marathon race. *Int Sports Med* 2012;33:224-229. DOI <http://dx.doi.org/10.1055/s-0031-1297956>.
- Dulai R, Ahmed Z, Morrissey D, Twycross-Lewis R, Greenwald SE. Arterial stiffness before and after effect of moderate intensity exercise in athletes and controls: a cross-sectional observational study. *Br J Sports Med.* 2011;45:e1.
- Edwards DG, Lang JT. Augmentation index and systolic load are lower in competitive endurance athletes. *Am J Hypertens.* 2005;18(5Pt 1):679-683. Doi:10.1016/j.amjhyper.2004.11.028.
- Green DJ, Spence AN, Thijssen DHJ, Naylor LH. Vascular adaptation in athletes: is there an 'athlete's artery'? *Exp Physiol* 2012 97(3):295-304. DOI: 10.1113/expphysiol.2011.058826.
- Kim HJ, Lee YH, Kim CK. Biomarkers of muscle and cartilage damage and inflammation during a 200 km run. *Eur J Appl Physiol* 2007;99(4):443-447. DOI:10.1007/s00421-006-0362-y.
- Knez WL, Sharman JE, Jenkins DG, Coombes JS. Central

- hemodynamics in ultra-endurance athletes. *J Sci Med Sport* 2008; 11(4) :390-395. DOI:10.1016/j.jsams.2006.11.005.
- Kröger K, Lehmann N, Rappaport I, Perrey M, Sarokin A, Budde T, Heusch G, Jöckel KH, Thompson PD, Erbel R, Möhlenkamp S. Carotid and peripheral atherosclerosis in male marathon runners. *Med Sci Sports Exerc* 2011;43(7):1142-1147. doi: 10.1249/MSS.0b013e3182098a51.
- Laurent P, Marenco P, Castagna O, Smulyan H, Blacher J, Safar ME. Differences in central systolic blood pressure and aortic stiffness between aerobically trained and sedentary individuals. *J Am Soc Hypertens*. 2011;5(2):85-93. doi: 10.1016/j.jash.2011.01.003.
- Laurent S, Boutouyrie P. Arterial stiffness: a new surrogate end point for cardiovascular disease? *J Nephrol* 2007;20 Suppl 12:S45-S50.
- Liu HB, Yuan W-X, Qin K-R, Hou J. Acute effect of cycling intervention on carotid arterial hemodynamics: basketball athletes versus sedentary controls. *BioMedical Engineering OnLine* 2015;14(Suppl 1):S17. <https://doi.org/10.1186/1475-925X-14-S1-S17>.
- London GM, Pannier B. Arterial function: how to interpret the complex physiology? *Nephrol Dial Transplant* 2010;25:3815-23. doi: 10.1093/ndt/gfq614.
- Maldonado J, Pereira T, Polonia J, Martins L. Modulation of arterial stiffness with intensive competitive training. *Rev Port Cardiol* 2006;25(7-8):709-714.
- Miyachi M. Effects of resistance training on arterial stiffness: a meta-analysis. *Br J Sports Med* 2013, 47(6):393-396. doi: 10.1136/bjsports-2012-090488.
- Miyauchi T, Masaki T. Pathophysiology of endothelin in the cardiovascular system. *Annu Rev Physiol* 1999;61: 391-415. DOI:10.1146/annurev.physiol.61.1.391.
- Morra EA, Zaniqueli D, Rodrigues SL, El-Aouar LM, Lunz W, Mill JG, Carletti L. Long-term intense resistance training in men is associated with preserved cardiac structure/function, decreased aortic stiffness, and central augmentation pressure. *J Hypertens* 2014;32(2):286-293. doi: 10.1097/HJH.0000000000000035.
- Newcomer SC, Thijssen DH, Green DJ. Effects of exercise on endothelium and endothelium/smooth muscle cross talk: role of exercise-induced hemodynamics. *J Appl Physiol* 2011;111:311-320. doi:10.1152/jappphysiol.00033.2011.
- Otsuki T, Maeda S, Iemitsu M, Saito Y, Tanimura Y, Ajsaka R, Miyauchi T. Vascular endothelium-derived factors and arterial stiffness in strength- and endurance-trained men. *Am J Physiol Heart Circ Physiol* 2007; 292: H786-H791. DOI:10.1152/ajpheart.00678.2006.
- Park S, Lakatta EG. Role of inflammation in the pathogenesis of arterial stiffness. *Yonsei Med J* 2012;53(2):258-261. DOI: 10.3349/ymj.2012.53.2.258.
- Patel RS, Al Mheid I, Morris AA, Ahmed Y, Kavtaradze N, Ali S, Dabhadkar K, Brigham K, Hooper WC, Alexander RW, Jones DP, Quyyumi AA. Oxidative stress is associated with impaired arterial elasticity. *Atherosclerosis* 2011;218(1):90-95. doi: 10.1016/j.atherosclerosis.2011.04.033.
- Petersen SE, Wiesmann F, Hudsmith LE, Robson MD, Francis JM, Selvanayagam JB, Neubauer S, Channon KM. Functional and structural vascular remodeling in elite rowers assessed by cardiovascular magnetic resonance. *J Am Coll Cardiol*. 2006;48(4):790-797. DOI:10.1016/j.jacc.2006.04.078.
- Rátgéber L, Lenkey Z, Németh A, Hidvégy E, Husznay R, Verzár Z, Miklós I, Bódis J, Cziráki A. The effect of physical exercise on arterial stiffness parameters in young sportsmen. *Acta Cardiol* 2017;70(1):56-65. DOI:10.2143/AC.70.1.3064594.
- Rieder MJ, Carmona R, Krieger JE, Pritchard KA Jr, Greene AS. Suppression of angiotensin-converting enzyme expression and activity by shear stress. *Circ Res*. 1997;80(3):312-319.
- Roman MJ, Devereux RB, Kizer JR, Lee ET, Galloway JM, Ali T, Umans JG, Howard BV. Central pressure more strongly relates to vascular disease and outcome than does brachial pressure: the Strong Heart Study. *Hypertension* 2007;50(1):197-203.
- Saka T, Sekir U, Dogan A, Akkurt S, Karakus M, Celebi MM, Sarli B, Oguzhan A. Arterial stiffness differences between aerobically and resistance trained Turkish elite athletes. *Anthropologist*. 2016;24(2):429-439.
- Sardeli AV, Chacon-Makahil MPT. Is the exercise induced increase in central arterial stiffness a risk factor for health ? *J Arch Mil Med* 2016;4(2):e36833.
- Skendery KP, Tsironi M, Lazaropoulou C, Anastasiou CA, Matalas AI, Kanavaki I, Thalmann M, Goussetis E, Papassotiropoulos I, Chrousos GP. Changes in free radical generation and antioxidant capacity during ultramarathon foot race. *Eur J Clin Invest*. 2008;38:159-165.
- Staniszewska M, Pudło A, Ryterska K, Stachowska E. Influence of physical effort on aortic stiffness in young male athletes. *Eur Rev Med Pharmacol Sci*. 2016; 20(16): 3440-3446.
- Tijssen DHJ, Cable NT, Green DJ. Impact of exercise training on arterial wall thickness in humans. *Clin Sci (Lond)* 2012;122:311-322. doi: 10.1042/CS20110469.
- Vlachopoulos C, Kardara D, Anastakis A, Baou K, Terentes-Printzios T, Tousoulis D, Stefanadis C. Arterial stiffness and wave reflections in marathon runners. *Am J Hypertens* 2010;23(9):974-979. doi: 10.1038/ajh.2010.99.
- Wilson MG, O'Hanlon R, Prasad S, Deighan A, Macmillan P, Oxborough D, Godfrey R, Smith G, Maceira A, Sharma S, George K, Whyte G. Diverse patterns of myocardial fibrosis in lifelong veteran endurance athletes. *Eur J Appl Physiol* 2011;110(6):1622-1626. doi: 10.1152/jappphysiol.01280.2010.

The shoulder - anatomical and biomechanics aspects

Um rul - aspecte de anatomie i biomecanic

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Abstract

The shoulder is one of the most complex joints of the human body, representing the pectoral arch. The capacity to perform this complex movement at the shoulder joint still remains a challenge until the present. The objective of this paper is to show a current understanding in the motion and stability of the shoulder joint given the particular anatomy and biomechanical aspects. The presentation of complex biomechanics aspects is important because the upper limb is only connected to the rest of the skeleton through the clavicle bone together with a strong and intricate system of muscles and ligaments that allow this joint its wide array of motion. This review can help us in the future to better approach the treatment of the diverse pathology and to improve rehabilitation techniques.

Keywords: shoulder, biomechanics, motion, stability.

Rezumat

Um rul este cea mai complexă articulație a corpului uman, participând la realizarea centurii scapulare. Performanța complexității mișcărilor la nivelul articulației umărului este în continuare o provocare. Studiul nostru își propune să prezinte aspecte actuale ale realizării mobilității și stabilității umărului, înțelegând conținutul particularităților anatomice și biomecanice. Prezentarea aspectelor biomecanice complexe este importantă, cu atât mai mult cu cât membrul superior este conectat de scheletul trunchiului doar prin intermediul claviculei ca sistem osos. La aceasta se adaugă un aranjament complex și intricat de ligamente și mușchi, care permite acestei articulații o mobilitate variată. Acest studiu sperăm să ajute în viitor la o mai bună alegere a abordării terapeutice mai bune a patologiei și îmbunătățirea tehnicilor de reabilitare.

Cuvinte cheie: umăr, biomecanic, mișcare, stabilitate.

Introduction

In order to properly understand how all the movements of the shoulder can be achieved and the forces necessary to perform all daily routine, we must first look at biomechanics in normal and pathological situations, which will allow us to get a better insight on how lesions form and to find the best way to repair or prevent them. This will also help us develop more efficient ways for the rehabilitation process so that patients can return to their normal lives in a shorter time period. What makes the shoulder joint special is that load bearing occurs in an opposite manner to the rest of the body, which means that instead of compression being the dominant force, here traction is the main acting force (Lugo et al., 2008).

Anatomy

- *Bones*

The pectoral arch is composed of 2 bones: the clavicle

and the scapula.

The *clavicle* is a long bone, shaped like the letter “S”, and it connects the manubrium to the acromion. It presents an internal curvature with an anterior convexity and an external curvature with an anterior concavity. This shape offers the collarbone a special resistance, which derives from the purpose of carrying all the weight of the upper limb (Lugo et al., 2008).

The *scapula* is a flat bone, with a triangular shape, and is situated on the posterior external side of the thorax, between the clavicle and the humerus (Braddom et al., 2007), providing large surface areas for muscle insertions. On the posterior side of the scapula, the scapular spine divides its dorsal aspect into two areas (supra and infraspinous) and provides the articular surface for the clavicle at the lateral extremity where it forms a great apophysis called the acromion (Lugo et al., 2008). At the superior internal angle, there is a cavity called the glenoid

Received: 2017, September 7; Accepted for publication: 2017, September 25

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<https://doi.org/10.26659/pm3.2017.18.4.215>

cavity. The neck of the scapula is a narrow portion that connects the glenoid cavity to the body of the scapula, and superior to this formation is the coracoid apophysis providing insertions for muscles and ligaments (Braddom et al., 2007; Renfree et al., 2003).

The *humerus* is a long bone forming the arm skeleton that presents 2 extremities and a shaft. The proximal extremity represents one third of a sphere and is 3-4 mm longer on a vertical axis rather than horizontal. The anatomic neck of the proximal humerus surrounds the articular surface and makes an angle of 130-140 degrees with the shaft (Baciu, 1981). There is also an anteversion of the articular surface, like in the femur, but with an angle between 10-30 degrees (Lugo et al., 2008; Braddom et al., 2007). The great tuberosity is outside the anatomic neck, and represents the insertion point for the rotator cuff (Braddom et al., 2007). The small tuberosity is inside the anatomical neck and provides the insertion for the subscapular muscle (Braddom et al., 2007).

- Joints

The shoulder joint actually comprises 5 separate joints that will be looked at separately, but our highest interest concerns the glenohumeral joint.

The sternoclavicular joint is the most proximal of the 5 joints and it represents the only bony bridge that connects the upper limb and the thorax. A small meniscus with a vertical disposition is interposed between the bony surfaces of the proximal clavicle and the sternal angle. The ligaments that ensure the stability of the joint are anterior, posterior, superior and inferior, and are joined by an articular capsule that strengthens them (Braddom et al., 2007). Besides these ligaments, we must focus our attention on the costoclavicular ligament because this is the fixed point of the clavicle and the bone rotates around this point while performing its motions (Renfree et al., 2003).

Distally, the clavicle meets the scapular bone and forms the acromioclavicular joint, which is strengthened by a fibrous capsule and 2 ligaments (superior and inferior) (Renfree et al., 2003).

The scapulothoracic joint is not a "true" joint, but must be treated like one due to its high importance and enters a category that Cloquet termed a *syssarcosis* (Baciu, 1981).

Our interest is focused on the scapulohumeral joint. The bony components are the distal humeral head and the glenoid surface representing the proximal surface. These joint surfaces are complementary. As such, the humeral head is spherically shaped, while the glenoid surface is almost plane with a glenoid labrum extending to the surface of the proximal component (Lugo et al., 2008). The articular capsule has a hardened superior portion, the coracohumeral ligament, and is strengthened anteriorly by the 3 glenohumeral ligaments.

The fifth joint of the shoulder is the subacromial bursa (Beals et al., 1998), which is also a *syssarcosis*, like the subscapular joint (Lugo et al., 2008).

- Muscles

The shoulder joint allows such a wide array of motions and strength due to its strong muscle groups that act on it in a complex and intricate way. Benninghoff cited 3 muscle arches.

Descending: upper region of trapezius, rhomboid,

upper portion of *teres major* muscles – have the role to oppose gravity and help in climbing.

Horizontal: *serratus major*, middle part of *trapezius*, *rhomboid* and *pectoralis major* - allow the shoulder to move on a horizontal plane forward, backward and medially and laterally.

Ascending: *pectoralis minor*, inferior parts of *serratus major*, *trapezius*, *pectoralis major* and the *latissimus dorsi* – pull the scapula down and act against gravity in hanging position (Baciu, 1981). The action of these muscles consists of fixing and stabilizing the shoulder and also, allowing it a wide degree of freedom; they are aided by the *scapulobrachial* muscles in doing so. The latter extend from the pectoral arch to the upper limb.

The *deltoid* muscle, given its insertions, can allow the abduction of the upper limb; if all the muscle contracts, the anterior fibers will result in an anterior projection of the arm, while the posterior fibers will antagonize, projecting the arm posteriorly. The fibers in the middle portion of the muscle are abductors by excellence. Also, if both the anterior and posterior fibers contract at the same time, they will antagonize the action of the middle part fibers, thus being adductors. Moreover, they stabilize the abduction motion, giving horizontal freedom and, over 60 degrees of abduction, these fascicles become abductors, helping the middle fibers (Braddom et al., 2007).

The *coracobrachialis* is a muscle that allows the anterior projection of the arm, adduction, and external rotation of the humerus due to its insertions (Braddom et al., 2007).

The *supraspinatus* muscle is mainly an abductor of the humerus and it is thought to initiate this motion (Baciu, 1981), but it was shown that it can perform abduction even without the help of the *deltoid* (Braddom et al., 2007).

The *infraspinatus* muscle has a role in the external rotation of the humerus (Braddom et al., 2007).

The *teres minor* has a small role in the mobility of the shoulder, but plays a major role in conferring stability to the shoulder, fixing the humeral head in the glenoid cavity, and it is also an adductor (Bechtol et al., 1980).

The *teres major* aids in arm adduction (Bechtol et al., 1980).

The *subscapularis* is the muscle which pulls the scapula towards the humerus while performing the internal rotation of the arm (Bechtol et al., 1980).

All these seven muscles described share a common feature, the triangular shape, with a base facing the clavicle and a tip facing the humerus, thus giving the arm its great range of motion.

The rotator cuff is a tendon blade covering the anterior, superior and posterior side of the shoulder joint capsule. The primary function of the rotator cuff is to keep the head of the humerus depressed and centered into the glenoid fossa, permitting a single center of rotation, while allowing efficient abduction or forward elevation of the arm (Pandey & Willems). This centering in the glenoid by the cuff is achieved by balancing the force couples around the glenohumeral joint. The wide range of motion of the shoulder is allowed by the variety of rotational moments of the cuff muscles. The action of the rotator cuff muscles must be precisely coordinated to obtain the desired movement.

Rotator cuff tendons are subjected to complex tension loads. The rotator cuff provides a stabilizing effect to the shoulder, because of the compression of the humeral head against the glenoid cavity (Lungo et al., 2012). The glenohumeral force couple is a modified force couple because the two forces involved are not opposite to one another. The deltoid produces a superior force, while the subscapularis and infraspinatus/teres minor produce a compressive and inferior force (1). A force couple is a pair of forces that act on an object and cause it to rotate. The *coronal force couple* is a result of the balance of moments created by the deltoid versus inferior rotator cuff, the *transverse force couple* is a balanced moment between the anterior subscapularis and posterior infraspinatus–teres minor muscles (Pandey & Willems). While the current literature suggests improved stability and function after surgical repair of the rotator cuff, higher-quality prospective studies are necessary to make definitive conclusions (Gombera et al., 2014).

Biomechanics

Given the purpose of our paper and the complexity of the shoulder joint, we will emphasize only the biomechanical aspects of the scapulohumeral joint.

The joint in our body with the greatest liberty of motion is the scapulohumeral joint, being the most mobile enarthrosis, which can perform actions in all axes and planes - abduction, adduction, internal and external rotation, ante- and retropulsion and, as a combined effect, circumduction.

Motions

Abduction and adduction: the upper limb weight center during this action is located distally, right over the elbow, and the deltoid muscle balances this resistance while pressing the humeral head in the glenoid cavity (reaching a maximum at 90 degrees of abduction). The amplitude is limited when the great tuberosity is in contact with the upper portion of the labrum and the force the deltoid develops greatly overcomes the weight of the upper limb by over 8 times at 90 degrees abduction (Baciu, 1981). It was believed that the supraspinatus muscle has the role of starting the motion for the first 10 degrees and then the deltoid can take over, but the main role of this muscle is in maintaining the humeral head in a favorable location within the joint surface and, thus, opposing a dislocation neither superior or inferior to the glenoid process. Clinical experience has taught us that patients with tear of the supraspinatus tendon have little to no deficiency concerning the first 10 degrees of abduction (Hansen et al., 2008). Shear stresses that affect the supraspinatus tendon due to narrowing of the coracoacromial arch (extrinsic impingement) have been identified as a plausible cause of rotator cuff injury as they may generate a laminated disrepair of the surfaces of the cuff (Spargoli, 2016). The incidence of rotator cuff tears increases with age, with full-thickness rotator cuff tears present in approximately 25% of individuals in their sixties, and more than 50% of those in their eighties (Edwards et al., 2016). Advances in the understanding of rotator cuff biology and biomechanics as well as improvements in surgical techniques have led to the development of new strategies that may allow a tendon-to-bone interface healing process, rather than the formation of

f brovascular scar tissue (Lorbach et al., 2015). Typically after the deep fibers tear, they retract because they remain under tension, even with the arm at rest. This results in an increased load on the remaining fibers that increases the likelihood of further rupture (Via et al., 2013). Another muscle that has a role in abduction is the long head of the biceps brachialis, but its role is secondary. The normal range of motion is 180 degrees (Renfree et al., 2003). Adduction is opposed to abduction, and the weight of the upper limb plays a major role as an active force, while the abductor muscles control the range of the motion (Braddom et al., 2007). The amplitude of the motion reaches a maximum when the arm reaches the trunk and the agonist muscles go into action only in certain situations (e.g. sport, climbing), which explains why there are so many strong muscle groups involved in this seemingly passive action.

Flexion and extension: the humeral shaft can balance forward and backward around an axis that goes through the center of the glenoid surface and allows an amplitude of 95 degrees anteriorly and 20 degrees posteriorly. These amplitudes can be increased with the aid of the pectoral arch and the spine up to 180 degrees flexion and 35 degrees extension (Baciu, 1981).

Flexion is made possible by the anterior fascicles of the deltoid, pectoralis major and the coracobrachialis, while antagonist motion is performed by the posterior fibers of the deltoid and latissimus dorsi (Braddom et al., 2007).

Internal and external rotation: the muscles involved turn the humeral head within the glenoid cavity and tense the joint capsule in the posterior (internal rotation) and anterior (external rotation) regions (Baciu, 1981).

The maximum amplitude of internal rotation (175 degrees) can only be reached while the patient places his forearm behind his back, which involves some degree of arm retropulsion, and external rotation (80 degrees) can be extended with the participation of the pectoral arch (Hansen et al., 2008). Humeral rotation affects rotator cuff fixation and should be considered in postoperative rehabilitation (Ahmad et al., 2008).

The circumduction motion totals all of the above motions, resulting in a motion around all of the 3 axes, while the humeral head describes a circle, following the contour of the glenoid cavity, whereas the humeral shaft describes a big circle, in an opposite way (the base of the circumduction cone) (Baciu, 1981).

Importantly, the motion of the scapula relative to the thorax can only occur by simultaneous motion at the acromioclavicular and sternoclavicular joints (Teece et al., 2008). This combined motion is what enables the scapula to move across the thorax.

In addition to the coupling of clavicular motion to scapulothoracic motion, during arm elevation in any plane, the scapula relative to the clavicle also moves at the acromioclavicular (AC) joint. These acromioclavicular joint motions may increase or decrease the overall scapulothoracic (SC) joint motion depending on whether they complement or offset the scapulothoracic joint coupled scapular motions. Although somewhat complex to understand, these interrelationships between how SC and AC joints contribute to overall motion of the scapula on the thorax are also important with regard to how they influence

muscle function (Ludewig et al., 2011).

Multiple studies describe shoulder motion abnormalities, showing the importance of the scapulothoracic joint in a variety of clinical disorders including impingement, rotator cuff tendinosis, rotator cuff tear, and shoulder instability (Ludewig et al., 2009). Significant abnormal scapular kinematics is seen in multidirectional instability of the shoulder, highlighting the importance of incorporating scapular positioning and stability exercises during rehabilitation (Ogston et al., 2007).

Despite conflicting results, growing evidence suggests that distinct scapular morphologies may accelerate the underlying degenerative process (Moor et al., 2014).

Glenohumeral stability is ensured by static restraints (glenohumeral ligaments, glenoid labrum, articular congruity and version, negative intraarticular pressure) and dynamic restraints (rotator cuff muscles, rotator interval and biceps long head, periscapular muscles) (3). Moreover, joint stability is not helped, but works against gravity, where the weight of the upper limb tries to extract the humeral head from the glenoid cavity, explaining the necessity of an articular capsule reinforced with ligaments in the inferior and superior portions, and strong muscles to press the two components together. The labrum and ligamentous structures are critical for glenohumeral stability because only one fourth of the humeral head is in contact with the glenoid at any point during the range of motion of the shoulder (Campbell et al., 2008). Important in stability is also the vacuum effect, and for this, there are three mechanisms: Intracapsular pressure - this is normally a negative pressure within the shoulder joint. A slightly negative intra-articular pressure existing in a normal shoulder aids in centering the humeral head.

Suction effect and Adhesion cohesion - when two wet surfaces, such as the humeral head and glenoid, come into contact with each other, this creates an adhesion-cohesion bond, which provides stability to the glenohumeral articulation (2). By looking at the whole biomechanics of the pectoral arch, we find that without the intervention of auxiliary components (spine, scapulothoracic gliding space, subacromial bursa, glenoid labrum and the complex distribution of muscle and ligament insertions), the scapulohumeral joint has a rather limited array of motion (4).

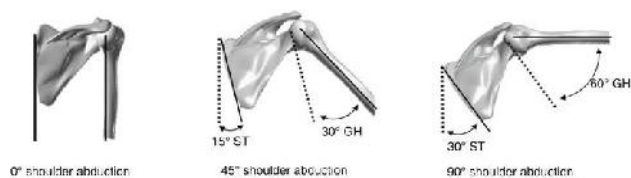


Fig. 1 – Shoulder abduction - graphic representation

However, it should not be forgotten that adjacent structures such as the acromioclavicular joint, blood vessels and nerves, which are generally well displayed, but often neglected in daily practice, should also be evaluated in order to fully exploit the diagnostic possibilities of the method and identify frequent diseases that are easily diagnosed by US (Bianchi & Martinoli, 2007; Yin et al., 2010).

Ultrasound is a new acquisition that gives us benefits, recording the anatomical structure, muscles and tendons. It allows to examine the joint in a dynamic way, while performing all motions, and offers us more biomechanical information (Prececutti et al., 2010). Also, it should not be forgotten that it is a less expensive alternative to MRI in the diagnosis of rotator cuff disorders and not only these (Nazarian, 2008). Musculoskeletal sonography is an important complementary tool to MRI and is essential for clinicians and radiologists who want to provide patients with state-of-the-art musculoskeletal imaging (Nazarian, 2008).

Evidence-based interventions in reviews are specific to musculoskeletal shoulder disorders, and specific intervention recommendations vary depending on the shoulder condition (Marik et al., 2017) and the clinical usefulness of shoulder stability exercises for shoulder pain and joint damage (Choi et al., 2013). Further research is required to measure functional outcomes of combined preparatory interventions and occupation-based interventions.

Conclusions

1. The shoulder biomechanics is a field of future research.
2. The complex ligaments, muscles, bursae and joints interfere through different intricate mechanisms, and although the articular surface is reduced, the area of movement is highly ensured by this interconditionality.
3. There are studies demonstrating that although the supraspinatus muscle plays a role in the second part of the abduction movement after the action of the deltoid muscle, clinical information contradicts this by the fact that damage of the deltoid only allows movement such as in the impingement of the supraspinatus, when abduction cannot be done by the deltoid.
4. Mobility is also ensured by adjacent structures, scapulothoracic gliding planes, bursae, accessory muscles (trapezius, latissimus dorsi), which make the biomechanical mechanism very complex.
5. As a conclusion, it can be said that emphasizing the level of functionality of the 4 other joints than scapulohumeral can improve the range of motion and thus, quality of life.

Conflicts of interest

There are no conflicts of interest.

References

- Ahmad CS, Kleweno C, Jacir AM, Bell JE, Gardner TR, Levine WN, Bigliani LU. Biomechanical performance of rotator cuff repairs with humeral rotation: a new rotator cuff repair failure model. *Am J Sports Med.* 2008; 36(5):888-892.
- Baciu C. *Aparatul Locomotor (anatomie functional, semiologie clinic, diagnostic diferential)*. Ed. Med. Bucuresti, 1981.
- Beals TC, Hanyman DT, Lazarus MD. Useful boundaries of the subacromial bursa. *Arthroscopy.* 1998;14(5):465-470.
- Bechtol CO. Biomechanics of the shoulder. *Clin orthop relat res.* 1980;(146):37-41.
- Bianchi S, Martinoli C. Ultrasound of the musculoskeletal

- system: shoulder. Springer-Verlag. 2007, 190-331.
- Braddom RL. Physical Medicine and Rehabilitation. Third ed. Saunders Elsevier, 2007;142-143.
- Campbell WC, Canale ST, Beatty JH. Campbell's operative orthopaedics. 11th ed. Philadelphia: Mosby/Elsevier, 2008.
- Choi S-H, Lee B-H. Clinical Usefulness of Shoulder Stability Exercises for Middle-aged Women. *J Phys Ther Sci*. 2013;25(10):1243-1246.
- Edwards P, Ebert J, Joss B, Bhabra G, Ackland T, Wang A. Exercise rehabilitation in the non-operative management of rotator cuff tears: a review of the literature. *Int J Sports Phys Ther*. 2016;11(2):279-301.
- Gombera MM, Sekiya JK. Rotator cuff tear and glenohumeral instability: a systematic review. *Clin Orthop Relat Res*. 2014;472(8):2448-2456.
- Hansen ML, Otis JC, Johnsons JS, Cordasco FA, Craig EV, Warren RF. Biomechanics of massive rotator cuff tears: implications for treatment. *J Bone Joint Surg Am*. 2008;90(2):316-325. doi: 10.2106/JBJS.F.00880.
- Longo UG, Berton A, Papapietro N, Maffulli N, Denaro V. Biomechanics of the Rotator Cuff: European Perspective. *Med Sport Sci*. 2012;57:10-17. doi:10.1159/000328870.
- Lorbach O, Baums MH, Kostuj T, Pauly S, Scheibel M, Carr A, Zargar N, Saccomanno MF, Milano G. Advances in biology and mechanics of rotator cuff repair. *Knee Surg Sports Traumatol Arthrosc*. 2015;23(2):530-541.
- Ludewig PM, Phadke V, Braman JP, Hassett RD, Cieminski CJ, LaPrade RF. Motion of the Shoulder Complex During Multiplanar Humeral Elevation. *J Bone Joint Surg Am*. 2009;91(2): 378-389. doi: 10.2106/JBJS.G.01483.
- Ludewig PM, Braman JP. Shoulder Impingement: Biomechanical Considerations in Rehabilitation. *Man Ther*. 2011;16(1):33-39. doi:10.1016/j.math.2010.08.004.
- Lugo R, Kung P, Ma CB. Shoulder biomechanics, *Eur J Radiol*, 2008;68(1):16-24.
- Marik TL, Roll CS. Effectiveness of Occupational Therapy Interventions for Musculoskeletal Shoulder Conditions: A Systematic Review. *Am J Occup Ther*. 2017;71(1):1-11.
- Moor BK, Wieser K, Slankamenac K, Gerber C, Bouaicha S. Relationship of individual scapular anatomy and degenerative rotator cuff tears. *J Shoulder Elbow Surg*. 2014;23(4):536-541.
- Nazarian LN. The top 10 reasons musculoskeletal sonography is an important complementary or alternative technique to MRI. *AJR Am J Roentgenol*. 2008;190(6):1621-1626.
- Ogston JB, Ludewig PM. Differences in 3-dimensional shoulder kinematics between persons with multidirectional instability and asymptomatic controls. *Am J Sports Med*. 2007; 35(8):1361-1370. doi:10.1177/0363546507300820.
- Prececutti M, Garioni E, Madonia L, Draghi F. US anatomy of the shoulder: Pictorial essay. *Journal of Ultrasound*, 2010;13(4):179-187.
- Renfree KJ, Wright TW. Anatomy and biomechanics of the acromioclavicular and sternoclavicular joints. *Clin Sports Med*. 2003;22(2):219-237.
- Spargoli G. Partial articular supraspinatus tendon avulsion (PASTA) lesion. Current concepts in rehabilitation. *Int J Sports Phys Ther*. 2016; 11(3):462-485.
- Teece RM, Lunden JB, Lloyd AS, Kaiser AP, Cieminski CJ, Ludewig PM. Three-dimensional acromioclavicular joint motions during elevation of the arm. *J Orthop Sports Phys Ther*. 2008; 38(4):181-190. doi:10.2519/jospt.2008.2386.
- Pandey V, Willems JW. Rotator cuff tear: A detailed update. *Asia-Pacif c J Sports Med Arthrosc Rehabil Technol*. 2015;2(1):1-14.
- Via AG, De Cupis M, Spoliti M, Oliva F. Clinical and biological aspects of rotator cuff tears. *Muscles Ligaments Tendons J*. 2013; 3(2):70-79. doi:10.11138/mltj/2013.3.2.070.
- Yin B, Vella J, Levine WN. Arthroscopic alphabet soup: recognition of normal, normal variants, and pathology. *Orthop Clin North Am*. 2010; 41(3):297-308.

Websites

- (1) Donatelli R. Shoulder Biomechanics and Exercises, March 30, 2016, Available online from <https://www.medbridgeeducation.com/blog/2016/03/shoulder-biomechanics-and-exercises/> Accessed in 2017, August 23.
- (2) Funk L. Shoulder instability biomechanics, Available online from <https://www.medbridgeeducation.com/blog/2016/03/shoulder-biomechanics-and-exercises/> Accessed in 2017, August 25.
- (3) Hughes M, Romeo A. Glenohumeral joint anatomy, stabilizer and biomechanics. American Shoulder and Elbow Surgeons. Available online from <https://www.orthobullets.com/sports/3032/glenohumeral-joint-anatomy-stabilizer-and-biomechanics> Accessed in 2017, August 11.
- (4) Fig. no 1. Available online from https://musculoskeletalkey.com/wp-content/uploads/2016/10/A319603_1_En_1_Fig2_HTML.gif. Accessed in 2017, August 10.

Contradictions and controversies in contemporary nutrition

Contradicții și controverse în nutriția contemporană

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Abstract

The role and the importance of food in health status conditioning and in disease prevention and treatment have been mentioned for a long time. Over the years, information about food has much evolved, notably in the last two centuries, but also nutrition discussions and presentations. Consumers are increasingly interested in their health status, and hence, in their food. Nowadays we are surrounded by a real food/nutritional/dietetic cacophony, which is defined by this agglomeration of many messages which are frequently incoherent, inconsistent or contradictory. Some highly recommend certain food, others contraindicate it, considering it toxic. With no intention of offering an exhaustive presentation, the paper only reviews some of very debated and controversial foods during the last years: milk, eggs, and meat. After the presentation of the main advantages and disadvantages of these foods, it could be said that a miracle/ideal food does not exist, and that the only healthy diet is a balanced and moderate diet, which respects traditional food patterns as part of the national cultural patrimony and of national food identity.

Keywords: food, nutrition, milk, meat, eggs, cacophony of food.

Rezumat

Rolul și importanța alimentelor în condiționarea stării de sănătate și în prevenirea sau tratamentul unor îmbolnăviri au fost menționate de mult timp. De-a lungul anilor, cunoștințele despre alimente au evoluat mult, mai ales în ultimele două secole, dar la fel au evoluat și discursurile și reprezentările nutriționale. Consumatorii sunt din ce în ce mai interesați de starea lor de sănătate, deci, de alimentația lor. Astăzi asistăm la o adevărată cacofonie alimentară/nutrițională/dietetică, care definește omniprezența, coabitarea mai multor mesaje sau recomandări, adesea incoerente, inconstante sau chiar contradictorii. Unii recomandă cu încredere anumite alimente, alții le contraindică, considerându-le chiar nocive. Fără pretenția sau intenția de a face o prezentare exhaustivă, lucrarea trece în revistă doar câteva dintre alimentele foarte dezbătute și controversate în ultimii ani: laptele, oule și carnea. După prezentarea principalelor avantaje și dezavantaje ale acestor alimente, se poate concluziona că nu există niciun aliment miraculos sau ideal și că singura dietă ce poate asigura o bună stare de sănătate este dieta variată, moderată și echilibrată, fără excese, care respectă modelele alimentare tradiționale ce definesc identitatea națională și fac parte din patrimoniul cultural național.

Cuvinte cheie: alimente, nutriție, lapte, carne, ou, cacofonie alimentară.

General considerations

The role and the importance of food in health status conditioning and in disease prevention and treatment have been mentioned for a long time. Functionally, food is “substance taken in to maintain life and growth” (***, 1997).

About 2500 years ago, Hippocrates established the principles of healthy eating, and said “Let your food be your medicine” (Ionu et al., 2004).

Over the years, information regarding food and nutrition has progressively developed, especially during the last two centuries.

Nowadays we live a paradoxical period: food availability is greater than ever; on the other hand, in a world of plenty, accessibility (the second dimension of food security) is pretty low. The United Nations Organization reported that the number of persons suffering from chronic hunger re-increased in 2016 after a declining period lasting more than a decade, reaching 815 million people (11% of the global population, up 38 million people from the previous year) (***, 2017a). The main causes are conflicts, floods and droughts. Hunger and malnutrition kill like cancer, especially among children. Almost half of the deaths by cancer of the world’s children aged less than 5 years (46%)

Received: 2017, September 30; *Accepted for publication:* 2017, October 6

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<https://doi.org/10.26659/pm3.2017.18.4.220>

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are caused by malnutrition (1 child every 6 seconds, an increase from 41% in 2000) (***, 2017b); (1); (2).

In this situation, the objective of sustainable development to “end hunger, achieve food security and improved nutrition” is far from being achieved.

Currently, the food - health relationship is very present in almost all debates and represents a veritable public health challenge. Consumers are increasingly interested in their health and consequently, in their nutrition. Rapid advances in science as well as the short life of certain foods end up in feeding, fluctuating, inconsistent or even contradictory nutrition messages and speeches.

Facing the more and more complex food universe, the wide supply of foods, and an omnipresence of incoherent scientific or pseudo-scientific messages/speeches, consumers are lost and disoriented.

Many nutrition speeches and food images are often subject to controversies or contradictions. As our knowledge of nutrition has become more sophisticated, the image, recommendations and guidelines of certain foods have changed.

Milk

Milk is at the same time a food and a drink of very high nutritional value (Ionu et al., 2004). It is an exclusive food for newborns, excellent for children and adolescents, very good in pregnancy/lactation, and good in almost every period of lifetime (with some exceptions, of course).

The main *advantages* are protein intake (of a high value, containing all the essential amino acids) and the presence of calcium and vitamin D (which reinforce bones and teeth, preventing osteoporosis and fractures). Due to calcium and to prebiotics and probiotics of dairy, milk and dairy products could be considered as foods having the force of medicines (Ionu et al., 2004).

Milk also has many *disadvantages*:

- the absence of iron (generating anemia) and vitamin C (especially in winter);
- the presence of sodium (which is why milk is not recommended in cardiovascular diseases)
- the presence of lactose (which can result in milk intolerance in people suffering from lactase insufficiency)
- some milk proteins are likely to be allergenic (casein, -lactalbumin and β -lactoglobulin)

Milk is *contraindicated* in some conditions: hypochlorhydria and achlorhydria, fermentation enterocolitis, and ulcerative colitis.

Over the years the image of milk has changed, and milk and dairy are nowadays among the most contradictory subjects. *The anti-milk campaign* that has emerged in recent years is intended as a warning for consumers not to consume excessive, useless or even dangerous amounts of milk. The cons are:

- *Milk is simply an agribusiness conspiracy.* Almost all recommendations about milk would be based on scientific research requested and sponsored by milk industries, and doctors would not have any option in their conclusions (Souccar, 2007).

- *Milk is considered a dangerous/toxic food because:*

a) *Milk accelerates cancer?*

Besides other pollutants, milk contains a growth

factor for calves - insulin-like growth factor (IGF-1) - a protein which stimulates the development of all human cells, including tumor cells, and generates breast cancer, prostate cancer and pulmonary cancer. From the point of view of milk carcinogenicity, studies are controversial. Some specialists have proved that cow milk has protective effects against colorectal cancer, by two nutrients: calcium (which prevents the development of polyps in the colon), and vitamin D (which inhibits the development of tumor cells in the colon) (***, 2007; Grau et al., 2003; Pufulete, 2008; Huncharek et al., 2009).

b) *Calcium does not prevent osteoporosis and fractures?*

Some researchers have shown that in countries where milk consumption is very high (Sweden, Norway, United States, Germany, Ireland, United Kingdom, Finland, Australia, New Zealand), the incidence of hip fractures is the highest. In China, on the other hand, where milk consumption is about 10 kg/person/year, the number of hip fractures is the lowest in the world. In Togo (less than 10 kg of milk/person/year), osteoporosis is extremely rare. This is a phenomenon called the “calcium paradox” (Bolland et al., 2010; Hess & Manson, 1984; Michaëlsson et al., 2014; Souccar, 2007).

Eggs

Eggs have an impressive nutritional profile. They contain proteins of the highest value, being used by the World Health Organization (WHO) as the reference when assessing the biological quality of *proteins* (Ionu et al., 2004).

Egg is a treasure of water-soluble and fat-soluble *vitamins*: B2 - equally distributed in egg yolk and egg white, B12; vitamin A - 19% of the daily value (DV), vitamin E - 50% of the daily value, vitamin D, choline - 60% of DV, folic acid (fat-soluble vitamins are only present in yolk), and *minerals* (mainly phosphorus and zinc) (Kiple, 2007; Howe et al., 2004).

Egg yolk contains *carotenoids* (lutein and zeaxanthin), which give its color and have an antioxidant effect, protecting against cardiovascular diseases and degenerative illnesses (cataract and macular degeneration).

The consumption of an egg results in no more than 70 calories, so it is a good choice to manage weight. An egg laid by a well nourished hen (which is fed a diet containing polyunsaturated fats from sources such as fish oil, chia seeds or flaxseeds (Coorey et al., 2015) has *omega-3 fatty acids* that promote good vision in infants and stimulate cerebral functions and memory. Pasture-raised free-range hens, which forage for their own food, also produce eggs that are relatively enriched in omega-3 fatty acids compared to cage-raised chickens (Anderson, 2011; Karsten et al., 2010).

Egg white can be used as an *antidote* to irritant or toxin poisoning (ovalbumin, the protein in egg white, having sulfhydryl groups in its structure, can bind and sequester heavy metal ions (Pb²⁺, Hg²⁺, etc.) and stop them from harming the body); it contains 2 natural antioxidant fluorescent substances (lumichrome and lumiflavin) which, along with sulfuraphane, restrain the multiplication of cancer-inducing viruses; some of the proteins (globulins

G1, G2 and G3, ovomacroglobulin, IgY antibody) could extend the lifespan of people with AIDS, due to their nutritional value and to their antimicrobial properties; white egg also prevents ulcer formation (Narahari, 2009).

In yolk and chalaza, there is sialic acid used in microbial infection (*Helicobacter pylori* and others) causing diseases such as ulcer, gastritis, enteritis or colorectal cancer.

Despite the high nutritional value of eggs, there are some disadvantages of egg consumption:

- Vitamin C is absent from eggs (Ionu et al., 2004).
- Some proteins (especially from egg white) are responsible for allergic reactions (Cantani, 2008).

- Another potential health issue arises from the saturated fatty acid and cholesterol content. During the 70's to 90's, saying "no to cholesterol which gives us cardiovascular stroke" was in fashion; as a result, eggs were banned. Later, it was established that, in fact, there are two kinds of cholesterol (HDL- and LDL-cholesterol), and, actually, egg contains good cholesterol. Other researchers have shown that the level of blood cholesterol is less influenced by food cholesterol intake (Qureshi et al., 2007), and that egg proteins even reduce stroke risk by 12% (Alexander et al., 2016). Consequently, egg was rehabilitated and was reintroduced in daily diet (Rong et al., 2013). The new American Dietary Guidelines (***, 2016; ***, 2015) no longer limit dietary cholesterol, but limit instead saturated fatty acid, salt and sugar intake. In order to benefit from all the advantages and to minimize the disadvantages of eggs, these must be cooked (the protein of a cooked egg is almost totally bio-available - 91%, whereas that in raw egg is only 51% bio-available). In over-cooked eggs, proteins are much less digested, so slight cooking (3 minutes) or poached eggs are recommended (Evenepoel et al., 1998).

- Eggs can be contaminated with salmonella enteritidis or tiphymurium, pathogenic bacteria (Little et al., 2007; Stephens et al., 2007), or with insecticides such as f pronil (in 2017, a great scandal starting in Netherlands has blocked millions of eggs from sale and has raised the price of eggs) (Boffey, 2017; Anderson, 2011; Karsten, 2010).

Meat

Meat is a prestige food having a great symbolic value, used as a life standard indicator. It used to be an expensive and rare food, only consumed during Sundays or feasts. Currently, it is an everyday food in some of the world's countries. It has a great *nutritional value* due to the *protein* content (rich in essential amino acids), the high amount of *iron* (especially in red meat and organs), and *vitamin B group* (Ionu et al., 2004).

The main *disadvantages* are:

- Muscle tissue can be rich in *saturated fatty acids* (Sacks et al., 2017).

- Some proteins from meat are digested to uric acid responsible for uric *lithiasis and gout* (Kenny & Goldfarb, 2010).

- Meat does not contain *dietary fibers* and is very low in *carbohydrates*.

- On October 26, 2015, The International Agency for Research on Cancer (IARC) and the World Health Organization (***, 2015c), as a result of more than 800

studies, announced that red meat is "probably *carcinogenic* to humans (Group 2A)", and processed meat (e.g., bacon, ham, hot dogs, sausages) is "carcinogenic to humans (Group 1), based on sufficient evidence in humans that the consumption of processed meat causes colorectal cancer" (Campbell & Campbell, 2005; Bradbury et al., 2014). The risk is higher for colorectal, pancreatic, and prostate cancer, as well as for stomach cancer (***, 2015). Red meat (more myoglobin in muscle fibers) includes beef, veal, pork, lamb, mutton, goat, horse meat. White meat, which is not considered carcinogenic, includes chicken and turkey (poultry). According to IARC, 50 g of processed meat raise the risk of colorectal cancer by 18% (***, 2015c). Although meat has been classified as a Group 1 carcinogen, the same category as tobacco smoke and asbestos, WHO does not conclude that meat should be banned, and recommends to avoid any paranoia or psychosis, because even though the risk increases with the amount, bacon or hot dogs are much less carcinogenic than smoking (1 million deaths/year caused by tobacco, 34.000 deaths/year caused by processed meat) (***, 2015c). Many hypotheses of the carcinogenic effect of meat are advanced: a) disruption of gut microbiota/microbiome by protein excess (Gagnière et al., 2016); b) meat is a pro-inflammatory food by heme iron (Hammerling et al., 2016; Guéraud, 2015), and arachidonic acid, an essential omega-6 fatty acid - the origin of many pro-inflammatory factors (cancer is related to inflammation in all phases) (Harris et al., 2009); c) the fat from meat needs bile acids for digestion, because gut bacteria turn these bile acids into cancer-promoting factors called secondary bile acids (e.g. lithocholic acid) which are very aggressive for the colon, and, secondly, meat fosters the growth of bacteria that cause carcinogenic secondary bile acids to form (Ayouz et al., 2014); and d) heating meat at high temperatures produces many highly toxic end products. The pollutants from cooked meat are: more than 20 *heterocyclic aromatic amines* (HAAs), linked to cancer, present in the blackened section of grilled and charred meats; *polycyclic aromatic hydrocarbons* (PAHs), such as benzo[a]pyrene; *advanced glycation end products* (AGEs), responsible for disease, aging, and death; *acrolein* (by fat breakdown); *acrylamide* (causing cancer and neurotoxic damage); and *N-nitroso-compounds* (NOC) (Jägerstad & Skog, 2005; Sinha et al., 1995; Butler et al., 2005).

However, the results are very controversial; some studies suggest that UK vegetarians do not have a lower risk of colorectal cancer (Key et al., 2009; Fraser, 2009). Meat can be eaten if accompanied by a large portion of vegetables (rich in antioxidants, anti-inflammatory, anti-proliferative and detoxifying agents). So, it is recommended to reduce the amount and the frequency of consumption of red and processed meat, and to use aromatic herbs, spices and marinade sauces without sugar. Antioxidant marinades of chili pepper, thyme, rosemary, garlic, and ginger can reduce HAAs by 74%. Acidic marinades containing lemon juice and/or vinegar could reduce AGEs. It is also important not to add sugar or honey into marinade sauces. Commercial marinades containing sugar, honey or corn syrup create 3 times more HAAs than grilling without marinades (Yu et al., 2015; Hernandez et al., 2015; Stone & Darlington, 2017).

At the same time, other researchers have proved that meat has only a minor role in promoting cancer (Alexander et al., 2009; Chao et al., 2005; Gehlhar & Coyle, 2001; ***, 2007; Murtaugh et al., 2004; Norat & Riboli, 2001).

There are opinions sustaining that, although beneficial, eating dietary fiber from fruit and vegetables has less or no benefit in reducing cancer risk (Gehlhar & Coyle, 2001).

As could be seen, nutrition messages and speeches are often contradictory. When speaking about a particular food, one can be told “it’s carcinogenic”, or “it isn’t”, or “it’s good”, or “it’s bad”; so, one cannot know who is right and what to believe. This is a situation called “cacophony of food” (gastronomy), which means the coexistence of plenty of incoherent, more or less contradictory messages, which determine cognitive dissonance, responsible for the loss of guidelines. The cacophony of food is an expression of modernity and represents a source of fear for consumers who are less and less certain of their nutrition; the composition of the dish is increasingly inadequate.

Conclusions

1. There is no ideal, miracle, or super food.
2. There are no totally good or totally bad foods.
3. The “forbidden” culture and the binary or dichotomous classification of foods into secure/insecure, white/black should be avoided.
4. Foods are not responsible for all bad things in our lives.
5. Some foods are more nutritious, and these must predominate in diet, but less nutritious foods, which have an affective, cultural, or gastronomic value, should not be excluded.
6. In order to protect our health, it is indicated to eat a variety of less processed foods, a diet rich in vegetables.
7. The only healthy diet, with no side effects or contraindications, is a balanced and common sense diet.
8. It is very important to preserve traditional food patterns, rich and diverse, as part of the cultural heritage, of national food identity.
9. Having a broad view of nutrition helps to avoid excesses, calm down anxiety, allowing everyone to define/build their own highlights according to their personality, personal history, biological uniqueness, pleasure and desires.

References

Alexander DD, Cushing CA, Lowe KA, Scurman B, Roberts MA. Meta-analysis of animal fat or animal protein intake and colorectal cancer. *Am. J. Clin. Nutr.* 2009;89(5):1402-1409. doi: 10.3945/ajcn.2008.26838.

Alexander DD, Miller PE, Vargas AJ, Weed DL, Cohen SS. Meta-analysis of egg consumption and risk of coronary heart disease and stroke. *J Am Coll Nutr.* 2016; 35(8):704-716, doi.org/10.1080/07315724.2016.1152928.

Anderson KE. Comparison of fatty acid, cholesterol, and vitamin A and E composition in eggs from hens housed in conventional cage and range production facilities. *Poult Sci.* 2011;90(7):1600-1608. doi:10.3382/ps.2010-01289.

Ayoub H, Mukherji D, Shamseddine A. Secondary bile acids: an underrecognized cause of colon cancer. *World J Surg Oncol.* 2014;12:164, <https://doi.org/10.1186/1477-7819-12-164>.

Boffey D. Millions of eggs removed from European shelves over toxicity fears. *The Guardian.* August 3, 2017. Retrieved August 3, 2017.

Bolland MJ, Avenell A, Baron JA, Grey A, MacLennan GS, Gamble GD, Reid IR. Effect of calcium supplements on risk of myocardial infarction and cardiovascular events: meta-analysis. *BMJ.* 2010;341:c3691. doi:10.1136/bmj.c3691.

Bradbury KE, Appleby PN, Key TJ. Fruit, vegetable, and fiber intake in relation to cancer risk: findings from the European Prospective Investigation into Cancer and Nutrition (EPIC). *Am J Clin Nutr.* 2014;100(suppl1):394S-398S. doi:10.3945/ajcn.113.071357.

Butler LM, Duguay Y, Millikan RC, Sinha R, Gagné JF, Sandler RS, Guillemette C. Joint effects between UDP-glucuronosyltransferase 1A7 genotype and dietary carcinogen exposure on risk of colon cancer. *Cancer Epidemiol Biomarkers Prev.* 2005;14(7):1626-1632. doi:10.1158/1055-9965.EPI-04-0682.

Campbell TC, Campbell TM. *The China Study.* First Ed. Pb. BenBella Books. USA, 2005

Cantani A. *Pediatric Allergy, Asthma and Immunology.* Berlin, Springer, 2008;710-713.

Chao A, Thun MJ, Connell CJ, McCullough ML, Jacobs EJ, FlandersWD, Rodriguez C, Sinha R, Calle EE. Meat consumption and risk of colorectal cancer. *J. Am. Med. Assoc.* 2005;293(2):172-182. DOI:10.1001/jama.293.2.172

Coorey R, Novinda A, Williams H, Jayasena V. Omega-3 fatty acid profile of eggs from laying hens fed diets supplemented with chia, fish oil, and flaxseed. *J Food Sci.* 2015;80(1):S180-S187. doi:10.1111/1750-841.12735.

Evenepoel P, Geypens B, Luybaerts A, Hiele M, Ghos Y, Rutgeerts P. Digestibility of Cooked and Raw Egg Protein in Humans as Assessed by Stable Isotope Techniques. *J Nutr.* 1998;128(10):1716-1722.

Fraser GE. Vegetarian diets: what do we know of their effects on common chronic diseases? *Am J Clin Nutr.* 2009;89(5):1607S-1612S. doi: 10.3945/ajcn.2009.26736K.

Gagnière J, Raisch J, Veziat J, Barnich N, Bonnet R, Buc E, Bringer MA, Pezet D, Bonnet M. Gut microbiota imbalance and colorectal cancer. *World J Gastroenterol.* 2016;14;22(2):501-518. doi:10.3748/wjg.v22.i2.501.

Gehlhar M, Coyle W. Global Food Consumption and Impacts on Trade Patterns, Chapter 1. In: Regmi A. *Changing Structure of Global Food Consumption and Trade.* Economic Research Service/USDA, 2001, 4-14.

Grau MV, Baron JA, Sandler RS, Haile RW, Beach ML, Church TR, Heber D. Vitamin D, calcium supplementation and colorectal adenomas: results of a randomized trial. *J Natl Cancer Inst* 2003;95(23):1765-1771.

Guéraud F, Taché S, Steghens JP, Milkovic L, Borovic-Sunjic S, Zarkovic N, Gaultier E, Naud N, Héliers-Toussaint C, Pierre F, Priymenko N. Dietary polyunsaturated fatty acids and heme iron induce oxidative stress biomarkers and a cancer promoting environment in the colon of rats. *Free Radic Biol Med.* 2015;83:192-200. doi:10.1016/j.freeradbiomed.2015.02.023.

Hammerling U, Bergman Laurila J, Grafström R, Ilbäck NG. Consumption of Red/Processed Meat and Colorectal Carcinoma: Possible Mechanisms Underlying the Significant Association. *Crit Rev Food Sci Nutr.* 2016;56(4):614-634. doi:10.1080/10408398.2014.972498.

Harris WS, Mozaffarian D, Rimm E, et al. Omega-6 fatty acids and risk for cardiovascular disease: a science advisory from the American Heart Association Nutrition Subcommittee of the Council on Nutrition, Physical Activity, and Metabolism; Council on Cardiovascular Nursing; and Council on Epidemiology and Prevention. *Circulation.* 2009;119(6):902-

907. doi: 10.1161/CIRCULATIONAHA.108.191627.
- Hernández ÁR, Boada LD, Almeida-González M, Mendoza Z, Ruiz-Suárez N, Valeron PF, Camacho M, Zumbado M, Henríquez-Hernández LA, Luzardo OP. An estimation of the carcinogenic risk associated with the intake of multiple relevant carcinogens found in meat and charcuterie products. *Sci Total Environ*. 2015;514:33-41. doi:10.1016/j.scitotenv.2015.01.108.
- Hess ML, Manson NH. Molecular oxygen: friend and foe. The role of the oxygen free radical system in the calcium paradox, the oxygen paradox and ischemia/reperfusion injury. *J Mol Cell Cardiol*. 1984;16(11):969-985.
- Howe JC, Williams JR, Holden JM, Holden JM. USDA Database for the Choline Content of Common Foods (PDF). United States Department of Agriculture (USDA), 2004:10. Archived from the original (PDF) on 5 December 2010.
- Huncharek M, Muscat J, Kupelnick B. Colorectal cancer risk and dietary intake of calcium, vitamin D, and dairy products: a meta-analysis of 26,335 cases from 60 observational studies. *Nutr Cancer*. 2009;61(1):47-69. doi:10.1080/01635580802395733.
- Ionu C, Popa M, Laza V et al. Compendiu de Igien . Ed Med Univ. "Iuliu Ha ieganu" Cluj-Napoca. 2004;327,432-446.
- Jägerstad M, Skog K. Genotoxicity of heat-processed foods. *Mutat Res*. 2005;574(1-2):156-172.
- Karsten HD, Patterson PH, Stout R, Crews G. Vitamins A, E and fatty acid composition of the eggs of caged hens and pastured hens. *Renewable Agriculture and Food Systems*. 2010;25(1):45-54. doi:10.1017/S17421705 09990214.
- Kenny JE, Goldfarb DS. Update on the pathophysiology and management of uric acid renal stones. *Curr Rheumatol Rep*. 2010;12(2):125-129.
- Key TJ, Appleby PN, Spencer EA, Travis RC, Rodam AW, Allen NE. Cancer incidence in vegetarians: results from the European Prospective Investigation into Cancer and Nutrition (EPIC-Oxford). *Am J Clin Nutr* 2009;89(5):1620S-1626S. doi: 10.3945/ajcn.2009.26736M.
- Kiple KF. Movable Feast: Ten Millennia of Food Globalization 2007, 22.
- Little CL, Surman-Lee S, Greenwood M, Bolton FJ, Elson R, Mitchell RT, Nichols GN, Sagoo SK, Threlfall EJ, Ward LR, Gillespie IA, O'Brien S. Public health investigations of Salmonella Enteritidis in catering raw shell eggs, 2002-2004. *Lett Appl Microbiol*. 2007;44(6):595-601. doi:10.1111/j.1472-765X.2007.02131.x.
- Michaëlsson K, Wolk A, Langenskiöld S, Basu S, Warensjö Lemming E, Melhus H, Byberg L. Milk intake and risk of mortality and fractures in women and men: cohort studies. *BMJ* 2014; 349: g6015. doi: 10.1136/bmj.g6015.
- Murtaugh MA, Ma KN, Sweeney C, Caan BJ, Slattery ML. Meat Consumption patterns and preparation, genetic variants of metabolic enzymes, and their association with rectal cancer in men and women. *J Nutr*. 2004;134(4):776-784.
- Narahary D. In praise of the humble egg, 2009. Available on <https://www.wattagnet.com/articles/638-in-praise-of-the-humble-egg>.
- Norat T, Riboli E. Meat consumption and colorectal cancer: a review of epidemiologic evidence. *Nutr Rev*. 2001;59(2):37-47.
- Pufulete M. Intake of dairy products and risk of colorectal neoplasia. *Nutr Res Rev*. 2008;21:56-67.
- Qureshi AI, Suri FK, Ahmed S, Nasar A, Divani AA, Kirmani JF. Regular egg consumption does not increase the risk of stroke and cardiovascular diseases. *Med. Sci. Monit*. 2007;13(1):CR1-CR8.
- Rong Y, Chen Li, Tingting Z, Yadong S, Yu M, Shan Z, Sands A, Hu FB, Liu L. Egg consumption and risk of coronary heart disease and stroke: dose-response meta-analysis of prospective cohort studies. *BMJ*. 2013;346 (e8539). doi:10.1136/bmj.e8539.
- Sacks FM, Lichtenstein A, Wu Jason HY, Appel LJ, Creager M, Kris-Etherton Penny M, Miller M, Rimm EB, Rudel LL, Robinson JG, Stone NJ, Van Horn, LV. Dietary Fats and Cardiovascular Disease: A Presidential Advisory from the American Heart Association. *Circulation*. 2017;136(3):e1-e23. doi:10.1161/CIR.0000000000000510.
- Sinha R, Rothman N, Mark SD, Murray S, Brown ED, Levander OA, Davies DS, Lang NP, Kadlubar FF, Hoover RN. Lower levels of urinary 2-amino-3,8-dimethylimidazol [4,5-f]-quinoxaline (MeIQx) in humans with higher CYP1A2 activity. *Carcinogenesis* 1995;16(11):2859-2861. <https://doi.org/10.1093/carcin/16.11.2859>.
- Souccar T. Lait, mensonge et propagande. Ed. Thierry Souccar. France, 2007,71-72.
- Stephens N, Sault C, Firestone SM, Lightfoot D, Bell C. et al. Large outbreaks of Salmonella Typhimurium phage type 135 infections associated with the consumption of products containing raw egg in Tasmania. *Commun Dis Intell Q Rep*. 2007;31(1):118-124.
- Stone TW, Darlington LG. Microbial carcinogenic toxins and dietary anti-cancer protectants. *Cellular and molecular life sciences: Cell Mol Life Sci*. 2017;74(14): 2627-2643. doi: 10.1007/s00018-017-2487-z.
- Yu Y, Li Q, Wang H, Wang B, Wang X, Ren A, Tao S. Risk of human exposure to polycyclic aromatic hydrocarbons: A case study in Beijing, China. *Environ Pollut*. 2015;205:70-77. doi: 10.1016/j.envpol.2015.05.022.
- ***. American College of cardiology. New Dietary Guidelines Focus on Eating Patterns vs. Food Groups. 2016, Available on <http://www.acc.org/latest-in-cardiology/articles/2016/01/07/10/30/2015-dietary-guidelines-recommend-limited-cholesterol-intake>, Accessed September 29, 2017.
- ***. BBC. Processed meats do cause cancer - WHO. News website. <http://www.bbc.com/news/health-34615621>. 2015a. Retrieved October 26, 2015.
- ***. FAO, IFAD, UNICEF, WFP and WHO. The State of Food Security and Nutrition in the World. 2017a. Building resilience for peace and food security. Rome, FAO. Available on <http://www.fao.org/3/a-I7695e.pdf>.
- ***. Oxford Dictionary. 1997: 291.
- ***. U.S. Department of Health and Human Services and U.S. Department of Agriculture. 2015-2020 Dietary Guidelines for Americans. 8th Edition. December 2015b. Available at <https://health.gov/dietaryguidelines/2015/guidelines/>.
- ***. UNICEF. Data: Monitoring the Situation of children and Women, Levels and Trends in Child Mortality: Report 2017b. Available on https://www.unicef.org/publications/index_101071.html. Accessed on September 29, 2017.
- ***. World Cancer Research Fund/American Institute for Cancer Research, Food, Nutrition, Physical Activity and the Prevention of Cancer; A Global Perspective. Washington, AICR, 2007.
- ***. World Health Organization - IARC Monographs evaluate consumption of red meat and processed meat (PDF). 2015c. Press release no.240. International Agency for Research on Cancer. Retrieved October 26, 2015.

Websites

- (1) http://www.who.int/mediacentre/factsheets/fs_178/en/. Accessed on September 29, 2017
- (2) https://en.wikipedia.org/wiki/Sustainable_Development_Goals. Accessed on September 29, 2017

Nutrition guidelines for competitive tennis

Linii directoare privind nutriția în tenisul competitiv

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Abstract

To provide evidence-based nutritional recommendations for performance tennis players.

Players should particularly focus their exercise program on the adequate and appropriate consumption of four primary nutrient categories - electrolytes, carbohydrates, protein and fat. For most players, the International Tennis Federation recommends a minimum of approximately 2500 calories a day, although some players may require in excess of 3500 calories.

The American College of Sports Medicine and the National Athletic Trainers Association have recommended that athletes should consume in general 30-60 g/h CHO during exercise.

It is important for tennis players to eat plenty of complex carbohydrate foods, especially those with a low glycemic index to help boost glycogen stores.

Protein is crucial for maintaining, building and repairing the tennis players' muscles. Players should consume 15-20 g of protein within 30 minutes after a tennis match. Fat takes the longest time to digest, and thus, it is not a good source of quick energy during exercise. Vitamins and minerals do not provide a source of energy but are needed to derive energy from nutrients that are consumed.

Keywords: nutrition, electrolytes, carbohydrates, protein.

Rezumat

Scopul acestui studiu este de a oferi recomandări nutriționale bazate pe dovezi pentru jucătorii de tenis de performanță. Jucătorii ar trebui să își concentreze atenția în mod deosebit asupra consumului adecvat al celor patru categorii principale de nutrienți - electroliti, carbohidrați, proteine și grăsimi. Pentru majoritatea jucătorilor, Federația Internațională de Tenis recomandă un minim de aproximativ 2500 de calorii pe zi, deși unii jucători pot solicita peste 3500 de calorii. Colegiul American de Medicină Sportivă și Asociația Națională de Formatori în Atletism recomandă ca sportivii să consume în general 30-60 g/h CHO în timpul exercițiilor fizice. Este important pentru jucătorii de tenis să mănânce o mulțime de alimente care sînt bogate în carbohidrați complecși cu un indice glicemic scăzut pentru a ajuta la creșterea stocurilor de glicogen. Proteina este esențială pentru menținerea, dezvoltarea și refacerea mușchilor jucătorilor de tenis. Jucătorii ar trebui să consume în interval de 30 de minute după meci 15-20 g de proteine. Grăsimile necesită mai mult timp pentru a fi digerată și prin urmare, nu este o sursă bună de energie rapidă în timpul exercițiilor fizice. Vitaminele și mineralele nu sunt o sursă de energie, ci sunt necesare pentru a obține energie din substanțele nutritive consumate.

Cuvinte cheie: nutriție, electroliti, carbohidrați, proteine.

Introduction

In preparing for junior competitions or senior grand slams, optimal nutrition is essential to increase tennis performance. For players who participate regularly in tournaments, this is even more of a must as they need to recover quickly and play again the next day or even later the same day. Scientific nutrition now plays an integral role in every professional tennis player's daily routine.

Food is the source of nutrients, and to get the required nutrients, a varied and well-balanced diet is necessary. A good selection of foods, electrolytes and supplements

may help players to obtain good performance and gain a competitive edge.

There are six classes of nutrients that include water, vitamins, minerals, proteins, fats, and carbohydrates. Each nutrient is very important and has an immediate effect on performance.

For most players, the International Tennis Federation (ITF) recommends a minimum of approximately 2,500 calories a day, although some players may require in excess of 3,000 calories. Pro players are predicted to need between 3,500 and 5,000 calories/day (1).

Received: 2017, September 5; *Accepted for publication:* 2017, September 15

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<https://doi.org/10.26659/pm3.2017.18.4.225>

General macronutrients for tennis

Players should particularly focus their efforts on the adequate and appropriate consumption of four primary nutrient categories – carbohydrates, protein, electrolytes, and fat.

a) Carbohydrates

Carbohydrates are the best source of energy, providing fuel for the muscles, brain, and organs. They are stored in the body in the form of glycogen, but too few carbohydrates lead to glycogen depletion, which may result in early fatigue on court. Carbohydrates should represent about 60% of dietary calories (Itftennis.com/scienceandmedicine/nutrition/eating-right.aspx).

It has been understood for many years that a high carbohydrate diet leads to increased muscle glycogen stores (Bergström et al., 1967), which contributes to optimal performance particularly in endurance activities (Hargreaves, 2004).

Sufficient amounts of carbohydrates should be provided from diet (Gidu, 2008).

As a general guideline, elite-standard tennis players should have a habitually high carbohydrate diet of 6-10 g/kg/day to ensure adequate glycogen stores, with women generally requiring slightly less than men. This recommendation should be tailored to suit daily energy expenditure (Ranchordas et al., 2013).

According to the American College of Sports Medicine and the National Athletic Trainers' Association, it has been recommended that athletes should consume in general 30-60 g/h CHO during exercise. CHO can be in the form of glucose, sucrose, maltodextrins, or some high glycemic starches. Fructose should be limited because of the possibility of gastrointestinal discomfort.

This rate of CHO ingestion can be accomplished by drinking 600-1200 ml/h of a solution containing 4-8% CHO (4-8 g/100 ml) (Kovacs, 2006b).

The importance of carbohydrate (CHO) as a substrate for contracting skeletal muscles and central nervous system function (Bergström et al., 1967), as well as the importance of glucose concentrations in endurance performance (Coyle, 1999) have been recognized (Kovacs, 2006a).

During general training, when intensity is moderate to high, athletes are recommended to consume 5-7 g/kg CHO on a daily basis (Burke et al., 2001).

If training is intense and during tournament weeks, this should be increased to 7-10 g/kg daily to maintain sufficient energy stores for performance and to aid recovery (Costill & Hargreaves, 1992).

For tennis players, the glycemic effect can be very important, and it is critical that players understand which carbohydrates they should consume and when (Panait et al., 2013).

It is generally recommended that complex carbohydrates, especially those with a low glycemic index, should be consumed because they have high fiber and vitamin content and give a sustained energy release over a long period of time (ITF).

They are found in cereals, bread, pasta, potatoes, rice, legumes, fruit, vegetables and sport products (energy bars and sport beverages).

b) Protein

Protein is crucial for building muscle and organ repair

in the tennis player's body; it provides a small source of energy for muscle exercise, but is not the ideal energy source on the court.

The consumption of 20-25 g protein after exercise is recommended in order to stimulate muscle protein synthesis and possibly lower the rate of muscle protein breakdown (Phillips & Van Loon, 2011).

Latest research shows that players should consume an easy-to-digest form of protein within 30 minutes after tennis play (1).

The recommended timing for protein ingestion is as soon as possible after exercise, particularly if optimum muscle adaptation and performance are a high priority (Kovacs & Baker, 2014).

It is recommended that tennis players who train daily at a high intensity should consume - 1.6 g protein/kg/day in 24 h between the training sessions (Ranchordas et al., 2013).

Phillips claims that protein intakes in the range of 1.3-1.8 g/kg/day consumed as 3-4 isonitrogenous meals will maximize muscle protein synthesis (Phillips & Van Loon, 2011).

Increasing the amount of protein to 1.8-2.0 g/kg/day, depending on the caloric deficit, may be beneficial in preventing lean mass losses during periods of energy restriction to promote fat loss (Phillips & Van Loon, 2011).

It is important to reiterate that tennis coaches and players should take into account the individual needs and preferences of athletes (Kovacs, 2014).

The ideal source of protein for tennis players is: meat (beef), poultry, fish (tuna), eggs, dairy, vegetables (broccoli, spinach) and nuts.

c) Fat

While carbohydrate is the predominant fuel that is used in tennis, fat oxidation will also contribute to energy provision, especially as the duration of the match or training session increases.

Fat intake as a percentage of total energy intake has been reported, with 70% of athletes consuming >30% of total energy per day from fat. The suggested amount of daily fat required to ensure adequate intramuscular triacylglyceride stores for an endurance athlete training for >2 h per day is 2 g/kg (Stellingwerff et al., 2011).

This recommendation should not be directly applied to tennis, where matches involve many high-intensity exertions (<75% VO₂ peak) with carbohydrate acting as the main fuel (Ranchordas et al., 2013).

The International Tennis Federation appreciates that fat should represent about 20-30% of dietary calories (a minimum of 30-40 grams/day), and up to 80-100 grams/day for the energy needs of elite players.

There are two main types of fats: saturated (found in animal fats, except fish), and unsaturated (found in vegetable fats, oil, and fish). Vegetable fats such as avocado, nuts are considered essential - small daily amounts are needed to help make hormones, to maintain healthy skin and hair, and as a secondary energy source for training.

Fat takes the longest time to digest; thus, it is not a good source of quick energy during exercise.

While there is no scientific evidence to show that low body fat levels are required to become a successful tennis player, the successes of highly lean and muscular tennis

players provide the evidence that there may be an advantage in having low body fat (Ranchordas et al., 2013).

d) *Electrolytes/minerals*

Fluid and electrolyte balance is an important factor for optimal physical exercise performance especially in sports such as tennis, where players often compete in hot and humid environments (Rodriguez et al., 2009).

Sweating rates in tennis players have been reported to range from less than 0.5 to over 2.5 L/h (Bergeron, 2003).

Tennis athletes should be on an individualized hydration schedule, consuming more than 200-400 ml of fluid every change over (approximately 10-15 minutes). Optimum hydration and temperature regulation will reduce the chance of tennis related muscle cramps and performance decrements (Kovacs, 2006b).

At high temperatures, tennis players should be well hydrated before matches and drink enough fluids during and after matches or exercise, to prevent dehydration and play at an optimal physical level.

Runners generally drink only 500 ml/h of fluid and thus allow themselves to dehydrate at rates of 500-1,000 ml/h (Coyle & Montain, 1992).

In collegiate tennis players, the athletes' water consumption was at an approximate rate of 1,000 ml/h (Bergeron et al., 1995).

Sodium is the essential electrolyte and main extracellular mineral lost in sweat, and it is important to increase its consumption in the nutrition of tennis players. Too little sodium may lead to fatigue, headache, dizziness, muscle cramps and heat illness (ITF).

In a tennis tournament or repeated days of practice in a hot and humid environment, the cumulative effect of repeated high Na⁺ losses over several days may result in a low extracellular Na⁺ level, especially if daily Na⁺ ingestion is low (MacLaren et al., 1998).

Drinking plain water can lead to hemodilution and enhanced urine production, followed by a reduced drive to drink (MacLaren et al., 1998).

Exercise-induced muscle cramping has multiple factors, and it has been shown that dehydration and electrolyte loss are not the sole reasons for muscle cramping (Jung et al., 2005).

The ingestion of a carbohydrate solution did not improve performance in a three-hour tennis match/practice situation (Mitchell et al., 1992).

This result is contrary to previous results (Coyle et al., 1983; Hargreaves et al., 1984; Mitchell et al., 1988).

If a tennis player has to follow up with a practice session or match within one to two hours, it is recommended that a CHO-electrolyte beverage that contains Na⁺ and Cl⁻ concentrations of 30 to 40 mmol/L should be consumed (Gisolf & Duchman, 1992).

The International Tennis Federation recommends beverages and foods that count toward daily water intake: water, seltzer, club soda, mineral water, flavored water, 100% fruit juices, lemonade, tomato and vegetable juices, low-fat milk, and does not agree that caffeinated beverages and alcohol are diuretics and count toward water intake.

e) *Supplements*

Vitamins and minerals do not provide a source of energy, but are needed to derive energy from carbohydrates,

proteins, and fats that are consumed.

Calcium is also a mineral lost in sweat, as well as the key mineral for strong bone density in tennis players. It is found in cheese, milk, yogurt, ice cream, fish bones, watercress and spinach. The recommended daily intake is 1000-1200 mg.

Iron is another key mineral because of its importance for the production and release of energy. It is found in hemoglobin, which carries oxygen from the lungs to working muscles. The recommended daily intake is 10-12 mg.

Potassium is the main intracellular mineral, so it is often misunderstood as a key electrolyte to increase in order to minimize heat illness risk. It is found in all fruits and fruit juices (especially bananas and melon), tomato juice, meat and dairy, green vegetables and bran. The recommended daily intake is 2500-3000 mg.

Pre-match recommendations

Just as it is important to eat a well-balanced diet on a daily basis, it is equally important to eat the right things before, during, and after competition and training.

The goal is to maximize energy stores so as to meet the energy demands throughout the playing duration and to aid subsequent muscle growth and repair.

The major goals of the tennis player are to gradually increase muscle glycogen stores and to stay hydrated. It is important to eat plenty of complex carbohydrate foods, especially those with a low glycemic index to help boost glycogen stores.

Up to four days before competition, in addition to maintaining a high carbohydrate and fluid intake, it is important to have a little extra protein, up to 1.5-2 grams/kilogram, to ensure that all tissues are fully repaired, and to support the production of creatine (Itftennis.com/scienceandmedicine/nutrition/eating-right.aspx).

The pre-competition meal should be high in carbohydrate, low in fat, low in protein, low in fiber. If athletes really do not feel like eating, they should try to have a liquid meal such as a carbohydrate drink or dairy and fresh fruit.

Recommended

- oatmeal, eggs, ham, roast beef.

Match recommendations

Recommended

- cold fluids on each change over to replace lost fluids and cool the body temperature;
- sports drinks are helpful to replace lost minerals and provide energy;
- moderate to high glycemic index foods, such as high carbohydrate energy bars or non-caffeinated energy gels that are low in fat and protein digest rapidly and are a good source of quick energy;
- nutritional bars between 300-400 calories, including 8-12 grams of protein.

Discouraged

- acidulated drinks;
- fatty snacks such as a chocolate candy bar: they are slow to digest and will sit in the stomach causing a feeling of fullness and reducing fluid absorption by the body (1).

After match recommendations

Post-match nutrition is very important. Glycogen stores can take 24-48 hours to refill; therefore, it is important to start replenishing carbohydrates immediately following exercise to accelerate the recovery process.

The first step is to rehydrate and resupply sodium.

It is equally important to drink water.

Immediately after match, research suggests the intake of 25-30 g protein.

Recommended

- within 1-2 hours after match: eat a well-balanced meal including a variety of carbohydrate sources, a protein portion, and fluids;

- high-carbohydrate sport drinks, sport bars, and other high-carbohydrate foods with a high glycemic index will facilitate the rapid restoration of muscle glycogen;

- chicken with rice and vegetables or;

- fish with potatoes and salad or;

- steak and potatoes with vegetables (Iftennis.com/scienceandmedicine/nutrition/eating-right.aspx).

Conclusions

1. Pro tennis players should focus their efforts on the adequate consumption of six classes of nutrients: water, vitamins, minerals, carbohydrates, protein and fat.

2. Water and sports beverages with electrolytes are essential for maintaining hydration and body temperature during intense play, and decrease the risk of dehydration.

3. Carbohydrates are the best source of energy during the matches.

4. Protein is essential for maintaining, building and repairing the tennis players' muscles. Immediately after the game, players should consume 15-20 g protein (after short matches) and 25-30 g protein (after long matches) because protein synthesis is more efficient immediately after the effort.

5. Fat oxidation will also contribute to energy provision, but fat takes the longest time to digest and thus, it is not a good source of quick energy during exercise.

6. Vitamins and minerals are important to derive energy from nutrients that are consumed.

Conflicts of interest

There were no conflicts of interests.

References

Bergeron MF, Maresh CM, Armstrong LE, Signorile JF, Castellani JW, Kenefick RW, La Gasse KE. Fluid-electrolyte balance associated with tennis match play in a hot environment. *Int J Sport Nutr.* 1995;5(3):180-193.

Bergeron MF. Heat cramps: fluid and electrolyte challenges during tennis in the heat. *J Sci Med Sport.* 2003;6(1):19-27.

Bergstrom J, Hermansen L, Hultman E, Saltin B. Diet, muscle glycogen and physical performance. *Acta Physiol Scand.* 1967;71(2):140-150. doi:10.1111/j.1748-1716.1967.tb03720.x.

Burke LM, Cox GR, Culmings NK. Guidelines for daily carbohydrate intake: do athletes achieve them? *Desbrow B Sports Med.* 2001;31(4):267-299.

Costill DL, Hargreaves M. Carbohydrate nutrition and fatigue. *Sports Med.* 1992;13(2):86-92.

Coyle EF, Hagberg JM, Hurley BF, Martin WH, Ehsani AA. Carbohydrate feeding during prolonged strenuous exercise can delay fatigue. *Holloszy JOJ Appl Physiol Respir Environ Exerc Physiol.* 1983;55(1 Pt 1):230-235.

Coyle EF, Montain S. Benefits of fluid replacement with carbohydrate during exercise. *J Med Sci Sports Exerc.* 1992;24(9 Suppl):S324-S330.

Coyle EF. Physiological determinants of endurance exercise performance. *Sci Med Sport.* 1999;2(3):181-189.

Gidu D. Influence of the diet on muscular glycogen. *Analele Univ "Ovidius" Constanța. Ovidius University of Constanța, Series Sport and Physical Education,* 2008;8(1):457-463.

Gisolf CV, Duchman SM. Guidelines for optimal replacement beverages for different athletic events. *Med Sci Sports Exerc.* 1992;24(6):679-687.

Hargreaves M., Costill DL, Coggan AR, Fink WJ, Nishibata I. Effect of carbohydrate feeding on muscle glycogen utilization and exercise performance. *Med Sci Sports Exerc* 1984;16(3):219-222.

Jung AP, Bishop PA, Al-Nawwas A. Influence of Hydration and Electrolyte Supplementation on Incidence and Time to Onset of Exercise-Associated Muscle Cramps. *Dale RBJ Athl Train.* 2005;40(2):71-75.

Kovacs MS. Carbohydrate intake and tennis: are there benefits? *Br J Sports Med* 2006a;40(5):e13. doi:10.1136/bjbm.2005.023291.

Kovacs MS, Baker LB. Recovery interventions and strategies for improved tennis performance. *Br J Sports Med.* 2014; 48(Suppl 1):i18-i21. doi:10.1136/bjsports-2013-093223.

Kovacs MS. Hydration and Temperature in Tennis -A Practical Review. *J Sports Sci Med.* 2006b;5(1):19.

MacLaren DPM, Lees A, Maynard I, Hughes M, Reilly T. Nutrition for racket sports. In: *Science and racket sports II*, editors. London: E & FN Spon. 1998,43-51.

Mitchell JB, Cole KJ, Granjean PW, Sobczak RJ. The effect of a carbohydrate beverage on tennis performance and fluid balance during prolonged tennis play. *J Appl Sport Sci Res.* 1992;6:96-102.

Mitchell JB, Costill DL, Houmard JA, Flynn MG, Fink WJ, Beltz JD. Effects of carbohydrate ingestion on gastric emptying and exercise performance. *Med Sci Sports Exerc* 1988;20(2):110-115.

Panait L, Du D, Negrea V. Experimental approach regarding investigation level of general physical training for tennis players aged 13 to 14 years, *Ovidius University Annals, Series Physical Education and Sport/Science, Movement and Health.* 2013;13(2 Supplement):280-284.

Phillips SM, Van Loon LJ. Dietary protein for athletes: from requirements to optimum adaptation. *J Sports Sci.* 2011;29 (Suppl 1):S29-S38.

Ranchordas MK, Rogerson D, Ruddock A, Killer SC, Winter EM. Nutrition for tennis: practical recommendations. *J Sports Sci Med.* 2013;12(2):211-224.

Rodriguez NR, Di Marco NM, Langley S, American Dietetic Association Dietitians of Canada, American College of Sports Medicine. American College of Sports Medicine position stand. Nutrition and athletic performance. *Med Sci Sports Exerc.* 2009;41(3):709-731. doi:10.1249/MSS.0b013e31890eb86.

Stellingwerff T, Maughan RJ, Burke LM. Nutrition for power sports: middle-distance running, track cycling, rowing, canoeing/kayaking, and swimming. *J Sports Sci.* 2011;29 (Suppl 1):S79-S89.

Websites

(1) International Tennis Federation. Available from: Iftennis.com/scienceandmedicine/nutrition/eating-right.aspx. Accessed in 2017, August 10

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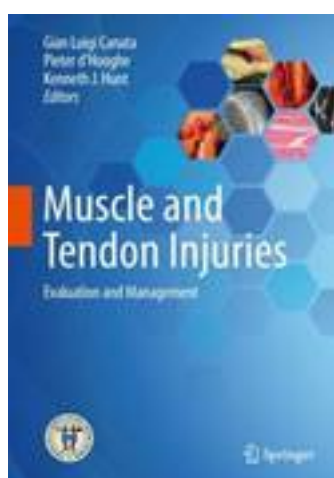
Muscle and tendon injuries. Evaluation and management

(Leziunile mu chilor i tendoanelor. Evaluare i management)

Editors: Gian Luigi Canata, Pieter d’Hooghe, Kenneth J. Hunt

Publishing House: Springer, May 2017

450 pages; price: 142.79 €



When looking at the latest publications related to muscle injuries in sport, two titles launched by Springer in 2017 have drawn our attention: “*Muscle Injuries in Sport Athletes. Clinical Essentials and Imaging Findings*” and “*Muscle and Tendon Injuries. Evaluation and Management*”. Knowing that muscle and tendon injuries are extremely common in sports, it is evident that both books are worthy of interest, but taking into consideration that it also addresses tendon pathology, we have decided to present here the second one. It is a book published under the auspices of ISAKOS (International Society of Arthroscopy, Knee Surgery, and Orthopedic Sports Medicine), whose president - Philippe Neyret - considers it “one of the fags of the education program” of their society.

Three editors and an unusually great number of 135 collaborators - all of them world-renowned experts in their felds - put together their expertise and experience, which was fnally worth it because their efforts resulted in an invaluable book from the perspective of very many professionals (if we consider that aside from the sporting activity, work-induced physical loading is involved in numerous other human activities). At the same time, this impressive book, with no less than 450 pages, summarizes the state of the art in muscle and tendon anatomy, biology, biomechanics and pathology, as well as in the diagnosis and treatment of the respective tissue disorders.

The book starts with the chapters dedicated to basic science on muscles and tendons, which are crucial not only for understanding the pathophysiology and management of lesions, but also for identifying the aspects that need special attention from researchers in the future. Then, within the next chapters, the entire range of topics related to muscle and tendon injuries are extensively approached. An important strength of the book is that even if all three editors are surgeons, it offers the readers detailed information on conservative management, which is of great interest and help to practitioners in sport medicine, traumatology and physiotherapy.

Although rather voluminous, the book looks like a well organized structure, whose elements form an integrated whole out of which no part is superfluous; this means that its entire content deserves our serious attention. However, some of the 40 chapters are essential, as they contain all that is relevant for acquiring the most modern perspective on muscle and tendon pathology. From this point of view, key sequences seem to be chapters 9 (*Classification of Muscle Lesions*), 10 (*Prevention of Musculotendinous Pathologies*), 11 (*Why the Tendon Tears and Doesn’t Like to Heal*), 14 (*New Strategies for Muscular Repair and Regeneration*) and 15 (*Conservative Treatments for Tendinopathy*).

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EVENTS



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The autumn cross country races for students in Frata (3rd ed.) and Râchițele-Mărgușu (7th ed.) continue

La Frata (ed. a 3-a) și Râchițele-Mărgușu (ed. a 7-a), continuă crossurile de toamnă ale elevilor

As usual, at the beginning of our report we mention some new facts compared to the last year's edition. The intention to organize the autumn cross country races earlier this year, before the setting in of cold weather, was partly achieved. Thus, the cross country race in Frata took place on 12 October 2017 compared to 10 November last year, while the competition organized in Râchițele-Mărgușu was held on 21 October 2017 compared to 22 October last year. Regarding participation, there was a significant increase in the number of participants in the Râchițele cross country event, which was attended by more than 140 students. This was due to the participation of some school teams from new commune centers, as well as to the participation of a greater number of students from the school of the organizing commune. The cross country race in Frata was attended by about 90 participants, similarly to last year. In both competitions, the prizes consisted of books and sports equipment. We mention that the two autumn cross country events are part of the Educational health prevention project in rural areas, *Sport – an alternative for a healthy life*.

Results:

Frata

Participating centers: Frata, Căminu, Sopor de Câmpie, Mociu, Luna, Căianu, Luncani, Boian/Ceanu Mare.

General ranking: I - Căminu Middle School with 39 points; II - Frata Middle School with 40 points; III - Sopor de Câmpie Middle School with 64 points.

First place in all age categories: 11-12 year-old boys, grades V-VI - Florin Trif - Frata; 11-12 year old girls, grades V-VI - Eliza Gașpar - Căminu; 13-14 year old boys, grades VII-VIII - Marian Mocian - Căminu; 13-14 year old girls, grades VII-VIII - Alina Gheorghiu - Sopor de Câmpie.

Team leading teachers: Frata Middle School - Popa Sebastian; Căminu Middle School - Revnic Vlad; Sopor de Câmpie Middle School - Pașca Tușă Maria; Mociu Middle School - Donea Tudor; Luna Middle School - Olar Maria; Luncani Middle School - Cservenecz Iuliu; Căianu Middle School - Brata Valentin; Boian Middle School - Toth Mihai.

Local officials: Teodor Bara - director of Frata Middle School; Vasile Trif – mayor



Before the start, the last indications from the starter



Prize awarding, 11-12 year old girls, by the director of the Frata School, Teodor Bara.



Prize awarding, 13-14 year old boys, by the teacher of the Frata School, Sebastian Popa



Group picture, with the organizers and the referee team



Three of the methodicians playing an important role in the cross country running and skiing competitions: Mihaly Béla, Ramona Ilea and Sorina Pop (Soso)



Awarding prizes to team leading teachers: Revnic Vlad - C m ra u Middle School; Popa Sebastian - Frata Middle School; Pa ca Tu a Maria - Sopor de Cîmpie Middle School

R chi ele-M rg u

Participating centers: Sâncraiu, M ri el, R chi ele, Izvorul Cri ului, Beli , Rogojel, Râ ca.

General ranking: I – *Ady Endre* Middle School, Sâncraiu; II - *Pelaghia Ro u* Middle School, M ri el; III – R chi ele Middle School.

First place in all age categories: preparatory grade boys - Marius B la - R chi ele; preparatory grade girls - Adela B la - R chi ele; 9-10 year old boys, grades III-IV - Lovász Balász - Sâncraiu; 9-10 year old girls, grades III-IV - Péntek Rita - Izvoru Cri ului; 11-12 year old boys, grades V-VI - Paul Todoru - R chi ele; 11-12 year old girls,

grades V-VI - Okos-Rigo Aliz - Sîncraiu; 13-14 year old boys, grades VII-VIII - Gheorghe B la - R chi ele; 13-14 year old girls, grades VII-VIII - Szöcs Imola - Sâncraiu.

Team leading teachers: *Ady Endre* Middle School, Sâncraiu - Csudom Norbert; *Pelaghia Ro u* Middle School, M ri el - Bal Ionu ; R chi ele Middle School - Ro u Claudiu; *Kos Káoly* Middle School, Izvoru Cri ului - Török Anamaria; *Avram Iancu* Middle School, Beli ; S cuieu/Rogojel Middle School - Cri an Aurel; Râ ca Middle School - Ilea Ardelean;

Local officials: Alexandra Ro u – director of M rg u Middle School; Petru Ungur – mayor of M rg u commune.



The opening ceremony – R chi ele, 2017



The preparatory grade team (9-10 years) of the R chi ele school and teacher Claudiu Ro u



Prize awarding ceremony, the 13-14 year old category, by teachers Sân Mirela and Pav l Simona (right), assisted by teacher Claudiu Ro u



Prize awarding ceremony, the preparatory grade category (9-10 years), by School Inspector Laura Ionescu



Cups awarded in the cross country running competition in R chi ele



Awarding prizes to team leading teachers: Csudom Norbert - *Ady Endre* Middle School, Sâncraiu; Ionu Bal - *Pelaghia Ro u* Middle School, M ri el; Ro u Claudiu - R chi ele Middle School
Ceremony conducted by the mayor of M ri el commune, Petru Ungur

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The 7th National Conference with International Participation “Nutrition - Medicine of the Future” & the Francophone Symposium on Nutrition and Food Safety “Nutrisûr”, 23-24 November 2017, Cluj-Napoca, Romania

*Conferin a Na ional cu Participare Interna ional “Nutri ia – Medicina Viitorului”,
Edi ia a VII-a & Colocviul Francofon privind Nutri ia i Siguran a Alimentar
“Nutrisûr”*

Between 23 and 24 November, the Seventh Edition of The National Conference with International Participation “Nutrition - Medicine of the Future” (CNMV) 2017 took place at the “Iuliu Ha ieganu” Aula in Cluj-Napoca, Romania. This year, the conference was preceded by the Francophone Symposium on Nutrition and Food Safety “Nutrisûr”. Both events were organized by the “Nutrition and Health” Association and “Iuliu Ha ieganu” University of Medicine and Pharmacy (UMPh) Cluj-Napoca, in collaboration with the Francophone University Association - Central and Eastern Europe subsidiary, the Academy of Romanian Scientists - Cluj-Napoca subsidiary, the College of Pharmacists in Romania, the “Gusturi Transilvane” Cluster, the Romanian Society for Pharmaceutical Sciences, the French Institute - Cluj-Napoca subsidiary, and various student organizations.

More than 550 participants and speakers including dietitians, physicians, pharmacists, nurses, chemists, biologists, nutrition scientists, and students from eight countries participated in this two-day event. All participants received medical or pharmaceutical education credits (EMC/EFC) and certificates.

As a meeting point for health care professionals (practitioners and researchers), the annual conference provided a full program of activities to allow interactive discussions on various topics of interest to the nutrition community. During the first day, advances in food safety and security were covered in the Francophone Symposium on Nutrition and Food Safety “Nutrisûr”, whereas novel practices in diet therapy were shared during two workshops: *Metabolic hallmarks of cancer cells as targets for*

nutritional therapies and Sports nutrition - from individual counseling to team counseling. The second day included keynote lectures and oral communications comprising issues such as *nutrigenomics and cancer; extra organic olive oil as a food medicine for all ages; hypertension, lifestyle, diet and prevention of cardiovascular diseases; Mediterranean diet and human milk; glucose transporter type 1 deficiency syndrome and ketogenic diets; genetics of eating behavior; nutritional metabolomics; nutrition in hospitalized patients.*

Moreover, “Dr. Albu” special scholarships in the field of nutrition and dietetics in Romania for Master’s Degree students in “Nutrition and Quality of Life” were presented, and 20 posters were evaluated during the conference. Also, three book presentations were included in the program: *Equation of weight loss. Nutrition and training guide for a good quality of life* (Dr. Ierban Damian - Superfit Nutrition Center Bucharest, RO); *Nutrition guide for amateur and professional athletes with applications in the rugby game* (Diet. Nicoleta Tupi - Nutrition Health and Wellness Manager, Nestlé Romania, RO); *Genetics. Personalized Nutrition and Precision Medicine* (Biol. Nutr. Marie Vrânceanu – “Iuliu Ha ieganu” UMPh Cluj-Napoca, RO).

Details about CNMV can be found on the conference website: <http://cnmv-umfcluj.ro/>, and pictures from CNMV 2017 are available on the Facebook page: <https://www.facebook.com/medicina.viitorului/>.

The consistently high quality of the research presentations and the dynamic participants, all contributed to the great success of this event. Thanks to all and see you at the next edition of CNMV!



Lect. Dr. Anamaria Cozma-Petru - general organizer of “Nutrisûr” Symposium



Prof. Dr. Felicia Loghin - scientific Vice-Rector of “Iuliu Haieganu” UMPH Cluj-Napoca & President of the Scientific Committee of “Nutrisûr” Symposium



Prof. Dr. Radu Oprean - member of the Regional Commission of Experts of the Agence universitaire de la Francophonie & member of the Scientific Council of the Agence universitaire de la Francophonie



Prof. Dr. Franco Veglio – invited speaker from the University of Turin (IT)



Prof. Dr. Rosita Gabbianelli - invited speaker from the University of Camerino (IT)



Prof. Dr. Zaid Afawi – invited speaker from Tel Aviv University (IL)

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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 University 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 address 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, Objective-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, Vi an D et al. Probleme de pedagogie în sport. Educa ie Fizic i Sport 2000; 25(4):2-8.

Books: Dr gan I (coord.). Medicina sportiv , Editura Medical , 2002, Bucure ti, 2002, 272-275.

Chapters from books: H ulic I, B l atu O. Fiziologia senescen ei. In: H ulic I. (sub red.) Fiziologia uman , Ed. Medical , Bucure ti, 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.

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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 Haieganu" 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 ATEN IA COLABORATORILOR

Tematica revistei

Ca tematic , revista are un caracter multidiscplinar orientat pe domeniile biomedical, s n tate, efort fizic, tiin e sociale, aplicate la activit ile de educa ie fizic i sport, astfel încât subiectele tratate i autorii apar in mai multor specialit i din aceste domenii. Principalele rubrici sunt: „Articole originale” i „Articole de sintez ”.

Exemplif c m rubrica „Articole de sintez ” prin temele importante expuse: stresul oxidativ în efort fizic; antrenamentul mintal; psihoneuroendocrinologia efortului sportiv; cultura fizic în practica medicului de familie; sporturi extreme i riscuri; determinan i emo ionali ai performan ei; recuperarea pacien ilor cu suferin e ale coloanei vertebrale; sindroame de stres i psihosomatic ; educa ia olimpic , aspecte juridice ale sportului; efortul fizic la vârstnici; tulbur ri ale psihomotricit ii; preg tirea sportiv la altitudine; fitness; biomecanica mi c rilor; testele EUROFIT i alte metode de evaluare a efortului fizic; reac ii adverse ale eforturilor; endocrinologie sportiv ; depresia la sportivi; dopajul clasic i genetic; Jocurile Olimpice etc.

Dintre articolele consacrate studiilor i cercet rilor experimentale not m pe cele care vizeaz : metodica educa iei fizice i sportului; inf uen a unor ioni asupra capacit ii de efort; prof ul psihologic al studentului la educa ie fizic ; metodica în gimnastica sportiv ; selec ia sportivilor de performan .

Alte articole trateaz teme particulare vizând diferite sporturi: înotul, gimnastica ritmic i artistic , handbalul, voleiul, baschetul, atletismul, schiul, fotbalul, tenisul de mas i câmp, luptele libere, sumo.

Autorii celor dou rubrici de mai sus sunt medici, profesori i educatori din înv mântul universitar i preuniversitar, antrenori, cercet ori tiin if ci etc.

Alte rubrici ale revistei sunt: editorialul, actualit ile editoriale, recenziile unor c r i - ultimele publicate în domeniu, la care se adaug i altele prezentate mai rar (inven ii i inova ii, universitara, preuniversitara, forum, remember, calendar competi ional, portrete, evenimente tiin if ce).

Subliniem rubrica “Memoria ochiului fotograf c”, unde se prezint fotografii, unele foarte rare, ale sportivilor din trecut i prezent.

De men ionat articolele semnate de autori din Republica Moldova privind organizarea înv mântului sportiv, variabilitatea ritmului cardiac, etapele adapt rii la efort, articole ale unor autori din Fran a, Portugalia, Canada.

Scopul principal al revistei îl constituie valorif carea rezultatelor activit ilor de cercetare precum i informarea permanent i actual a speciali tilor din domeniile amintite. Revista î i asum i un rol important în îndeplinirea punctajelor necesare cadrelor didactice din înv mântul universitar i preuniversitar precum i medicilor din re eua medical (prin recunoa terea revistei de c tre Colegiul Medicilor din România), în avansarea didactic i profesional .

Un alt merit al revistei este publicarea obligatorie a cuprinsului i a câte unui rezumat în limba englez , pentru toate articolele. Frecvent sunt publicate articole în extenso într-o limb de circula ie interna ional (englez , francez).

Revista este publicat trimestrial iar lucr rile sunt acceptate pentru publicare în limba român i englez . Articolele vor f redactate în format WORD (nu se accept articole în format PDF). Expedierea se face prin e-mail sau pe dischet (sau CD-ROM) i listate, prin po t pe adresa redac iei. Lucr rile colaboratorilor reziden i în str in tate i ale autorilor români trebuie expediate pe adresa redac iei:

Revista «Palestrica Mileniului III»

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Obiective

Ne propunem ca revista s continue a f o form de valorif care a rezultatelor activit ii de cercetare a colaboratorilor si, în special prin stimularea particip rii acestora la competi ii de proiecte. Men ion m c articolele publicate în cadrul revistei sunt luate în considerare în procesul de promovare în cariera universitar (acreditare ob inut în urma consult rii Consiliului Na ional de Atestare a Titlurilor i Diplomelor Universitare).

Ne propunem de asemenea s încuraj m publicarea de studii i cercet ri, care s cuprind elemente originale relevante mai ales de c tre tineri. Toate articolele vor trebui s aduc un minimum de contribu ie personal (teoretic sau practic), care s fe eviden iat în cadrul articolului.

În perspectiv ne propunem îndeplinirea criteriilor care s permit promovarea revistei la niveluri superioare cu recunoa tere interna ional .

STRUCTURA I TRIMITEREA ARTICOLELOR

Manuscrisul trebuie preg tit în acord cu prevederile Comitetului Interna ional al Editurilor Revistelor Medicale (<http://www.icmjee.org>).

Num rul cuvintelor pentru formatul electronic:

- 4000 cuvinte pentru articolele originale,
- 2000 de cuvinte pentru studiile de caz,
- 5000-6000 cuvinte pentru articolele de sintez .

Format pagin : 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.

Ilustrațiile:

Figurile (grafice, fotografii etc.) vor fi numerotate consecutiv în text, cu cifre arabe. Vor fi editate cu programul EXCEL sau SPSS, și vor fi trimise ca fișiere separate: „figura 1.tif”, „figura 2. jpg”, iar la solicitarea redacției în original. Fiecare grafic va avea o legendă care se trece sub figura respectivă.

Tabelele vor fi numerotate consecutiv în text, cu cifre romane, și vor fi trimise ca fișiere separate, însoțite 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 instituției, adresa poștală și 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 consacrați). Toate articolele vor avea un rezumat în limba engleză. Nu se vor folosi prescurtări, note de subsol sau referințe.

Premize și obiective: descrierea importanței studiului și precizarea premizelor și obiectivelor cercetării.

Metodele: includ următoarele aspecte ale studiului:

Descrierea categoriei de bază a studiului: de orientare sau aplicativ.

Localizarea și perioada de desfășurare a studiului. Colaboratorii vor prezenta descrierea timpului de lucru, sexul (genul), vârsta și alte variabile socio-demografice.

Metodele și instrumentele de investigație folosite.

Rezultatele vor prezenta datele statistice descriptive și inferențiale obținute (cu precizarea testelor statistice folosite): diferențele dintre măsurtoarea inițială și cea finală, pentru parametri investigați, semnificația coeficienților de corelație. Este obligatorie precizarea nivelului de semnificație (valoarea *p* sau mărimea efectului *d*) și a testului statistic folosit etc.

Concluziile care au direct legătură cu studiul prezentat.

Articolele de orientare și 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 și Metode (inclusiv informațiile etice și statistice), Rezultate, Discutarea rezultatelor, Concluzii (și 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 menționa: numele tuturor autorilor și inițialele prenumelui, anul apariției, titlul articolului în limba originală, titlul revistei în prescurtare internațională (caractere italice), numărul volumului, paginile

Articole: Pop M, Albu VR, Vișan D et al. Probleme de pedagogie în sport. *Educația Fizică și Sportul* 2000; 25(4):2-8.

Cărți: Drăgan I (coord.). *Medicina sportivă aplicată*. Ed. Editis, București 1994, 372-375.

Capitole din cărți: Hulea I, Bălatu O. *Fiziologia senescenței*. În: Hulea I. (sub red.) *Fiziologia umană*. Ed. Medicală, București 1996, 931-947.

Începând cu revista 4/2010, fiecare articol va trebui să se bazeze pe un minimum de 15 și un maximum de 100 referințe bibliografice, în majoritate articole nu mai vechi de 10 ani. Sunt admise un număr limitat de cărți și articole de referință (1-3), cu o vechime mai mare de 10 ani. Un procent de 20% din referințele bibliografice citate trebuie să menționeze literatură străină studiată, cu respectarea criteriului actualității acesteia (nu mai vechi de 10 ani).

Procesul de recenzare (peer-review)

Într-o primă etapă toate materialele sunt revizuite riguros de cel puțin doi referenți competenți în domeniu respectiv (profesori universitari doctori și doctori docenți) pentru ca textele să corespundă ca fond și formă de prezentare cerințelor unei reviste serioase. După această etapă materialele sunt expediate referenților revistei, în funcție de profilul materialelor. În urma observațiilor primite din partea referenților, redacția comunică observațiile autorilor în vederea corectării acestora și încadrării în cerințele de publicare impuse de revistă. Acest proces (de la primirea articolului până la transmiterea observațiilor) durează aproximativ 4 săptămâni. Cu această ocazie se comunică autorului dacă articolul a fost acceptat spre publicare sau nu. În situația acceptării, urmează perioada de corectare a articolului de către autor în vederea încadrării în criteriile de publicare.

Conflicte de interes

Se cere autorilor să menționeze toate posibilele conflicte de interes incluzând relațiile financiare și de alte tipuri. Dacă sunteți siguri că nu există nici un conflict de interes vă rugăm să menționați acest lucru. Sursele de finanțare ar trebui să

fe men ionate în lucrarea dumneavoastr .

Preciz ri

Preciz rile trebuie f cute doar în leg tur cu persoanele din afara studiului, care au avut o contribu ie substan ial la studiul respectiv, cum ar f anumite prelucr ri statistice sau revizuirea textului în limba englez . Autorii au responsabilitatea de a ob ine permisiunea scris din partea persoanelor men ionate cu numele în cadrul acestui capitol, în caz c cititorii se refer la interpretarea rezultatelor i concluziilor acestor persoane. De asemenea, la acest capitol se vor face preciz ri în cazul în care articolul valorif c rezultate par iale din anumite proiecte sau dac acesta se bazeaz pe teze de masterat sau doctorat sus inute de autor, alte preciz ri.

Criterii deontologice

Redac ia va r spunde în timp util autorilor privind acceptarea, neacceptarea sau necesitatea modif c rii textului i î i rezerv dreptul de a opera modif c ri care vizeaz forma lucr rilor.

Nu se accept lucr ri care au mai fost tip rite sau trimise spre publicare la alte reviste. Autorii vor trimite redac iei odat cu articolul propus spre publicare, într-un f ier word separat, o declara ie scris în acest sens, cu angajamentul respect rii normelor deontologice referitoare la citarea surselor pentru materialele folosite (referin e bibliograf ce, f guri, tabele, chestionare).

Pentru articolele originale, în conformitate cu îndeplinirea condi iilor Declara iei de la Helsinki, a Protocolului de la Amsterdam, a Directivei 86/609/EEC i a reglement rilor Comisiilor de Bioetic din loca iile unde s-au efectuat studiile, autorii trebuie s prezinte:

- acordul informat din partea familiei, pentru studiile pe copii i juniori;
- acordul informat din partea subiec ilor adul i, pacien i i sportivi, pentru participare;
- adeverin de Malpraxis pentru medici, pentru cercet rile/studiile pe subiec i umani;
- adeverin din partea Comisiilor de Etic , pentru protocolul de studiu pe subiec i umani;
- adeverin din partea Comisiilor de Bioetic , pentru protocolul de studiu pe animale.

Datele vor f men ionate în articol la sec iunea Material i metod . Documentele vor f ob inute înainte de începerea studiului. Se va men iona i num rul de înregistrare al adeverin ei din partea Comisiilor de Etic .

Materialele trimise la redac ie nu se restituie autorilor, indiferent dac sunt publicate sau nu.

ÎN ATEN IA SPONSORILOR

Solicit rile pentru spa iile de reclam , vor f adresate redac iei revistei "Palestrica Mileniului III", Str. Clinicilor nr. 1, cod 400006 Cluj-Napoca, România. Pre ul unei pagini de reclam full color A4 pentru anul 2012 va f de 250 EURO pentru o apari ie i 800 EURO pentru 4 apari ii. Costurile public rii unui Logo pe coper ile revistei, vor f stabilite în func ie de spa iul ocupat. Plata se va face în contul Societ ii Medicale Române de Educa ie Fizic i Sport, CIF 26198743. Banca Transilvania, sucursala Cluj Cod IBAN: RO32 BTRL 0130 1205 S623 12XX (LEI).

ÎN ATEN IA ABONA ILOR

Revista "Palestrica Mileniului III" este tip rit trimestrial, pre ul unui abonament f ind pentru str in tate de 100 Euro pentru institu ii, i 50 Euro individual. Pentru intern, pre ul unui abonament institu ional este de 120 lei, al unui abonament individual de 100 lei. Men ion m c taxele de difuzare po tal sunt incluse în costuri.

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Preciz m c începând cu anul 2010 a fost introdus taxa de articol. Ca urmare, to i autorii semnatari ai unui articol vor achita împreun suma de 150 Lei, în contul Societ ii Medicale Române de Educa ie Fizic i Sport publicat mai sus.

Autorii care au abonament vor f scuti i de aceast tax de articol.

Alte informa ii se pot ob ine online de pe www.pm3.ro „Pentru autori” sau pe adresa de mail a redac iei palestrica@gmail.com sau pe adresa po tal : Str. Clinicilor nr.1 cod 400006, Cluj-Napoca, România, Telefon:0264-598575.

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pISSN: 1582-1943; eISSN: 2247-7322; ISSN-L: 1582-1943

Prof I: revist de studii i cercet ri interdisciplinare

Editor: Universitatea de Medicin i Farmacie „Iuliu Ha ieganu” din Cluj-Napoca i Societatea Medical Român de Educa ie Fizic i Sport, în colaborare cu Inspectoratul colar al Jude ului Cluj

Nivelul de atestare al revistei: revist acreditat în categoria B+ de CNCS în perioadele 2007-2011 i atestat CMR din anul 2003 i în prezent

Revist indexat în Bazele de Date Interna ionale (BDI): EBSCO, Academic Search Complete, USA i Index Copernicus, Journals Master List, Polonia, DOAJ (Directory of Open Access Journals), Sweden

Anul primei apari ii: 2000

Periodicitate: trimestrial

Cuprinsul, rezumatele i instruc iunile pentru autori se g sesc pe pagina de Internet: <http://www.pm3.ro> Accesul la cuprins i articole in extenso (în format .pdf) este gratuit.

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