

# **PALESTRICA OF THE THIRD MILLENNIUM - CIVILIZATION AND SPORT**

*A quarterly of multidisciplinary study and research*

© Published by The "Iuliu Hațieganu" 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,  
CFR (Romanian College of Pharmacists) since 2015 and CMDR since 2018

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  
CiteFactor, Canada/USA  
CrossRef, Lynnfield, MA (US)/Oxford (UK)

# 3

Vol. 19, No. 3, July-September 2018

## **Editorial Board**

### **Chief Editor**

Traian Bocu (Cluj-Napoca, Romania)

### **Deputy Chief Editors**

Simona Tache (Cluj-Napoca, Romania)    Ioan Onac (Cluj-Napoca, Romania)  
Dan Riga (București, Romania)        Adriana Filip (Cluj-Napoca, Romania)

### **Bio-Medical, Health and Exercise Department**

Cezar Login (Cluj-Napoca, Romania)  
Adriana Albu (Cluj-Napoca, Romania)  
**Adrian Aron (Radford, VA, USA)**  
Taina Avramescu (Craiova, Romania)  
Cristian Bârsu (Cluj-Napoca, Romania)  
Gheorghe Benga (Cluj-Napoca, Romania)  
Simion Bran (Cluj-Napoca, Romania)  
Consuela Monica Brăilescu (București, Romania)  
**Roxana Carare (Southampton, UK)**  
Irina Chiș (Cluj-Napoca, Romania)  
Simona Clichici (Cluj-Napoca, Romania)  
Victor Cristea (Cluj-Napoca, Romania)  
Anne-Marie Constantin (Cluj-Napoca, Romania)  
**Daniel Courteix (Clermont Ferrand, France)**  
Gheorghe Dumitru (Constanța, Romania)  
Lorena Filip (Cluj-Napoca, Romania)  
Mira Florea (Cluj-Napoca, Romania)  
**Satoro Goto (Chiba, Japan)**  
Nicolae Hâncu (Cluj-Napoca, Romania)  
Anca Ionescu (București, Romania)  
Lászlo Irsay (Cluj-Napoca, Romania)  
**Wolf Kirsten (Berlin, Germany)**  
**Gulshan Lal Khanna (Faridabad, India)**  
Valeria Laza (Cluj-Napoca, Romania)  
**Jordi Mañes (Valencia, Spain)**  
Daniela Motoc (Arad, Romania)  
Radu Oprean (Cluj-Napoca, Romania)  
Alina Pârvu (Cluj-Napoca, Romania)  
Liviu Pop (Cluj-Napoca, Romania)  
**Zsolt Radak (Budapest, Hungary)**  
**Suresh Rattan (Aarhus, Denmark)**  
Sorin Riga (București, Romania)  
**Aurel Saulea (Chișinău, Republic of Moldavia)**  
Șoimița Suci (Cluj-Napoca, Romania)  
**Robert M. Tanguay (Quebec, Canada)**  
Gheorghe Tomoaia (Cluj-Napoca, Romania)  
Rodica Ungur (Cluj-Napoca, Romania)  
Mirela Vasilescu (Craiova, Romania)

### **Social sciences and Physical Activities Department**

Dana Bădău (Tg. Mureș, Romania)  
Daniela Aducovschi (București, Romania)  
Dorin Almășan (Cluj-Napoca, Romania)  
Maria Aluș (Cluj-Napoca, Romania)  
Robert Balazsi (Cluj-Napoca, Romania)  
Lorand Balint (Brașov, Romania)  
Vasile Bogdan (Cluj-Napoca, Romania)  
Marius Crăciun (Cluj-Napoca, Romania)  
Mihai Cucu (Cluj-Napoca, Romania)  
Remus Dumitrescu (București, Romania)  
Ioan Virgil Ganea (Cluj-Napoca, Romania)  
Leon Gomboș (Cluj-Napoca, Romania)  
Emilia Florina Grosu (Cluj-Napoca, Romania)  
**Vasile Guragata (Chișinău, Republic of Moldavia)**  
Iacob Hanțiu (Oradea, Romania)  
Mihai Kiss (Cluj-Napoca, Romania)  
**Eunice Lebre (Porto, Portugal)**  
Sabina Macovei (București, Romania)  
Ștefan Maroti (Oradea, Romania)  
Ion Măcelaru (Cluj-Napoca, Romania)  
Bela Mihaly (Cluj-Napoca, Romania)  
Alexandru Mureșan (Cluj-Napoca, Romania)  
Ioan Mureșan (Cluj-Napoca, Romania)  
**Cătălin Nache (Nancy, France)**  
**Enrique Navarro (Madrid, Spain)**  
Nicolae Neagu (Tg. Mureș, Romania)  
Ioan Pașcan (Cluj-Napoca, Romania)  
Constantin Pehoiu (Târgoviște, Romania)  
Nicolae Horațiu Pop (Cluj-Napoca, Romania)  
Cornelia Popovici (Cluj-Napoca, Romania)  
Voichița Rus (Cluj-Napoca, Romania)  
Monica Stănescu (București, Romania)  
Demostene Șofron (Cluj-Napoca, Romania)  
Octavian Vidu (Cluj-Napoca, Romania)  
Alexandru V. Voicu (Cluj-Napoca, Romania)  
Ioan Zanc (Cluj-Napoca, Romania)

### **Honorary Members**

Univ. Prof. MD. Marius Bojiță ("Iuliu Hațieganu" University of Medicine and Pharmacy, Cluj-Napoca, Romania)  
Univ. Prof. MD. Mircea Grigorescu ("Iuliu Hațieganu" University of Medicine and Pharmacy, Cluj-Napoca, Romania)  
Univ. Prof. PhD. Radu Munteanu (Technical University, Cluj-Napoca, Romania)  
Univ. Prof. MD. Liviu Vlad ("Iuliu Hațieganu" University of Medicine and Pharmacy, Cluj-Napoca, Romania)

### **Editorial Office of the Journal of „Palestrica of the Third Millennium” Civilization and Sport**

Street: Clinicilor no. 1  
400006, Cluj-Napoca  
Telephone: 0264-598575  
E-mail: palestrica@gmail.com

pISSN 2601 - 2537  
eISSN 2601 - 2545  
ISSN-L 2601 - 2537  
www.pm3.ro

### **Editors for English Language**

Sally Wood-Lamont *swood@umfcluj.ro*  
Denisa Marineanu *margitana@yahoo.com*

### **Marketing, PR**

Cristian Potoră *crispotora@gmail.com*

### **International relations**

Tudor Mirza *midor1967@gmail.com*  
Irina Chiș *irinaus@yahoo.com*  
Mihai Kiss *mishu71@yahoo.com*  
Cornelia Popovici *popovicicornelia@yahoo.com*

### **Website maintenance**

Transmondo

## Contents

### ORIGINAL STUDIES

- Non-specific maximal testing results, under certain training conditions, can be associated with roller skiing performances during a competitive 5K event**  
*Ștefan Adrian Martin, Roxana Maria Hadmaș, Dan Dobreanu* ..... 141
- A strategy for an interdisciplinary intervention on children with diabetes: a pilot study**  
*Constanța Urzeală, Mihaela Vlăiculescu, Daniel Courteix* ..... 147
- Differences in dietary supplements used by performance athletes and recreationally active individuals**  
*George Jîtcă, Amelia Tero-Vescan, Amalia Miklos, Camil-Eugen Vari, Bianca-Eugenia Ősz* ..... 153
- Promoting and supporting physical activity and sport among young people in the Republic of Moldova**  
*Serghei Cebanu, Mariana Tutunaru, Raisa Deleu, Angela Cazacu-Stratu, Grigore Friptuleac* ..... 158
- Study of the physiotherapist – patient relationship**  
*Alexandra-Camelia Gliga, Nicolae Neagu, Tiberiu Bătagă* ..... 165
- Six-minute walk test outcome in COPD patients**  
*Ana Florica Chiș, Ruxandra Mioara Râjnoveanu, Milena Adina Man, Doina Adina Todea, Bogdan Augustin Chiș, Carmen Monica Pop* ..... 170
- Menu structure for children and youth swimmers during micro-cycle training**  
*Alexandru Maștei, Roxana Maria Hadmaș, Ștefan Adrian Martin* ..... 176

### REVIEWS

- Physical activity in colorectal cancer**  
*Laura Ioana Gavrițaș, Corina Ionescu, Ovidiu Bălăcescu, Daniel Cruceriu, Lorena Filip, Doina Miere* ..... 181

### RECENT PUBLICATIONS

- Book reviews**  
Debra J. Rose (editor). Physical activity instruction of older adults. 2nd edition  
*Gheorghe Dumitru* ..... 187

### SCIENTIFIC MANIFESTATIONS

- The 4<sup>th</sup> National Conference of Medicine Applied to Physical Education and Sports, Higher Quality**  
*Traian Bocu* ..... 188

### EVENTS

- Evocation of Professor Dr. Iuliu Hațieganu in Dârja (3)**  
*Traian Bocu* ..... 190
- The annual meeting of veteran athletes of the „U” Cluj Club (24)**  
*Traian Bocu* ..... 192

### FOR THE ATTENTION OF CONTRIBUTORS

- The editors* ..... 193

## Cuprins

### ARTICOLE ORIGINALE

- Rezultatele testării nespecifice, la efort maximal, pot fi asociate cu performanța sportivului, pe parcursul unui efort maximal specific de 5 km**  
*Ștefan Adrian Martin, Roxana Maria Hadmaș, Dan Dobreanu* ..... 141
- Strategie de intervenție interdisciplinară asupra copilului cu diabet: studiu pilot**  
*Constanța Urzeală, Mihaela Vlăiculescu, Daniel Courteix* ..... 147
- Diferențe în utilizarea suplimentelor alimentare de către sportivii de performanță și cei amatori**  
*George Jîtcă, Amelia Tero-Vescan, Amalia Miklos, Camil-Eugen Vari, Bianca-Eugenia Ősz* ..... 153
- Promovarea și susținerea activităților fizice și sportului printre tinerii din Republica Moldova**  
*Serghei Cebanu, Mariana Tutunaru, Raisa Deleu, Angela Cazacu-Stratu, Grigore Friptuleac* ..... 158
- Studiu privind relația fizioterapeut – pacient**  
*Alexandra-Camelia Gliga, Nicolae Neagu, Tiberiu Bătagă* ..... 165
- Rezultatele testului de mers de șase minute în rândul pacienților cu BPOC**  
*Ana Florica Chiș, Ruxandra Mioara Râjnoveanu, Milena Adina Man, Doina Adina Todea, Bogdan Augustin Chiș, Carmen Monica Pop* ..... 170
- Particularități alimentare la cadeții înotători pe parcursul unui microciclu de pregătire**  
*Alexandru Maștei, Roxana Maria Hadmaș, Ștefan Adrian Martin* ..... 176

### ARTICOLE DE SINTEZĂ

- Activitatea fizică în cancerul colorectal**  
*Laura Ioana Gavrițaș, Corina Ionescu, Ovidiu Bălăcescu, Daniel Cruceriu, Lorena Filip, Doina Miere* ..... 181

### ACTUALITĂȚI EDITORIALE

- Recenzii cărți**  
Debra J. Rose (editor). Instruirea adulților vârstnici în activitatea fizică  
*Gheorghe Dumitru* ..... 187

### MANIFESTĂRI ȘTIINȚIFICE

- A patra Conferință Națională de medicină aplicată la educația fizică și sport, calitate superioară**  
*Traian Bocu* ..... 188

### EVENIMENTE

- Evocarea Profesorului Dr. Iuliu Hațieganu la Dârja (3)**  
*Traian Bocu* ..... 190
- Întâlnirea anuală a atleților veterani de la „U” Cluj (24)**  
*Traian Bocu* ..... 192

### ÎN ATENȚIA COLABORATORILOR

- Redacția* ..... 196

## ORIGINAL STUDIES

# Non-specific maximal testing results, under certain training conditions, can be associated with roller skiing performances during a competitive 5K event

*Rezultatele testării nespecifice, la efort maximal, pot fi asociate cu performanța sportivului, pe parcursul unui efort maximal specific de 5 km*

Ștefan Adrian Martin<sup>1</sup>, Roxana Maria Hadmaș<sup>2</sup>, Dan Dobreanu<sup>1</sup>

<sup>1</sup> Physiology Department, University of Medicine and Pharmacy Târgu Mureș, Romania

<sup>2</sup> Community Nutrition and Food Hygiene Department, University of Medicine and Pharmacy Târgu Mureș, Romania

### Abstract

*Background.* Cardiopulmonary analysis, through  $\text{VO}_2\text{max}$  testing, can represent the basis of training development.

*Aims.* Our aim was to demonstrate that non-specific  $\text{VO}_2\text{max}$  testing can provide important information regarding cardiopulmonary adaptation and its influence over a specific maximal exercise.

*Methods.* The study group consisted of 8 male XC skiers with international competitive results. During day 1, one single  $\text{VO}_2\text{max}$  test (T1) was conducted, assessing cardiopulmonary capacity and training periodization over day 1 to day 24. On day 24, the athletes competed in a specific 5k roller skiing event (T2), confirming individual exercise capacity, based on T1 measurements:  $\text{VO}_2\text{max}$ , VE,  $\text{PetCO}_2$ ,  $\text{PetCO}_2$ ,  $\text{VE}/\text{VO}_2$ , RER.

*Results.* Between T1 – T2, all training sessions were monitored. An increased  $\text{VT}_1$ , during T1 analysis, was related to the maximal HR during T2 ( $p=0.001$ ). Both  $\text{VT}_1$  ( $p=0.03$ ) and  $\text{VT}_2$  values ( $p=0.03$ ) were correlated with the median pace during T2. During T1, the  $\text{PetCO}_2$  was significantly correlated with the  $\text{VCO}_2$  determined value ( $p=0.001$ ), relating an improved  $\text{CO}_2$  removal rate.

*Conclusions.* Unlike  $\text{PetCO}_2$  effects on T2 performances, through  $\text{PetO}_2$  analysis, no similar results were found. Over T1, an increased aerobic activity was correlated to an improved pace and effort time during the T2 exercise. Increased VE values, along with  $\text{VO}_2$  and  $\text{VE}/\text{VO}_2$  generated an improved  $\text{PetCO}_2$  ratio and athletes' performance, through an enhanced oxygen extraction, resulting in an improved T2 time, due to an increased aerobic power, stated in T1.

**Keywords:** elite, training, performance, exercise capacity

### Rezumat

*Premize.* Analiza cardio-pulmonară, prin testarea maximală la efort, poate reprezenta un punct de pornire pentru dezvoltarea, formarea și periodizarea antrenamentului sportiv. Aceasta poate permite aprecierea formei sportive la un moment dat.

*Obiectivul.* Obiectivul nostru a fost să demonstrăm că testarea  $\text{VO}_2\text{max}$ , în asocierea unui efort nespecific, poate oferi informații importante cu privire la capacitatea la efort, adaptarea individuală și evoluția în asocierea efortului maximal specific.

*Metode.* Grupul de studiu a fost alcătuit din 8 schiori fondești, cu practică sportivă internațională. Prin metodologia de studiu, a fost monitorizat antrenamentul sportiv pe parcursul a 24 de zile. În ziua 1 a fost desfășurată o testare maximală  $\text{VO}_2\text{max}$  (T1), cu scopul de a determina capacitatea la efort și a iniția programarea antrenamentului sportiv între zilele 2-23. În ziua 24, prin intermediul un efort specific, probă de 5 km role, stilul liber, denumit T2, a fost confirmată capacitatea la efort și principalii parametrii evolutivi analizați în T1, prin  $\text{VO}_2\text{max}$ , VE,  $\text{PetO}_2$ ,  $\text{PetCO}_2$ ,  $\text{VE}/\text{VO}_2$ , RER.

*Rezultate.* Între T1 și T2, toate perioadele de pregătire au fost monitorizate. Creșterea  $\text{VT}_1$ , în asocierea analizei T1, a influențat semnificativ evoluția FCmax pe timpul T2 ( $p = 0.01$ ). Valorile  $\text{VT}_1$  ( $p = 0.03$ ) și  $\text{VT}_2$  ( $p = 0.03$ ) au fost corelate cu viteza de deplasare, în timpul T2. Astfel, în asocierea T1,  $\text{PetCO}_2$  a fost semnificativ corelat cu valoarea determinată  $\text{VCO}_2$  ( $p = 0.01$ ), stabilind un raport îmbunătățit de eliminare a  $\text{CO}_2$ .

*Concluzii.* Spre deosebire de efectele  $\text{PetCO}_2$  asupra performanțelor T2, prin analiza  $\text{PetO}_2$ , nu s-au identificat rezultate similare. Peste rezultatele T1, efortul preponderent aerob a fost corelat cu îmbunătățirea performanței în asocierea T2. Valorile crescute VE, alături de  $\text{VO}_2$  și  $\text{VE}/\text{VO}_2$ , au generat un raport  $\text{PetCO}_2$  îmbunătățit, respectiv o creștere a performanței sportivilor printr-o extracție de oxigen îmbunătățită, rezultând un timp T2 îmbunătățit.

**Cuvinte cheie:** elită, antrenament, performanță, capacitate la efort

---

Received: 2018, June 23; Accepted for publication: 2018, July 3

Address for correspondence: University of Medicine and Pharmacy, Târgu Mureș, Gheorghe Marinescu Str. No.38, 540139, Romania

E-mail: martinestefanadrian@gmail.com

Corresponding author: Martin Ștefan Adrian, martinestefanadrian@gmail.com

<https://doi.org/10.26659/pm3.2018.19.3.141>

## Introduction

Competitive cross-country skiing can reflect different qualities of athletes based on the distance and the course profile. As a result, several differences can be identified regarding the performance of an athlete, between short and long distance events (Sandbakk et al., 2011; Bolger et al., 2015).

The athletic potential can be described through functional analysis during different effort stages. As a result, the muscle fiber type, capillary density along with mitochondrial capacity will influence muscle efficiency. During a prolonged effort, skeletal muscle activity can be characterized through the anaerobic threshold value, the athletes' ability to maintain oxygen consumption,  $VO_2$  performance and the maximum volume of oxygen (Stellingwerff & Spriet, 2014). From a practical point of view, while defining the effort capacity, all the mentioned factors will influence the performance during a specific competitive effort (Joyner & Coyle, 2008).

High intensity training (HIT) represents a well-known method which is implemented in all sports, whether they are team, individual or endurance sports (Buchheit & Laursen, 2013). Training as a winter sports endurance athlete requires a comprehensive aerobic capacity (Tønnessen et al., 2015). Therefore, aerobic training should be predominant during the general training stages, with a transition to anaerobic effort during pre-competitive specific activity. The anaerobic capacity development is associated with both maximum oxygen consumption ( $VO_{2max}$ ) and increased anaerobic threshold (AT). Yet, performance differences seem to be related to a well-planned anaerobic capacity, as against an increased maximum oxygen consumption development (Sandbakk & Holmberg, 2014; Hébert-Losier et al., 2017).

An alternative training method involves a volume reduction by increasing effort intensity (Stöggl & Sperlich, 2015). HIT activity seems to generate similar functional adaptations to those obtained as a result of aerobic specific training (Stöggl & Müller, 2009). Among them, metabolic markers, endothelial vascular activity and cardiopulmonary improvements, along with morphological and skeletal muscle metabolism changes, have similar adaption results for the two training methods, under certain recovery conditions (Lundgren et al., 2015).

## Hypothesis

Cardiopulmonary analysis, through  $VO_{2max}$  testing, can represent the basis of the training development and periodization. Training analysis will reflect the individuals' ability to perform a maximal effort under specific conditions. Therefore, through the implemented methodology, our objective will be to demonstrate that non-specific  $VO_{2max}$  testing can provide important information regarding the cardiopulmonary adaptation and its influence over a specific maximal effort. Based on similar changes between the specific and non-specific tests, we will try to relate the cardiopulmonary results to the specific maximal test performances, as a result of a pre-determined training program.

## Material and method

### Research protocol

The study is an observational cross-sectional one, during the 2017-2018 general training period. The following methodology was implemented after obtaining the athletes' acceptance to participate, and the University's Ethical Committee approval to conduct the study.

#### a) Period and place of the research

The study was conducted between June - July 2017, in Brasov, Romania, where the athletes' training center was found.

#### b) Subjects and groups

The study group consisted of 8 male cross country skiers with international competitive activity. In order to be included in the study group, clinical medical acceptance was mandatory. The medical consent was aimed at confirming that the athlete was clinically fit to be included in an organized training program.

#### c) Tests applied

A complete training analysis was conducted over 24 days. The program was initiated at the start of the general roller skiing training stage, in the absence of a specific skiing climate. The training temperatures were stated between 15-20°C.

During the analyzed period (24 days), one single  $VO_{2max}$  test (T1) was conducted on day 1. Following the maximal test ( $VO_{2max}$ , T1), we initiated a training program between day 2 and day 23, closing the analysis with a specific classic roller skiing test (T2), on day 24, as shown in Fig. 1.



**Fig. 1** – The study protocol, detailing the training, recovery and testing periods over 24 days

#### - Maximal exercise testing ( $VO_{2max}$ )

One  $VO_{2max}$  test (T1) was performed by applying the Bruce Maximal Testing Protocol on a running treadmill. The testing took place 48 hours after the last training session. As part of the testing protocol, food intake was standardized 48 hours before the maximal test at 8.6 g/kg carbohydrates, 1.9 g/kg protein and 1.2 g/kg fat.

The cardiopulmonary test was performed using Cosmed Quark CPET (Rome, Italy) equipment, Cosmed F150 Ergometer (Rome, Italy) and Polar H7 Bluetooth CardioFrequency Meter. The equipment calibration took place at the start of each test with known  $O_2$  (16%) and  $CO_2$  (5%) concentrations. The flow meter was calibrated at the start of each test using a Cosmed Syringe (3L). Based on the paper objective, different functional categories were used to describe the athletes' exercise capacity. Among them, relative  $VO_2$  (oxygen volume, ml/min/kg) and absolute  $VO_2$  (oxygen volume, ml/min),  $VT_1$  (ventilatory threshold 1, b/min),  $VT_2$  (ventilatory threshold 2, b/min), VE (ventilation, L/min),  $VE/VO_2$  (ventilatory equivalent for oxygen, ml/min) and  $VE/VCO_2$  (ventilatory equivalent for carbon dioxide, ml/min) were included as performance parameters. The respiratory frequency

(Rf, b/min) along with VT (tidal volume, L/min), VCO<sub>2</sub> (carbon dioxide production, ml/min), PetO<sub>2</sub> (end-tidal oxygen tension, mmHg), PetCO<sub>2</sub> (end-tidal carbon dioxide tension, mmHg), HR<sub>max</sub> (maximum heart rate, b/min), tHR (theoretical maximal heart rate, b/min) %HR<sub>max</sub> (percent of the maximum heart rate, %) EEt (minute energy consumption during effort, kcal/min), CHO (carbohydrate metabolism, %) and Fat (fat metabolism, %) were all included as functional parameters.

As a result of T1 (VO<sub>2max</sub>), 5 cardiovascular training zones (Zones 1-5) were created by using the percentage of the determined maximal heart rate values. Training Zone 1 (55-75% of HR<sub>max</sub>) and Zone 2 (75-85%) were used as aerobic exercise zones. Zone 3 (85-90%) represented a mixed exercise zone, while Zones 4 (90-95%) and 5 (95-100%) were implemented as anaerobic exercise zones (Seiler & Tonnessen, 2006).

*- Training analysis*

Following the VO<sub>2max</sub> testing, a training program was implemented between day 2 and day 23, including 14 roller skiing sessions, 10 cycling, 11 trail running and 4 Nordic walking sessions. During the 31 training sessions, the athletes covered a median distance of 950.6 km in 3.507 minutes. Of all the trainings, 2 sessions per day were conducted on 12 different days, while 1 single training session per day was conducted on 7 different days. During 3 of the 23 training days, no training sessions were scheduled.

Training analysis (days 2-23) was documented in a Microsoft Excel database. Using Polar V400 and Polar H7 Bluetooth CardioFrequency Meter, the following parameters were monitored: effort time (minutes), distance (km), heart rate (HR, b/min), positive altitude (+meters) and negative altitude difference level (-m), along with the HR value in the following 5 exercise zones (55-100% of HR<sub>max</sub>), in order to confirm the training objective.

*- Classic roller skiing test*

During the 24<sup>th</sup> day, a specific roller skiing test (T2) was performed. No training sessions were scheduled 48 hours before the specific test (days 22 and 23) in order to minimize the impact of fatigue on the obtained results. The athletes' food intake was standardized 48 hours before the test at a similar quantitative and qualitative value. Macronutrient consumption was set at 8.6 g/kg carbohydrates, 1.8 g/kg protein and 1.2 g/kg fat 24 hours before the test. No medication was administered prior to effort.

The test involved competing in a classic roller skiing event over a 5 kilometer track (385 meters positive altitude difference; no negative altitude difference level). The start of the effort was programmed at 30 second intervals. The time was recorded digitally (hh:mm:ss) by recording the time needed to perform the distance, from the start (point *a*) to the finish (point *b*) of the track. Using the Polar V400 and Polar H7 Bluetooth heart rate monitor, the following parameters were measured: total exercise time (minutes), distance (km), speed (km/h), altitude difference gain, heart rate (HR, b/min), and the HR value in the following effort zones: Z1-Z5 (55-100% of HR<sub>max</sub>).

*d) Statistical processing*

Statistical analysis was performed using the GraphPad Prism 5.0 software. Standard deviation (SD), coefficient

of variation (CV%), and median values were used in the descriptive analysis. The Normality D'Agostino & Pearson test was applied, while several correlations between two different or similar parameters, analyzed during T1-T2, were obtained by applying the Spearman test and one sample *t* test. A *p* value of <0.05 value was considered statistically significant, with the confidence interval (CI) assigned to a standard value of 95%.

**Results**

*Maximal exercise testing analysis (VO<sub>2max</sub>)*

The maximum volume of oxygen was measured at 68.12 ml/min/kg. Following the test, VT<sub>1</sub> was measured at 152.5 b/min, while VT<sub>2</sub> reached 189 b/min. During the test, the median heart rate reached 97.97% of the theoretical HR<sub>max</sub>. Due to an increased heart rate percentage, VO<sub>2</sub>/HR ratio was stated at 22.48 ml/b/min. VE was monitored at a median value of 90.2 l/min, with a determined VT of 2.13 L/min and 37.42 b/min respiratory frequency. VE/VO<sub>2</sub> was measured at a median value of 25.01, while VE/VCO<sub>2</sub> reached 27.09.

During the test, the energy expenditure was estimated at a median value of 17.54 kcal/min. Based on the RQ evolution, 32.17% of the energy use was attributed to fat metabolism, while 67.82% was attributed to carbohydrate metabolism. Further on, the end-tidal oxygen tension was measured at 104.2 mmHg, while end-tidal carbon dioxide tension reached 40.97 mmHg during the VO<sub>2max</sub> test.

*Training analysis*

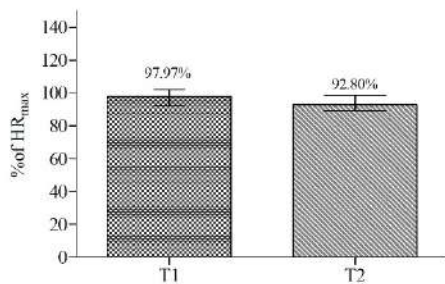
In training, the roller skiing sessions were conducted in 1128 minutes over 366.8 kilometers, at a median heart rate of 63.10% of HR<sub>max</sub>. The cycling sessions were conducted over 428.5 km, unlike roller skiing which reached 366.8 km distance (p=0.07). During the cycling training sessions, the athletes reached a median training time of 1168 minutes (p>0.05), performed at 55.89% of HR<sub>max</sub>, compared to the roller skiing training, performed at 63.10% of HR<sub>max</sub> (p=0.01). The trail running sessions were programmed in 693.3 minutes of exercise, over 127.5 km distance. The median heart rate percentage reached 65.7% of HR<sub>max</sub>, representing the most elevated HR%, compared to cycling (p=0.01) and roller skiing values (p=0.01). Nordic walking sessions were performed over 406.8 minutes, reaching only 44.05 km distance. The median HR during the Nordic walking sessions was measured at 60.14% of HR<sub>max</sub>, being lower than the running HR% (p=0.01), but higher than the cycling HR% (p=0.08).

As part of the training report, no more than 1.293,38 minutes of exercise (36.88%) were conducted in training zone 1, while 1.157,66 minutes (33.01%) were completed in training zone 2. Further on, during training, 688.42 min (19.63%) were conducted in exercise zone 3, with a reduction for training zone 4 to a median time of 138.17 min (3.94%), while 137.82 min (3.93%) of the total training time were conducted in training zone 5. During general analysis, aerobic training was performed over 2.451,04 min, representing as much as 69.89% of the entire activity that was conducted between the first tests (T1) (day 1 of 24) and the second tests (T2) (day 24 of 24).

*Classic roller skiing test analysis*

T2 evolution had a median run time of 21.36 minutes over a 5 km distance. The median speed was monitored

at 13.40 km/h, while the maximum speed reached 22.80 km/h. Based on the test analysis, the median HR value, during T2, reached 92.8% of HR<sub>max</sub>, being statistically different from the T1 median HR% value (p=0.03) (Fig. 2).



**Fig. 2** – Differences in the HR<sub>max</sub> value monitored during T1 and T2 (p=0.03), presented as median values+ range

As a result, 83.52% of the exercise was conducted between 95-100% of HR<sub>max</sub>, representing the exercise zone 5, as shown in the descriptive data illustrated as median, minimum and maximum values, in Table I.

The race time was statistically related to HR evolution during the exercise (p = 0.01, r = -0.87, 95%CI = -0.96 to -0.59). Improved testing performances were related to an elevated speed (p = 0.01, r = 0.97, 95%CI = 0.91 to 0.99)

and a reduced track time throughout conducting a constant effort, from point a to point b, at a value between 90-100% of HR<sub>max</sub> (p = 0.01, r = -0.98, 95%CI = -0.99 to -0.94). A lower T2 time, as against an improved T2 time, was related to a reduced HR range, stated between 85-90% of HR<sub>max</sub> (p=0.01, r= -0.85, 95%CI = -0.96 to -0.44).

**Table I**  
Roller skiing testing (T2) descriptive analysis, illustrated as median, minimum and maximum value

Training related data	Median	Range	
		Minimum	Maximum
Distance, km	5	5	5
Time, min	21.36	20.40	23.75
Positive difference level, m	386	386	386
Speed, km/h	13.40	12.30	22.80
%HR <sub>max</sub>	92.80	89.30	98.85
Z5, %	83.52	14.66	99.85
Z4, %	8.79	0.09	76.06
Z3, %	3.78	0.01	9.22
Z2, %	0.39	0.01	3.14
Z1, %	0.02	0.01	0.33

An increased VT<sub>1</sub>, during T1 analysis, was related to the athlete's maximal HR during T2 (p = 0.01, r = 0.84, 95%CI = 0.52 to 0.95). Withal, both VT<sub>1</sub> (0.03, r=0.60, 95%CI =0.05 to 0.87) and VT<sub>2</sub> values (p = 0.03, r = 0.60, 95%CI = 0.02 to 0.87) were significantly correlated with the median pace during T2. Over T1, the monitored VE values were

**Table II**  
Training influence over the specific 5k roller skiing competition test

General training (days 2-23)	Proposed parameters		Statistical results				
	Median value (range)	T2 performance parameters	Median value (range)	p	r	95% confidence interval	
						Upper	Lower
Training in Z1,%	36.88 (0 – 146.6)	Time, s	21.36 (20.5 – 23.7)	0.01	-0.90	-0.97	-0.67
		%HR <sub>max</sub>	92.80 (89.3 – 98.8)	0.01	0.99	0.98	0.99
		Average speed km/h	13.40 (12.3 – 15.1)	0.01	0.98	0.95	0.99
		Maximum speed km/h	22.80 (19.8 – 26.2)	0.01	0.98	0.93	0.99
Training in Z2,%	33.01 (0 – 48.334)	Time, s	21.36 (20.5 – 23.7)	0.96	-0.01	-0.58	0.56
		%HR <sub>max</sub>	92.80 (89.3 – 98.8)	0.12	-0.46	-0.81	0.15
		Average speed km/h	13.40 (12.3 – 15.1)	0.40	-0.26	-0.72	0.36
		Maximum speed km/h	22.80 (19.8 – 26.2)	0.26	-0.37	-0.76	0.28
Training in Z3,%	19.63 (0 – 22.93)	Time, s	21.36 (20.5 – 23.7)	0.05	0.56	-0.01	0.85
		%HR <sub>max</sub>	92.80 (89.3 – 98.8)	0.01	-0.87	-0.96	-0.60
		Average speed km/h	13.40 (12.3 – 15.1)	0.01	-0.80	-0.94	-0.42
		Maximum speed km/h	22.80 (19.8 – 26.2)	0.01	-0.87	-0.96	-0.60
Training in Z4,%	3.94 (0.86 – 17.55)	Time, s	21.36 (20.5 – 23.7)	0.01	0.94	0.80	0.98
		%HR <sub>max</sub>	92.80 (89.3 – 98.8)	0.01	-0.69	-0.90	-0.20
		Average speed km/h	13.40 (12.3 – 15.1)	0.01	-0.83	-0.95	-0.49
		Maximum speed km/h	22.80 (19.8 – 26.2)	0.01	-0.76	-0.93	-0.34
Training in Z5,%	3.93 (0 – 17.55)	Time, s	21.36 (20.5 – 23.7)	0.01	0.89	0.67	0.97
		%HR <sub>max</sub>	92.80 (89.3 – 98.8)	0.04	-0.58	-0.86	-0.02
		Average speed km/h	13.40 (12.3 – 15.1)	0.01	-0.74	-0.92	-0.29
		Maximum speed km/h	22.80 (19.8 – 26.2)	0.01	-0.66	-0.89	-0.14

significantly correlated with the oxygen volume ( $p=0.01$ ) and the carbon dioxide excretion ratio ( $p=0.01$ ). Therefore, a significant statistical relationship was established between the determined VE ( $p=0.03$ ,  $r=0.62$ ,  $95\%CI = 0.88$  to  $0.07$ ),  $VO_2$  ( $p=0.01$ ),  $VCO_2$  ( $p=0.01$ ), during T1, and the individual's capacity to perform during T2 in exercise zone 5.

During T1, the  $PetCO_2$  was significantly correlated with the  $VCO_2$  determined value ( $p=0.01$ ), relating an improved  $CO_2$  removal rate. Unlike  $PetCO_2$  effects on T2 performances, through  $PetO_2$  analysis, no similar results were found ( $p\geq 0.05$ ).

An increased training time ( $CV=15.79\%$ ) within the 23 day period was associated with an improved effort time during T2 ( $p=0.01$ ). Based on the analysis, training in effort zones 3 (85-90% of  $HR_{max}$ ) and 4 (90-95% of  $HR_{max}$ ), unlike training in effort zones 1 and 2 (55-85% of  $HR_{max}$ ), was associated with an impaired pace during T2. Improved performances, based on T1 analysis, were related to an increased pace (speed) and  $HR\%$  during T2. However, this adaptation was monitored as a result of the general aerobic training, in association with short intensive activity, within the 23 day training period, as shown in Table II.

## Discussion

During many recent studies, different testing protocols have been applied to provide additional data regarding the effort capacity (Losnegard & Hallén, 2014a).

The main training objective during a specific effort will offer important information in order to choose a medium-long term testing protocol. The main differences between different types of physical activities are related to the fact that each one involves different functional demands (Hébert-Losier et al., 2017). Applying the correct protocol will simulate event-specific physical demands under different conditions. In contrast to this hypothesis, we managed to conduct and obtain important data regarding a non-specific maximal test and its interpretation over a specific maximal activity.

### *Training impact on specific exercise performances*

Through the obtained results, we can confirm that increased aerobic training, as opposed to general anaerobic effort, can induce an enhanced performance through an improved effort capacity. According to Stangier et al. (2016), conducting both running and cycling training sessions during a general training period, at 50-60% of  $HR_{max}$ , can generate a positive effect on the aerobic capacity.

In our study protocol, both cycling and running were included as training sessions, along with roller skiing and Nordic walking training. Of the programmed activity, roller skiing and trail running sessions represented both low intensity and high intensity training methods, while cycling and Nordic walking sessions were used only as aerobic training activities. Through our findings, we confirm that all of them, being part of the training program, had an important role in achieving the main objective. Yet, the results of Ateş & Çetin (2017) illustrate improvements during roller skiing training, unlike other training methods. In our study, an increased aerobic activity over the 23-day training cycle was significantly correlated with the athletes' ability to perform in exercise zone 5, generating an improved pace during T2 testing. As a result, we believe

that high volume and moderate intensity training, combined with inappropriate recovery periods, can have an opposite effect on the athletes' capacity during high intensity activity, similarly to the outcomes of Seiler & Kjerland (2006).

T1 results were related to the actual T2 performances, contrary to the results of Losnegard & Hallén (2014b), who found similar improvements but during submaximal effort, as against maximal activity. However, we obtained important results regarding the cardiopulmonary evolution and the athletes' specific effort performances that can influence  $O_2$  extraction as described by Boushel et al. (2014), during maximal activity.

*VO<sub>2</sub>max test as a performance predictor in specific exercise*

The highest aerobic power is measured in cross-country skiing athletes, compared to any other sport. Both absolute (L/min) and relative aerobic power values (ml/min/kg) are very important in the activity outcome, as described by Holmberg (2015). Unlike the median values measured in our study, at 68.71 ml/min/kg, values up to 90 ml/min/kg can be measured in different training stages of elite cross country skiers, as seen in the paper of Sandbakk & Holmberg (2014).

From a practical point of view, the aerobic power will be proportional to the maximum volume of oxygen, as shown in our results through the aerobic power results. The method of analysis is of particular importance, as shown by Sandbakk et al. (2016). In the current paper, due to unavailable equipment, the  $VO_2max$  test was performed on a running treadmill, unlike the tests performed in other studies by using a specific roller skiing treadmill. Published papers regarding the comparison of the two testing methods presented differences in the determined  $VO_2max$  values (Vergès et al., 2006). Therefore, our results regarding cardiopulmonary evolution can be compared with the partial outcomes of the treadmill testing presented by Losnegard & Hallén (2014b). According to the results of Losnegard & Hallén (2014b), during a treadmill running test, the measured  $VO_2$  value will be higher as opposed to the one recorded during specific cross-country roller skiing.

Both aerobic and anaerobic capacity defines the athletes' performance during specific or general effort. Based on our findings,  $PetCO_2$  evolution over the T1 test was used as an important prediction factor for the  $CO_2$  excretion rate. Unlike this outcome, Larsson et al. (2002) and Stöggl et al. (2017) did not illustrate a direct relationship between the athletes' performance and  $PetCO_2$  evolution during laboratory tests. In our analysis,  $PetCO_2$  and  $VE/VCO_2$  evolution, during T1, was significantly correlated with the median pace during T2, unlike in the paper of Hébert-Losier K et al. (2017), which failed to link the laboratory test results with the specific exercise performances. An elevated ventilation was strongly related to a lower VT measurement and an increased  $VO_2$  value, establishing a strong correlation with the median HR value during T2. However, an increased heart rate during T2 was related to both an improved effort zone 5 performance and an elevated pace during the effort. As a result,  $VT_1$  measurement was related to an increased VE, which was associated with an important rise in  $VO_2$  and a proper adapted  $PetCO_2$ , during T1, generating an important influence on the athletes' capacity during T2 maximal exercise. Yet, Verges

et al. (2003) illustrated a similar hypothesis, but without any differences regarding lactate production during the two tests. The main differences regarding aerobic power were identified during the specific test as opposed to the indoor running test.

## Conclusions

1. Through VO<sub>2</sub>max testing, the cardiopulmonary non-specific analysis represents an important method used to analyze functional and individual performance.

2. The actual impact of training on a high intensity exercise evolution is related to aerobic training, during a medium period of time, which, in our analysis, was stated at a 65% aerobic exercise.

3. During T1, an increased aerobic activity was correlated with an improved pace and exercise time over T2. However, an increased VE value, along with VO<sub>2</sub> and VE/VO<sub>2</sub>, generated an improved PetCO<sub>2</sub> ratio and athletes' performance, through an enhanced oxygen extraction, resulting in an improved T2 time, due to an increased aerobic power, stated during the non-specific testing.

4. Proper cardiopulmonary development, based on a well-established ratio between ventilation, oxygen volume, oxygen extraction and CO<sub>2</sub> removal rate, during a non-specific maximal test, related the athlete's capacity to perform over a high intensity specific exercise.

## Conflicts of interest

The authors of this paper state that there are no conflicts of interest regarding the study methodology, results and conclusions drawn.

## Acknowledgments

Partial results of this paper represent data from the first author's PhD thesis.

## References

Ateş B, Çetin E. Roller-Ski Aerobic High-Intensity Interval Training Improves the VO<sub>2</sub>max and Anaerobic Power in Cross-Country Skiers. *Int J Appl Exerc Physiol*. 2017;6(2):27-33. <https://doi.org/https://doi.org/10.22631/ijaep.v6i2.158>

Bolger CM, Kocbach J, Hegge AM, Sandbakk Ø. Speed and heart-rate profiles in skating and classical cross-country skiing competitions. *Int J Sports Physiol Perform*. 2015;10(7):873-880. doi: 10.1123/ijsp.2014-0335.

Boushel R, Ara I, Gnaiger E, Helge JW, Gonzalez-Alonso J, Munck-Andersen T, Sondergaard H, Damsgaard R, van Hall G, Saltin B, Calbet JA. Low-intensity training increases peak arm VO<sub>2</sub> by enhancing both convective and diffusive O<sub>2</sub> delivery. *Acta Physiol (Oxf)*. 2014;211(1): 122-134. doi: 10.1111/apha.12258.

Buchheit M, Laursen PB. High-intensity interval training, solutions to the programming puzzle. Part II: anaerobic energy, neuromuscular load and practical applications. *Sports Med*. 2013;43(10):927-954. doi: 10.1007/s40279-013-0066-5.

Hébert-Losier K, Zinner C, Platt S, Stöggl T, Holmberg HC. Factors that Influence the Performance of Elite Sprint Cross-Country Skiers. *Sports Med*. 2017;47(2):319-342. doi: 10.1007/s40279-016-0573-2.

Holmberg HC. The elite cross-country skier provides unique insights into human exercise physiology. *Scand J Med Sci*

*Sports*. 2015;25 (Suppl 4):100-109. doi: 10.1111/sms.12601.

Joyner MJ, Coyle EF. Endurance exercise performance: the physiology of champions. *J Physiol*. 2008;586(Pt 1):35-44. doi: 10.1113/jphysiol.2007.143834.

Larsson P, Olofsson P, Jakobsson E, Burlin L, Henriksson-Larsén K. Physiological predictors of performance in cross-country skiing from treadmill tests in male and female subjects. *Scand J Med Sci Sports*. 2002;12(6):347-353.

Losnegard T, Hallén J. Elite cross-country skiers do not reach their running VO<sub>2</sub>max during roller ski skating. *J Sports Med Phys Fitness*. 2014a;54(4):389-393.

Losnegard T, Hallén J. Physiological differences between sprint- and distance-specialized cross-country skiers. *Int J Sports Physiol Perform*. 2014b;9(1):25-31. doi: 10.1123/ijsp.2013-0066.

Lundgren KM, Karlsen T, Sandbakk Ø, James PE, Tjønnå AE. Sport-Specific Physiological Adaptations in Highly Trained Endurance Athletes. *Med Sci Sports Exerc*. 2015;47(10):2150-2157. doi: 10.1249/MSS.0000000000000634.

Sandbakk Ø, Holmberg HC. A reappraisal of success factors for Olympic cross-country skiing. *Int J Sports Physiol Perform*. 2014;9(1):117-121. doi: 10.1123/ijsp.2013-0373.

Sandbakk Ø, Losnegard T, Skattebo Ø, Hegge AM, Tønnessen E, Kocbach J. Analysis of Classical Time-Trial Performance and Technique-Specific Physiological Determinants in Elite Female Cross-Country Skiers. *Front Physiol*. 2016;7:326. <http://doi.org/10.3389/fphys.2016.00326>.

Sandbakk Ø, Etema G, Leirdal S, Jakobsen V, Holmberg HC. Analysis of a sprint ski race and associated laboratory determinants of world-class performance. *Eur J Appl Physiol*. 2011;111(6):947-957. doi: 10.1007/s00421-010-1719-9.

Seiler KS, Kjerland GØ. Quantifying training intensity distribution in elite endurance athletes: is there evidence for an "optimal" distribution? *Scand J Med Sci Sports*. 2006;16(1):49-56. doi:10.1111/j.1600-0838.2004.00418.x.

Seiler KS, Tønnessen E. Intervals, thresholds, and long slow distance: the role of intensity and duration in endurance training. *Sports Science*. 2009;13:32-53.

Stangier C, Abel T, Hesse C, Claen S, Mierau J, Hollmann W, Strüder HK. Effects of Cycling vs. Running Training on Endurance Performance in Preparation for Inline Speed Skating. *J Strength Cond Res*. 2016;30(6):1597-1606. doi: 10.1519/JSC.0000000000001247.

Stellingwerff T, Spriet LL. Nutritional triggers to adaptation and performance. *Appl Physiol Nutr Metab*. 2014; 39(9): v-vi. doi: 10.1139/apnm-2014-0217.

Stöggl R, Müller E, Stöggl T. Do Maximal Roller Skiing Speed and Double Poling Performance Predict Youth Cross-Country Skiing Performance? *J Sports Sci Med*. 2017;16(3):383-390.

Stöggl TL, Müller E. Kinematic determinants and physiological response of cross-country skiing at maximal speed. *Med Sci Sports Exerc*. 2009;41(7):1476-1487. doi: 10.1249/MSS.0b013e31819b0516.

Stöggl TL, Sperlich B. The training intensity distribution among well-trained and elite endurance athletes. *Frontiers in Physiology*. 2015;6:295. doi: 10.3389/fphys.2015.00295.

Tønnessen E, Haugen TA, Hem E, Leirstein S, Seiler S. Maximal aerobic capacity in the winter-Olympics endurance disciplines: Olympic-medal benchmarks for the time period 1990-2013. *Int J Sports Physiol Perform*. 2015;10(7):835-839. doi: 10.1123/ijsp.2014-0431.

Vergès S, Flore P, Favre-Juvin A. Blood lactate concentration/heart rate relationship: laboratory running test vs field roller skiing test. *Int J Sports Med*. 2003;24(6):446-451. doi:10.1055/s-2003-41176.

Vergès S, Flore P, Laplaud D, Guinot M, Favre-Juvin A. Laboratory running test vs. field roller skiing test in cross-country skiers: a longitudinal study. *Int J Sports Med*. 2006;27(4):307-313.

# **A strategy for an interdisciplinary intervention on children with diabetes: a pilot study**

*Strategie de intervenție interdisciplinară asupra copilului cu diabet: studiu pilot*

**Constanța Urzeală<sup>1</sup>, Mihaela Vlăiculescu<sup>2</sup>, Daniel Courteix<sup>3</sup>**

<sup>1</sup> *National University of Physical Education and Sports from Bucharest, Romania*

<sup>2</sup> *DiabNutriMed Clinic of Diabetes, Bucharest, Romania*

<sup>3</sup> *Université d'Auvergne, Clermont-Ferrand, France*

## **Abstract**

*Background.* Specialists draw attention to the alarming incidence of type 1 diabetes mellitus during childhood, registering over 140,000 young people with this disease in Europe.

*Aims.* The aim was to explore a strategy based on motor, psychological, social and nutritional interventions addressed to children with type 1 diabetes mellitus, besides specific medical care, in order to improve their overall well-being.

*Methods.* This study comprised 11 children aged between 5 and 12 years and their families. For the motor intervention, the experiment included extracurricular physical activity once per week. The assessments consisted of Matorin and Eurofit tests. For the psychological intervention, our goal was to identify the emotional challenges that children with diabetes had to face. In this respect, the Man test was applied. For the social intervention, we conducted a social survey based on two questionnaires: one for the parents of children with diabetes, and one for the classmates of a child. For the nutritional intervention, counseling sessions for parents were conducted. The nutritionist's reports and the medical records were analyzed.

*Results.* The applied physical exercises were the only extracurricular physical activity performed by the subjects, with 3 exceptions. Ninety percent of children drew the entire silhouette, 10% drew only the torso. The parents rarely faced social problems. The report on nutritional counseling activities highlighted a major difficulty in carrying out this approach.

*Conclusions.* The strategy was effective in fulfilling the specific medical diabetes care and indirectly increasing the well-being of the subjects.

**Keywords:** diabetes, children, physical activity.

## **Rezumat**

*Premize.* Specialiștii atrag atenția asupra incidenței alarmante a diabetului zaharat de tip 1 la copii, înregistrându-se peste 140.000 de tineri cu această afecțiune în Europa.

*Obiective.* Obiectivul principal al acestui studiu a fost de a explora o strategie interdisciplinară bazată pe intervenții de ordin motric, psihologic, social și nutrițional, adresată copiilor cu diabet zaharat tip 1, alături de îngrijirea medicală de specialitate, în vederea creșterii calității vieții acestora.

*Metode.* Cercetarea a inclus 11 copii, cu vârste cuprinse între 5 și 12 ani și familiile acestora. Pentru intervenția motrică, experimentul a presupus desfășurarea de activități motrice extracurriculare o dată pe săptămână. Evaluarea s-a realizat prin intermediul testelor Matorin și Eurofit. Pentru intervenția psihologică, scopul nostru a fost de a identifica dificultățile de natură emoțională cu care se confruntă copilul cu diabet. În acest sens, a fost aplicat testul Omului. Pentru intervenția socială, s-au desfășurat două anchete pe bază de chestionar: una adresată părinților copiilor cu diabet și alta adresată colegilor de clasă ai unuia dintre subiecții cercetării. Pentru intervenția nutrițională, au fost organizate ședințe de consiliere și analizate rapoartele elaborate de către nutriționist.

*Rezultate.* Programul de exerciții fizice aplicat a constituit singura formă de activitate extracurriculară desfășurată de către subiecți, cu excepția a 3 dintre aceștia. Nouăzeci la sută din copii au desenat corpul în întregime, iar 10% au desenat numai torsul. Părinții au întâmpinat rar dificultăți sociale. Raportul privind consilierea nutrițională a evidențiat o dificultate majoră în implementarea acestei direcții de intervenție.

*Concluzii.* Strategia de intervenție interdisciplinară aplicată a fost eficientă în ceea ce privește atingerea obiectivelor de ordin medical, specifice diabetului și, indirect, a determinat creșterea calității vieții subiecților.

**Cuvinte cheie:** diabet zaharat, copii, exercițiu fizic.

---

*Received:* 2018, June 27; *Accepted for publication:* 2018, July 3

*Address for correspondence:* National University of Physical Education and Sports from Bucharest; 140, Constantin Noica, 6<sup>th</sup> District, Bucharest, 060057, Romania

*E-mail:* ritmicuta@gmail.com

*Corresponding author:* Constanța Urzeală, ritmicuta@gmail.com

<https://doi.org/10.26659/pm3.2018.19.3.147>

## Introduction

Worldwide specialists draw attention to the alarming incidence of diabetes during childhood, as this autoimmune disorder occurs more often between 0 and 4 years old (Green & Patterson, 2001). Statistics show that in Europe, over 140,000 people suffer from type 1 diabetes mellitus (T1DM). Under the age of 25, there are as many or even more, according to estimates, because no updated record exists in this respect. Regarding children diagnosed with T1DM in Romania, it is known that there are almost 3,000 medically recorded cases (Moraru et al., 2008) and up to 2,000 unrecorded cases.

Facing the challenge of T1DM at early ages requires complex treatment for good diabetes management and changes in the lifestyle of the whole family. Besides the specific therapy involving insulin dependence, diet and physical activity, children with diabetes must cope with social issues linked to their possibilities of taking part in different activities alongside their peers (Sherrill, 2004). The topic of T1DM is even more complex, since medical references emphasize the comorbidities that an individual with chronic disease may develop throughout life. Among the diabetes complications, Nathan (1993) mentions the following: peripheral and autonomic neuropathy, silent ischemia, cardiac arrhythmia and sudden death. Hypoglycemia unawareness during the night, also known as the “dead-in-bed syndrome”, is the cause of sudden unexplained deaths of young people with T1DM (Secrest et al., 2011).

Evidence claims that regular physical activity improves health and well-being in T1DM individuals, leading them to achieve the targeted lipid profile, body composition, fitness and glycemia goals (Quirk et al., 2014). Authors such as Bachmann et al. (2016) recommend physical activities for T1DM children after they are trained on how to fight and manage blood glucose fluctuations.

Although physical activity is recognized to have essential advantages for T1DM patients, most children tend to have a less active lifestyle. Hypoglycemia that may occur both during and after physical exercise is closely linked to physical activity. Thus, the fear of an uncontrolled decrease in the blood glucose levels influences the involvement of T1DM children in sports activities (Riddell et al., 2017) and may lead to a sedentary lifestyle. Repeated hypoglycemic episodes generate anxiety, depression, low self-esteem, limitations in daily activities and social issues due to school absenteeism (Alvarez-Guisasola et al., 2010). These aspects are reflected in the overall well-being of T1DM children and their quality of life. Moreover, each family member will be emotionally affected and disturbed by the health state of their relative.

## Objectives

The aim of the study was to explore an interdisciplinary strategy based on motor, psychological, social and nutritional interventions, addressed to children with type 1 diabetes mellitus, besides the specific medical care, in order to achieve a good diabetes management without major oscillations of glycemia values and indirectly to improve the overall well-being.

## Hypothesis

The study hypothesis was that applying an interdisciplinary intervention to children with type 1 diabetes mellitus would allow avoiding hypoglycemia episodes due to physical exercise and would lead to educate young patients for embracing an active way of living, in order to increase their quality of life.

## Material and methods

### *Research protocol*

This study was designed as a pilot research that could be developed and applied for European funds within the Erasmus + Sport program and H2020 projects. The entire strategy was planned with the diabetes medical care and was structured into four components: motor, psychological, social and nutritional.

The research complied with the World Medical Association Declaration of Helsinki (1). The legal guardians of the children gave their written consent for the participation of the subjects in the project activities, the processing of personal data and the publication of results. The research protocol was supervised by a medical specialist in pediatric diabetes care (VM subj). The Ethics Committee of UNEFS Bucharest approved this study involving human subjects (893/21.03.2016).

### *a) Period and place of the research*

The research took place at the National University of Physical Education and Sports from Bucharest, in collaboration with DiabNutriMed Clinic of Diabetes, during 2014 - 2016.

### *b) Subjects and groups*

The strategy involved 11 children with T1DM, aged between 5 and 12 years (8 boys and 3 girls), from the DiabNutriMed Clinic of Diabetes in Bucharest. Their medical history showed that they had unbalanced diabetes and repeated severe fluctuations in blood glucose levels when they were included in the study. Also, their treatment was focused only on insulin therapy and blood glucose control, neglecting physical activity, psychological challenges, healthy diet and social interactions.

Their families, adults aged 35 to 45 years, were also engaged in the research. Eleven parents (3 fathers and 8 mothers) participated in our study, 3 of the mothers working as social personal assistants for their children.

### *c) Tests applied*

For the *motor intervention*, the designed experiment included leisure activities, with physical activity once per week (Urzeală, 2014). The applied program was based on moderate-intensity aerobic exercise performed for 1 hour to 1 hour and a half, varying according to blood glucose levels. The physical activity sessions included dynamic games, dance, gymnastics and body expression, all of them tailored to the metabolic reactions of children. For safety reasons, fresh fruit juice, carbohydrate products with fast and slow absorption, still water and dextrose tablets were made available to children. Pre-, intra- and post-effort blood glucose levels were measured and registered for each subject. Depending on those values, snacks were provided to avoid hypoglycemia. Two assessments, initial and final, were conducted at the beginning and at the

end of the motor intervention, consisting of the Matorin test and the Eurofit Test Battery. A major difficulty was encountered in organizing the physical exercise program, because of the children's timetable and extracurricular activities, the parents' professional duties and the distance to cover to get to UNEFS in rush hours. These issues led to only one physical activity per week, on Saturdays, but each subject was given individual recommendations about what to perform at home, at least twice a week.

For the *psychological intervention*, our goal was to identify the emotional challenges that children with diabetes had to face. For this purpose, the Man test (Draw yourself!) was applied (Verza, 2004). Children received a piece of paper and were asked to draw themselves. With the support of a psychologist from UNEFS, we described the emotional aspects revealed by analyzing each body limb drawn (Urzeală & Bejan, 2016).

For the *social intervention*, we conducted a social survey based on two questionnaires: one addressed to the parents of T1DM children, and the other addressed to the classmates of a subject with type 1 diabetes mellitus (AND subj) that was part of our group. In this study, the analysis of the items was presented only partially, as considered relevant for the global pictures of the interdisciplinary strategy. The questionnaire for parents was designed by us and included 19 items grouped on three main directions: the child's functional independence, his/her social integration and the support from healthcare services. The respondents were asked to express their opinions relating to different social contexts (Urzeala & Teodorescu, 2015). For the social integration issues of T1DM children, our intervention considered only one of the subjects, namely a boy (AND subj) facing the need to be understood by his classmates. In this respect, 18 healthy children (aged 6-7 years) matched for age and the school grade, participated in the research. The classmates of the T1DM child filled out a questionnaire with 12 items concerning: the involvement of their peer in physical education lessons; team building and choosing the practice partner; the pupils' opinions about the different lifestyle of their peer. Items 6 to 9 allowed creating Moreno matrices, which emphasized the axiological relationships expressed during the physical education lessons.

For the *nutritional intervention*, 10 nutritional counseling sessions for parents were conducted by a nutritionist from the "Anamaria Iulian" Individual Medical

Practice in Bucharest, while the T1DM children were performing physical activities. These activities aimed to raise parental awareness of the energy value of different foods, so that they could choose the healthiest products. In this regard, our references are based on the report drawn up by the nutritionist.

*Medical care* was provided by the children's diabetes physician (MV subj) from DiabNutriMed Clinic of Diabetes in Bucharest. The specialist watched the subjects 24 hours a day and monitored their blood glucose levels using modern telemedicine devices (Continuous Glucose Monitoring System, insulin pumps, Night Scout platform), preparing reports for each patient. In this study, we present the case of a girl (AT subj) using an Omnipod wireless insulin pump.

#### d) Statistical processing

Data analysis was performed using Microsoft Office Excel 2007. For motor assessment, the mean, standard deviation and paired t-test were calculated. For the questionnaires, a percentage analysis and Moreno social matrices (Neculau, 2007) were performed, also calculating the group cohesion index (Dragnea, 2006).

## Results

The participating subjects (Table I), aged between 5 and 12 years (mean: 8.9 years), were normal weight children, without body composition problems. Their average Body Mass Index (BMI) was 17.80, indicating good control of their body weight, according to age.

The patients had no other health issues or diabetes complications, with only one exception, a gluten allergic patient (NC subj). They were not registered with medical exemptions from the physical education lessons, being encouraged by their physician to participate in sports activities. Children's involvement in physical exercise was facilitated by the use of Dexcom Platinum G4 Continuous Glucose Monitoring System (CGMS) (7 subjects). Only 3 children used insulin pumps - 1 wireless (AT subj) and 2 wire pumps. The physical activity program organized within our project was the only extracurricular physical activity for the subjects, except for 3 boys: 2 practicing basketball and 1 performing swimming, as leisure.

Significant improvements were noticed in 4 of the applied *motor assessments*, namely in 2 Eurofit tests (Flamingo and tapping), and in the Matorin test (Table II).

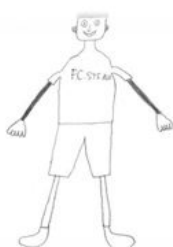
**Table I**  
Children with T1DM participating in the research

No.	Subjects' initials	Age (years)	Gender	Weight (kg)	Height (cm)	BMI	CGMS user	Insulin pump	Physical activity
1	AB	8	M	35	140	17.9	yes	yes	basketball
2	AM	12	F	55	167	19.7	no	no	none
3	AND	6	M	22	119	15.5	yes	no	swimming
4	ARC	11	M	43	149	19.4	yes	no	none
5	AT	9	F	38	160	14.8	yes	yes	none
6	VE	5	M	20	116	14.9	no	no	none
7	MM	9	M	30	138	15.8	yes	no	none
8	NC	5	F	21	119	14.8	yes	no	none
9	ȘtS	9	M	37	138	19.4	yes	yes	basketball
10	AR	12	M	51	153	21.8	no	no	none
11	MP	12	M	54	157	21.9	no	no	none

**Table II**  
Statistics for the motor assessments

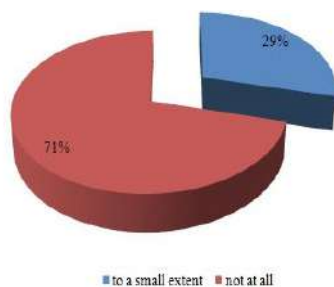
Motor assessment	Mean		T-statistic	P
	Initial	Final		
Flamingo	13.45 ± 9.05	10.90 ± 8.12	4.81	<0.001
Tapping	19.27 ± 5.04	17.63 ± 6.59	1.82	<0.05
Right turn jump	300.9 ± 59.74	335.90 ± 3.085	3.085	<0.01
Left turn jump	257.27 ± 88.55	290.90 ± 60.73	3.29	<0.01

We focused on the *emotional challenges* revealed by the Man test. Ninety percent of children with diabetes drew the entire silhouette and 10% drew only the torso. In 46% of cases, the eyes were missing or were small, and 73% of subjects drew themselves without ears. Also, 45% of children drew the face with no nose, and 55% drew only a pointed out nose. There were 10 drawings with wavy, mop or neat hair, while the hair was missing in one drawing. Fig. 1 illustrates a drawing made by one of the participants who showed anxiety and fear of expressing his emotions.



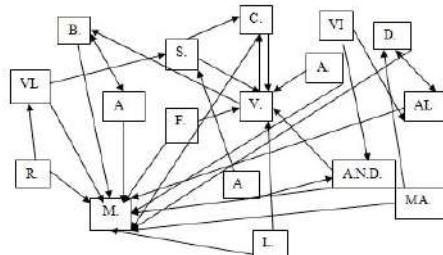
**Fig. 1** – Example of drawing made by one of the participants

The *social survey* revealed that the parents of T1DM children had rarely faced social problems related to isolation or marginalisation: 29% - to a small extent, and 71% - not at all (Fig. 2).



**Fig. 2** – Attitudes of social rejection felt by the parents

The social survey also showed that the classmates of the T1DM child had a tendency to isolate him during the physical education classes, and only two options for shared motor tasks were recorded (Fig. 3).



**Fig. 3** – Moreno matrices for the child with T1DM in physical exercise.

For this child, the survey evidenced a social status index of 0.37 and a group cohesion index of 0.02.

The report on *nutritional counseling activities* highlighted a major difficulty in carrying out this approach, because parents fighting against their children’s disease were convinced that they were acting properly when choosing the diet, and therefore they were reluctant to other recommendations. Strong persistence was noted in giving their children only the usual food, although they understood that certain products were less healthy. Thus, an inner conflict arises between the pain generated by the child’s lifestyle and the restrictions imposed in the choice of food.

The *diabetes medical report* emphasized that including physical activity in the treatment of T1DM children helps achieve the glycemia goals and reduce the amount of insulin. In this respect, we exemplify the monitoring of diabetes for one subject (AT subj), by using the DexCom Platinum CGMS, Omnipod wireless insulin pump and Night Scout platform in two different days, with and without physical activity. We noted that the need for insulin dropped by 0.7 units on the day the child performed physical activity.

**Discussions**

The quality of life of the investigated children was difficult to measure due to their age and limited functional independence related to the caregiving provided by their parents. Thus, the research objective was assessed through the balanced diabetes obtained during our intervention, which was revealed by the medical follow-up. As a result of our interdisciplinary strategy, better control of blood glucose fluctuations was achieved for all participants, which improved their quality of life by allowing them to practice sports without any risk, attend all school activities (without absenteeism caused by hypoglycemia) and raise parents’ awareness of the emotional challenges and social issues faced by their children. Furthermore, insulin therapy was improved for one subject, which led to good diabetes management and consequently to better quality of life.

*Motor intervention*

It was noticed that children became more active and increased their participation in physical activities. During the program, their great emotional involvement, strong wish to play and win, minor worry for blood glucose levels and fewer reported symptoms of blood glucose fluctuations were also observed. Regarding our recommendation to perform physical training sessions at home, parents recognized they had not complied with the individual programs prescribed for their children. The subjects generally performed 3 physical activity sessions per week, with an average duration of 60 minutes each (2 physical education classes in school and 1 physical activity within our intervention). Even so, the American Diabetes Association standards regarding the amount of physical activity that T1DM children must include in their daily treatment program were not reached. An average 60 minutes/day of moderate to vigorous intensity aerobic activity is prescribed, with muscle strengthening and bone strengthening activities included at least 3 days/week (\*\*\*, 2017).

For children with T1DM, the BMI is not an impediment to get involved in physical activity and, since their weight

is normal, they do not perceive the sedentary lifestyle they have as a threat for their body composition and risk of obesity. As studies highlight that intensive insulin therapy leads to BMI issues for adults with T1DM (\*\*\*, 2001), we consider it important to educate children to adopt an active lifestyle for their future normal development.

The age distribution from 5 to 12 years influenced the choice of the instruction contents and the relevance of motor assessments. Being a socially harmonious group of children before our intervention, their parents refused to have them divided into two categories of ages to perform various training sessions. Moreover, children preferred to play all together, regardless of their age, the older ones always helping the younger kids in performing the same motor tasks. Physical activity was customized for each repetition in accordance with their age, motor skills and blood glucose fluctuations. The CGMS proved to be an efficient tool in conducting physical activities with the investigated subjects and avoiding hypoglycemic episodes.

*Psychological intervention* - Emotional issues related to anxiety, communication difficulties and the worry about not disappointing their parents and peers were identified. Lawrence et al. (2012) emphasized similar results in their studies, explaining that T1DM subjects might face distress, depression, anxiety and eating disorders.

*Social intervention* - Families participating in our survey had a social comfort created over time by carefully choosing the social group they wanted to join, as a protective measure for the child and themselves.

Even if we conducted team building activities with the classmates of the child exposed to social isolation, this subject moved to another school the following year. The cohesion index was influenced by the fact that the initial group matching his school age had been formed a short time ago (6 months).

*Nutritional intervention* - In case of hypoglycemia, children preferred to consume the sweets they were used to, but not always the healthier ones, even if they had other choices. This intervention failed, parents being reluctant to accept the proposed nutritional counseling activities. As diet is an important factor for the growth process of each child, we consider that this intervention has still remained unexplored. Bento et al. (2015) also supported in their studies the need for food and nutrition education strategies in order to enable adult people to recognize and adopt a healthy diet for their children and themselves.

*Diabetes medical care* - Children did not record severe hypoglycemia during our interdisciplinary intervention and achieved good diabetes management, which was revealed by the regular blood analysis specific to this metabolic disease. The need for insulin is lower when the T1DM child gets involved in physical activity, which was demonstrated for one of the studied subjects. This outcome is consistent with the American Diabetes Association Standards of Care (\*\*\*, 2017), which have emphasized insulin resistance as one of the physical activity benefits for T1DM children. Because of the high cost, the young patients with T1DM included in our research cannot easily benefit from wireless insulin pumps and CGMS as standards of care able to ensure proper insulin therapy.

## **Limitations of the study**

The quality of life of the investigated subjects was not directly assessed, due to their young age and limited functional independence. This can be viewed as a study limitation.

Children showed low availability for extracurricular activities, which restricted the statistical analysis on the differences between boys and girls, preschool and primary school subjects. The large range of participants' age limited the analysis of any existing psychosocial differences.

The use of non-standardized tests is another limitation of this pilot study, the findings not being presented in a totally objective approach.

## **Conclusions**

1. The applied interdisciplinary strategy was effective in improving the quality of life of T1DM children and, even if this aspect was not directly assessed, it was reflected in the diabetes management that was achieved.

2. The motor, psychological, social and nutritional interventions addressed to T1DM children fulfilled the specific medical diabetes care and positively interacted, which led to an increase in the well-being of these young patients.

3. The physical activity program was also effective in combating the participants' sedentary lifestyle, but it can be improved in further studies by adjusting the subjects' compliance and including other kinds of sports (e.g. playful outdoor activities or aquatics).

4. Further nutritional intervention must be pursued, as the strategy applied in this study did not receive the expected echoes from the participating parents. Their poor involvement in healthy diet counseling must be countered by further educational approaches meant to change the eating behaviors of the whole family.

5. The complex therapy of T1DM children should address not only insulin dependence, diet and physical activity, but also the psychosocial challenges that the young patients and their families must face and manage throughout life.

## **Conflicts of interests**

The authors had no interests in the outcomes of this study that might be considered a personal advantage or a compromising fact for the integrity of this research.

## **Acknowledgements**

This study was achieved and published under the aegis of the National University of Physical Education and Sports of Bucharest, as a partner in the programme co-financed by the European Social Fund through the Sectoral Operational Programme for Human Resources Development 2007-2013, developed through the project Pluri- and interdisciplinarity in doctoral and post-doctoral programmes, Project Code: POSDRU/159/1.5/S/141086, its main beneficiary being the Research Institute for Quality of Life, Romanian Academy.

## References

- Alvarez-Guisasola F, Yin DD, Nocea G, Qiu Y, Mavros P. Association of hypoglycemic symptoms with patients' rating of their health-related quality of life state: A cross sectional study. *Health and Quality of Life Outcomes*. 2010; 8:86. doi: 10.1186/1477-7525-8-86.
- Bachmann S, Hess M, Martin-Diener E, Denhaerynck K, Zumsteg U. Nocturnal hypoglycemia and physical activity in children with diabetes: New insights by continuous glucose monitoring and accelerometry. *Diabetes Care*, 2016; 39(7): e95-e96. doi: 10.2337/dc16-0411.
- Bento IC, Esteves JM., França TE. Healthy eating and the difficulties faced in making it a reality: Perceptions of parents/guardians of pre-school children in Belo Horizonte/MG, Brazil. In *Cien Saude Colet.*, 2015; 20(8):2389-2400. doi: 10.1590/1413-81232015208.16052014.
- Dragnea A. Elemente de psihosociologie a grupurilor sportive. Ed. CD Press, București, 2006.
- Green A, Patterson CC. Trends in the incidence of childhood-onset diabetes in Europe 1989-1998. *Diabetologia*, 2001;44(Suppl. 3): B3-8. DOI: 10.1007/PL00002950.
- Lawrence JM, Yi-Frazier JP, Black MH, Anderson A, Hood K, Imperatore G, Klingensmith GJ, Naughton M, Mayer-Davis EJ, Seid M. Demographic and clinical correlates of diabetes-related quality of life among youth with type 1 diabetes. *J Pediatr*. 2012;161(2):201-207. doi: 10.1016/j.jpeds.2012.01.016.
- Moraru D, Moraru E, Oltean C, Bozomitu L, Bogdan A, Stana BA. Date actuale privind diabetul zaharat de tip 1 la copil. *Rev Ro Ped*. 2008;LVII(3):214-227. Available at: [http://rjp.com.ro/articles/2008.3/Pedia\\_Nr-3\\_2008\\_Art-8.pdf](http://rjp.com.ro/articles/2008.3/Pedia_Nr-3_2008_Art-8.pdf).
- Nathan DM. Long-term complications of diabetes mellitus. *N Engl J Med*. 1993;328(23):1676-1685. DOI: 10.1056/NEJM199306103282306.
- Neculau A. Dinamica grupului și a echipei. Ed. Polirom Iași, 2007.
- Quirk H, Blake H, Dee B, Glazebrook C. "You can't just jump on a bike and go": A qualitative study exploring parents' perceptions of physical activity in children with type 1 diabetes. *BMC Pediatrics*. 2014;14: 313. DOI: 10.1186/s12887-014-0313-4.
- Riddell MC, Gallen IW, Smart CE, Taplin CE, Adolfsson P, Lumb A, Kowalski A, Rabasa-Lhoret R, McCrimmon RJ, Hume C, Annan F, Fournier PA, Graham C, Bode B, Galassetti P, Jones TW, Millán IS, Heise T, Peters AL, Petz A, Laffel LM. Exercise management in type 1 diabetes: A consensus statement. *Lancet Diabetes Endocrinol*. 2017;5(5):377-390. doi: 10.1016/S2213-8587(17)30014-1.
- Secrest AM, Becker DJ, Kelsey SF, Laporte RE, Orchard TJ. Characterizing sudden death and dead-in-bed syndrome in Type 1 diabetes: Analysis from two childhood-onset type 1 diabetes registries. *Diabet Med* 2011;28(3):293-300. Available at: <https://doi.org/10.1111/j.1464-5491.2010.03154.x>.
- Sherrill C. Adapted physical activity, recreation and sport, cross-disciplinary and lifespan (6<sup>th</sup> Ed). New York: McGraw Hill, 2004.
- Urzeală C. Aspects regarding the motor capacity development in children with diabetes. *Studia Universitatis. Educatio Artis Gymnasticae*. 2014;59(4):91-99.
- Urzeală C, Bejan R. Study about the body schema and the emotional charge of children with DM. *Discobolul – Physical Education, Sport and Kinetotherapy Journal*, 2016;XI(44):80-85. Available at: [http://www.unefs.ro/discobolulmagazine/extenso/2016/DISCOBOLUL\\_2\\_44\\_2016\\_FULL\\_v2.pdf](http://www.unefs.ro/discobolulmagazine/extenso/2016/DISCOBOLUL_2_44_2016_FULL_v2.pdf).
- Urzeală C, Teodorescu S. Study regarding the social difficulties felt by the family of the child with type 1 diabetes mellitus. *Ovidius Univ Ann*, 2015;15(Suppl. 2):555-563. [Series Phys Ed Sport/Sci, Mov Health].
- Verza FE. Afectivitate și comunicare la copiii în dificultate: Ed Fundației Humanitas, București, 2004.
- \*\*\*. American Diabetes Association. Standards of medical care in diabetes. *Diabetes Care*, 2017;40(1): S33-S43. doi: 10.2337/dc17-S007.
- \*\*\*. The Diabetes Control and Complications Trial Research Group. Influence of intensive diabetes treatment on body weight and composition of adults with type 1 diabetes in the Diabetes Control and Complications Trial. *Diabetes Care*, 2001; 24(10):1711-1721. <https://doi.org/10.2337/di-care.24.10.1711>.

## Websites

- (1) WMA. 2013 World Medical Association Declaration of Helsinki - Ethical principles for medical research involving human subjects. Available at: <https://www.wma.net/wp-content/uploads/2016/11/DoH-Oct2013-JAMA.pdf>. Accessed online: 2014, 17<sup>th</sup> Sept.

## Differences in dietary supplements used by performance athletes and recreationally active individuals

*Diferențe în utilizarea suplimentelor alimentare de către sportivii de performanță și cei amatori*

George Jîtcă, Amelia Tero-Vescan \*, Amalia Miklos, Camil-Eugen Vari, Bianca-Eugenia Ősz  
Faculty of Pharmacy, University of Medicine and Pharmacy Târgu Mureș, Romania

\* All authors have equal contributions to this study

### Abstract

**Background.** Nutrition is a highly debated topic in athletes, as well as the use of dietary supplements (DS) to improve sport performance. However, a proper delimitation must be made between performance athletes (PA) and those interested in sports but who do not seek to achieve performance, recreationally active individuals (RAI), as the need for supplementing the daily diet with various proteins, carbohydrates, etc. is different.

**Aims.** The purpose of the study was to identify the preference for certain DS among PA members in sport clubs (active or retired athletes) and RAI.

**Methods.** Standardized questionnaires were distributed to 121 athletes (PA or RAI), 18-50 years old. Men (n=64) and women (n=57) answered an anonymous questionnaire containing 16 questions regarding the diets followed and the preference for certain DS.

**Results.** Among the study participants, only in the RAI group types of diet (ovo-lacto-vegetarian or strictly vegetarian) other than omnivore were found, PA having a mixed diet, according to their nutritional needs. Vitamins and minerals were the most commonly used DS in both categories, followed by carbohydrates. A preference for post-exercise and muscle recovery DS was identified in PA, and weight-loss DS were the most frequently used among RAI.

**Conclusions.** DS are used both by PA and RAI, but while PA use DS to increase their athletic performance, RAI use DS for aesthetic reasons, to improve their body image. If in the case of PA the use of DS is highly recommended for pharmacologic reasons, in the case of RAI, the use of DS is often influenced by mass-media and frequently these DS are not chosen correctly, according to the type of exercise.

**Keywords:** diet, dietary supplements, performance athletes, recreationally active individuals

### Rezumat

**Premize.** Alimentația și utilizarea suplimentelor alimentare pentru îmbunătățirea performanței sportive este un subiect extrem de controversat în literatura de specialitate. Totuși, trebuie făcută diferența între sportivii de performanță și cei care practică sportul recreațional în ce privește nevoia suplimentării dietei cu proteine, carbohidrați, etc.

**Scop.** Scopul acestui studiu a fost de a identifica preferința pentru utilizarea unor anumite suplimente alimentare de către sportivii amatori și cei de performanță, legitimați în cluburi sportive.

**Metode.** Au fost distribuite 121 de chestionare standardizate sportivilor amatori și de performanță (activi sau retrași din activitatea sportivă) cu vârsta cuprinsă între 18-50 de ani. La chestionarul format din 16 întrebări referitoare la dietele urmate și utilizarea suplimentelor alimentare au răspuns sub anonim 64 bărbați și 57 femei.

**Rezultate.** Între participanții la studiu, doar sportivii amatori au prezentat alte tipuri de dietă decât cea omnivoră (ovo-lacto-vegetariană sau vegetariană strictă), în timp ce sportivii de performanță urmează o dietă echilibrată conform cerințelor nutriționale. Suplimentele alimentare cu vitamine și minerale au fost cele mai utilizate de către ambele grupe de sportivi, urmate de carbohidrați. La sportivii de performanță a fost pusă în evidență preferința pentru suplimente alimentare pentru recuperare musculară, iar în cazul sportivilor amatori pentru suplimente alimentare și scăderea în greutate.

**Concluzii.** Suplimentele alimentare sunt utilizate atât de către sportivii de performanță, cât și de cei amatori, dar în timp ce sportivii de performanță le utilizează pentru îmbunătățirea performanței sportive, sportivii amatori le utilizează din motive estetice. Utilizarea suplimentelor alimentare este recomandată sportivilor de performanță din motive farmacologice, iar alegerea suplimentelor alimentare de către sportivii amatori este adesea incorectă, influențată de mass-media și neținând cont de tipul de efort fizic depus.

**Cuvinte cheie:** diete, suplimente alimentare, sportivi de performanță, sportivi amatori

---

Received: 2018, June 15; Accepted for publication: 2018, June 30

Address for correspondence: Faculty of Pharmacy, University of Medicine and Pharmacy Târgu Mureș, 38th Gheorghe Marinescu Street, 540139 Târgu Mureș, Romania

E-mail: amelia.tero.vescan@umftgm.ro

Corresponding author: Amelia Tero-Vescan, amelia.tero.vescan@umftgm.ro

<https://doi.org/10.26659/pm3.2018.19.3.153>

## Introduction

Nowadays, more and more people choose to change their lifestyle, dreaming of a healthier one. But we cannot speak about a healthy lifestyle without referring to sport and a balanced diet. Performance athletes (PA) and recreationally active individuals (RAI) exercise to achieve their goal (to obtain a certain physical appearance or a better performance) and often use dietary supplements (DS). There are many “specialists” who promote through the media various diets and DS to “help” them. However, there is a difference between PA and RAI when it comes to following a particular diet or using DS, a difference that starts with proper counseling. PA registered in sport clubs benefit from counseling in sports medicine and nutrition, have a balanced diet and use DS with an appropriate composition and nutrient amounts, according to personal needs.

Problems appear in the case of RAI, who, in order to achieve their goal as quickly as possible, usually related to aesthetic reasons rather than achieving performance in sport, use different DS without benefiting from an expert’s advice. Unfortunately, there are many websites on the internet that recommend various DS to enhance physical performance and to help achieve that much dreamed of physical appearance. Few persons question whether these recommendations are appropriate for them and forget that the main purpose of these sites is product marketing and promotion.

## Hypothesis

The selection of a certain DS must consider the energy needs correlated with the conformational type and exercise intensity. PA are usually well informed regarding the quality and content of active substances in DS, while RAI use mass media information about DS in order to achieve the desired physical appearance without knowledge of the real needs. RAI usually use weight-loss DS to get the desired results much faster.

## Material and methods

The purpose of our study was to identify the differences between PA and RAI in using DS based on a 16-item questionnaire. The study was approved by the Ethical Committee of Scientific Research from the University of Medicine and Pharmacy of Târgu Mureş, Romania.

a) *Place of the research.* The survey was run for 3 months in gyms from Târgu Mureş city, Romania.

b) *Subjects and groups*

The questionnaire was completed by 121 subjects - 51 performance athletes (active or retired from sports) and 70 recreationally active individuals, aged between 18 and 50 years. The gender distribution was 53% males and 47% females.

c) *Test applied*

Participants were asked to fill out a questionnaire after being informed about its purpose (the use of DS among athletes). The questionnaire was anonymous and freely consented to (the decision to complete and return the survey was interpreted as an indicator of the consent to participate).

d) *Data analysis*

Data analysis was performed by obtaining the percentages of each response (Yes or No) using Microsoft Excel.

The differences between age categories and genders were analyzed using Kruskal-Wallis test followed by Dunn’s multiple comparison test as a post hoc test. T-test was used to compare the BMI between athlete groups (PA and RAI) of the same gender. All tests were performed using Graph Pad Prism 5, differences being considered statistically significant if  $p < 0.05$ .

## Results

The first two questions were related to gender and age.

Age distribution among athletes differed. PA were mostly under 30 years old (61%), while RAI were aged between 30-40 years (~ 40%) or between 40-50 years (~ 30%).

**Table I**  
Age distribution (%) by gender and the type of physical activity (PA or RAI)

Age categories	Men		Women	
	PA	RAI	PA	RAI
18-30	61	61	33	26
30-40	32	35	42	38
40-50	7	4	25	36
>50	0	0	0	0
p* (PA vs. RAI /gender)	p > 0.05		p > 0.05	

\* Kruskal-Wallis and Dunn’s multiple comparison tests

There were no statistically significant differences between age groups, regardless of the variable (male PA vs. male RAI, female PA vs. female RAI).

The answers to questions 3 and 4 (related to height and weight) were used to calculate the BMI [weight (kg)/height (m)<sup>2</sup>]. The results are presented in table II as average ± SD.

**Table II**  
Anthropometric data

Monitored parameters	Men		Women	
	PA	RAI	PA	RAI
Weight (kg)	74.25 ± 6.02	75.53 ± 10.12	56.25 ± 7.05	63.02 ± 11.03
Height (cm)	176.25 ± 4.01	175.22 ± 4.49	163.01 ± 8.21	161.51 ± 7.25
BMI	23.89 ± 1.75	24.59 ± 3.06	21.20 ± 2.15	24.80 ± 4.33
p*	p > 0.05		p < 0.05	

\* t-test

The BMI differences were statistically significant only between female PA and RAI.

The self-perception regarding their inclusion in one of the four weight categories (underweight, normal weight, overweight, obese) and constitutional type (ectomorph, mesomorph or endomorph) was also evaluated (questions 5 and 6). Most athletes considered themselves as being normal weight (85% PA and 64% RAI) and having a mesomorph (67% PA) or endomorph (43% RAI) body type. Of all participants, 17% considered themselves obese, but the inclusion in this weight category was confirmed only in 5% of the cases taking into account the BMI value.

Question 7 evaluated the number of training sessions/week. Participants had to choose between 1, 2, 3 or more than 3 training sessions/week. Most of the PA declared

more than 3 (60%), while RAI reported one (32%) or two training sessions (27%).

The answers to *questions 8 and 9* were used to identify the type of diet followed by athletes. First (question 8), they had to choose between Yes or No to answer if they suffered from any diseases requiring a special diet. Only 2% of RAI gave an affirmative answer.

Participants were then asked to choose between different types of diet: mixed, ovo-lacto-vegetarian, strictly vegetarian or other (question 9). The results (%) are presented in Table III.

**Table III**  
The type of diet followed by athletes (results presented as %)

Type of diet	Men		Women	
	PA	RAI	PA	RAI
Mixed	100	100	89	70
Ovo-lacto-vegetarian	0	0	11	18
Strictly vegetarian	0	0	0	12
Other	0	0	0	0

The question 10 (*Do you take dietary supplements?*) was answered by all PA with Yes, unlike the RAI group, in which 78% of men and only 29% of women reported the use of dietary supplements.

Questions 11-16 evaluated the type of dietary supplement used by athletes. They had to choose between Yes or No.

**Table IV**  
The type of dietary supplement used according to gender and the type of physical activity (no. of affirmative answers presented as %)

Do you take.....?	Men		Women	
	PA	RAI	PA	RAI
DS containing carbohydrates	100	42	100	24
DS containing creatine, arginine, nitric oxide donors	37	56	39	9
Weight-loss DS	0	25	0	53
Vitamins and minerals	100	19	100	53
Post-exercise and muscle recovery DS	100	17	100	9
DS containing ephedrine, pseudoephedrine, L-carnitine	0	28	0	0

DS containing carbohydrates and post-exercise and muscle recovery DS were preferred especially by PA. The percentages of PA using DS containing creatine, arginine, nitric oxide donors were similar. In the case of RAI, men preferred DS containing creatine, arginine, nitric oxide donors, while women preferred vitamins and minerals. Only RAI mentioned that they used weight-loss DS, and 28% of male RAI reported the use of DS containing ephedrine, pseudoephedrine, L-carnitine.

## Discussion

Most of the PA (men and women) use carbohydrates, vitamins, minerals and post-exercise and muscle recovery DS, while male RAI use carbohydrates, creatine, arginine, nitric oxide donors, ephedrine, pseudoephedrine or L-carnitine. Female RAI use mostly vitamins and minerals or DS for weight loss.

PA have a balanced diet which theoretically should ensure their daily energy expenditure, and when they

use DS, these are judiciously selected according to their energy needs. For fitness programs that require a workout of 30-40 minutes/day (up to 3 days a week) without a necessary increase in caloric intake, the energy expenditure is between 1800-2400 kcal/day. In the case of medium intensity exercise (2-3 h/day, 5-6 times/week) or high intensity exercise (3-6 h/day in 1-2 workouts for 5-6 days/week), the energy needs are much higher, up to 600-1.200 kcal or more per hour during exercise (Kreider et al., 2010). Moreover, in order to prevent gastric discomfort during exercise, a meal timetable of 4-6 meals and snacks/day is recommended.

Daily nutrition of an athlete must benefit from carbohydrates and proteins, the percentage and amount of carbohydrates depending on exercise intensity and duration. In practicing sports that require aerobic exercise, the main causes of fatigue are glycogen depletion and dehydration due to long-lasting exercise (Briars et al., 2017). Almost all athletes consume before exercise a commercially prepared high carbohydrate energy bar which contains approximately 47-50 g carbohydrates that are oxidized in 50-60 minutes (as the body can oxidize 1-1.1 grams of carbohydrates/minute or about 60 grams/hour) (Kerksick et al., 2008). This is all the energy that RAI need during 1 h of exercise, and supplementary energy from the meal they eat before workout is not required. In the case of increased intensity training, the protein intake should be double than the recommended daily dose of 1.5-2.0 g/kg/day in order to maintain protein balance (Kreider et al., 2010). The quality of proteins is also very important because they are used differently in the body, DS that contain whey, colostrum, casein, milk and egg proteins being the best choice of high quality protein (van Loon, 2014). Carbohydrate supplementation improves sports performance, and carbohydrate mixtures (monosaccharides - glucose, fructose, etc. with fast absorption, or polysaccharides with long-time digestion and slow absorption) have a great importance, providing a quick but also constant effect over time.

Increased preference regarding the use of *creatine, arginine and nitric oxide donor DS* was found especially in male RAI. L-arginine is important for the ammonia detoxification of the body, through the urea cycle, but it also controls the release of several hormones such as insulin, glucagon, growth hormone (GH), prolactin and catecholamines that influence metabolism. The growth hormone is an anabolic hormone which stimulates lipolysis and reduces glucose oxidation to maintain blood glucose levels, while insulin increases glucose storage, as glycogen, in liver and muscle cells. Although all these mechanisms enhance exercise performance, there are no studies reporting that these DS could have any benefits in PA (Bescós et al., 2012). L-arginine supplementation induces an increase in capillary density during acute anaerobic exercise, but this effect disappears after exercise. During anaerobic exercise, oxygen delivery is increased through vasodilatation according to different metabolic demands. Although muscle capillary density is lower in women than in men, during training it increases more in women (Pranskunas et al., 2015).

All PA took DS containing *vitamins and minerals*.

Few studies have correlated vitamins with an ergogenic effect, but vitamin intake is important for many metabolic processes, energy generation from different endogenous substances, cell integrity and some neurological processes. Among vitamins, the most frequently used are vitamins C and E because they reduce muscle damage and, hence, shorten the regeneration time between trainings or competitions. Omega 3 fatty acids (eicosapentaenoic and docosahexaenoic acid) have an important role in anabolic processes, stimulating Leydig cells to produce testosterone, an anabolic hormone (Rowell et al., 2018).

Minerals are also important in numerous metabolic pathways as constituents of enzymes and hormones, which is why mineral supplementation improves exercise capacity. For example, iron deficiency could lead to anemia limiting work capacity, while magnesium deprivation reduces endurance performance by increasing oxygen requirements (Paulsen et al., 2014). Our study also revealed that female RAI take vitamins and minerals more often than men. Women are exercising for aesthetic reasons and most of them have a restrictive diet, so the supplementation is justified. Iron has a direct effect on sports performance by playing an important role in oxygen transport and metabolism both in PA and RAI. A decrease in the iron content of mitochondrial cytochromes influences skeletal muscle metabolic processes with decreased energy output and decreased sports performance. Frequent training increases the risk of developing iron deficiency as a result of hemolysis. Women in both groups have a higher chance of developing anemia by iron depletion as a result of the menstrual cycle. An optimal level of iron for both groups, PA and RAI, should be monitored before starting supplementation to prevent side effects caused by iron. Zinc is frequently found in DS because it has an important role in regulating metabolism and immune processes, but it also influences antioxidant enzymes, being part of the structure of *superoxide dismutase* (Nikolaidis et al., 2012).

*Post-exercise and muscle recovery DS* are important for athletes. The administration schedule is very important not only for improving physical performance and delaying fatigue, but also for accelerating regeneration. The right combination must be chosen according to the exercise type and exercise intensity. Protein DS are often consumed by athletes even though there are no evidence-based data on their benefits (Pasiakos et al., 2014). Restoring glycogen deposits in the muscle is essential for PA because it directly influences their results, so intake of carbohydrates immediately after training will increase glycogen synthesis (Burke et al., 2017). Fast-absorption carbohydrates with low glycemic index are recommended for quick recovery as they induce a lower insulin response; the use of a mixture of carbohydrates and proteins seems to have a greater beneficial effect but should be consumed as soon as possible after exercise (Outlaw et al., 2014). The increase in insulin sensitivity can be achieved with a mixture of leucine-phenylalanine-tyrosine-carbohydrate DS (Nakayama et al., 2018).

Only male RAI admitted that they used *ephedrine, pseudoephedrine and L-carnitine DS*. These are considered thermogenic DS and are designed to stimulate the metabolism and to promote weight loss (Tinsley et

al., 2017). Because ephedrine and pseudoephedrine are monitored in competition, due to their stimulant activity, it is unlikely that PA use such substances.

PA use and mobilize fatty acid reserves in the adipose tissue much more efficiently than sedentary people, and a DS used in this regard is *L-carnitine*, which facilitates the transport of free fatty acids to mitochondria for beta-oxidation and provides a greater amount of energy than carbohydrates. In speed sports, special attention must be given to the lactic acid produced from anaerobic glycolysis causing a pH decrease both in the blood and in the muscles. For this purpose, a non-proteinogenic amino acid, beta-alanine, may be used as a DS. It must be administered a few weeks before competition to prevent pH decrease (Baguet et al., 2010). Beta-alanine increases the levels of carnosine (beta-alanyl-L-histidine) in the muscle, a dipeptide that presents a rather important buffer ability. Another way to adjust pH is to use sodium bicarbonate. Administration of these two DS provides a better buffer capacity, both intracellular (beta-alanine) and extracellular (bicarbonate) (Sale et al., 2011).

For people who practice sports only to improve their appearance, weight is an important issue. It must be considered that rapid weight loss may have dangerous physiological consequences such as dysfunctions of the immune and endocrine systems, bone decalcification, hydro-electrolyte imbalances, depression and dysfunctions of the nervous system. Dehydration during rapid weight loss should be avoided. Longer and more intense training produces free radicals that will be neutralized by the use of DS antioxidants taken by both PA and RAI. There are no experimental studies with conclusive results demonstrating that the use of antioxidants would improve sports performance. In some cases, they delay fatigue, but the effects are accompanied by a decrease in strength. The general purpose of antioxidants is to reduce oxidative stress, which influences normal enzyme activity, alters cell membranes or the structure of DNA. Administration of resveratrol reduced exercise performance in low-capacity rats; instead, those with increased capacity showed an increase in physical performance (Hart et al., 2013; Hart et al., 2014). This shows that there is an impact of genotype on diet adaptation responses.

Administering caffeine before a competition can also have a beneficial role because (it reaches a maximum plasma concentration at 30-90 minutes after ingestion) (Astley et al., 2018) it improves resistance to exercise, stimulates sensitive hormone lipase and releases fatty acids that will be used during the exercise.

## Conclusions

1. DS are a controversial topic today and the effectiveness of some is not supported by scientific studies. Choosing a DS should be done with caution and taking into account the nature of the exercise (aerobic or anaerobic), its intensity and the physical fitness of the athlete.

2. PA are very attentive to their diet, which is adapted to their energy needs, but also to the type of DS used and the correct administration before, during or after exercise.

3. RAI are more interested in achieving a certain target (weight loss, muscle gain or a certain physical appearance),

often abusing of DS (including those for weight loss).

4. In order to use these DS correctly, it is necessary to consult a specialist in this area, as mass-media often provides incomplete data, promising the desired results in a short time.

### Conflict of interests

There are no conflicts of interest.

### References

- Astley C, Souza DB, Polito MD. Acute Specific Effects of Caffeine-containing Energy Drink on Different Physical Performances in Resistance-Trained Men. *Int J Exerc Sci*. 2018;11(4):260-268.
- Baguet A, Koppo K, Pottier A, Derave W. Beta-alanine supplementation reduces acidosis but not oxygen uptake response during high-intensity cycling exercise. *Eur. J. Appl. Physiol*. 2010;108(3):495-503. doi: 10.1007/s00421-009-1225-0.
- Bescós R, Sureda A, Tur JA, Pons A. The effect of nitric-oxide-related supplements on human performance. *Sports Med*. 2012;42(2):99-117. doi: 10.2165/11596860-000000000-00000.
- Briars GL, Gordon GS, Lawrence A, Turner A, Perry S, Pillbrow D, Walston FE, Molyneux P. Swim drink study: a randomised controlled trial of during-exercise rehydration and swimming performance. *BMJ Paediatr Open*. 2017;1(1): e000075. doi: 10.1136/bmjpo-2017-000075.
- Burke LM, van Loon LJC, Hawley JA. Postexercise muscle glycogen resynthesis in humans. *J Appl Physiol*. (1985).2017;122(5):1055-1067. doi: 10.1152/jappphysiol.00860.2016.
- Hart N, Sarga L, Csende Z, Koch LG, Britton SL, Davies KJ, Radak Z. Resveratrol attenuates exercise-induced adaptive responses in rats selectively bred for low running performance. *Dose-Response*. 2014;12(1):57-71. doi: 10.2203/dose-response.13-010.Radak.
- Hart N, Sarga L, Csende Z, Koltai E, Koch LG, Britton SL, Davies KJ, Kouretas D, Wessner B, Radak Z. Resveratrol enhances exercise training responses in rats selectively bred for high running performance. *Food Chem. Toxicol*. 2013;61:53-59. doi:10.1016/j.fct.2013.01.051.
- Kerksick C, Harvey T, Stout J, Campbell B, Wilborn C, Kreider R, Kalman D, Ziegenfuss T, Lopez H, Landis J, Ivy JL, Antonio J. International Society of Sports Nutrition position stand: nutrient timing. *J Int Soc Sports Nutr*. 2008;5:17. doi: 10.1186/1550-2783-5-17.
- Kreider R B, Wilborn C D, Taylor L, Campbell B, Almada A L, Collins R, Cooke M, Earnest CP, Greenwood M, Kalman DS, Kerksick CM, Kleiner SM, Leutholtz B, Lopez H, Lowery LM, Mendel R, Smith A, Spano M, Wildman R, Willoughby DS, Ziegenfuss TN, Antonio J. ISSN exercise & sport nutrition review: research & recommendations. *J Int Soc Sports Nutr*. 2010;7: 7. doi: 10.1186/1550-2783-7-7.
- van Loon LJ. Is there a need for protein ingestion during exercise?. *Sports Med*. 2014;44 Suppl 1:S105-S111. doi: 10.1007/s40279-014-0156-z.
- Nakayama K, Sanbongi C, Ikegami S. Effects of Whey Protein Hydrolysate Ingestion on Postprandial Aminoacidemia Compared with a Free Amino Acid Mixture in Young Men. *Nutrients*. 2018;10(4).pii:E507. doi: 10.3390/nu10040507.
- Nikolaidis MG, Kerksick CM, Lamprecht M, McNulty SR. Does vitamin C and E supplementation impair the favorable adaptations of regular exercise? *Oxid Med. Cell. Longev*. 2012;2012:707941. doi: 10.1155/2012/707941.
- Outlaw JJ, Wilborn CD, Smith-Ryan AE, Hayward SE, Urbina SL, Taylor LW, Foster CA. Effects of a pre-and post-workout protein-carbohydrate supplement in trained cross fit individuals. *Springerplus*. 2014;3:369. doi: 10.1186/2193-1801-3-369.
- Pasiakos SM, Lieberman HR, McLellan TM. Effects of protein supplements on muscle damage, soreness and recovery of muscle function and physical performance: a systematic review. *Sports Med*. 2014;44(5):655-670. doi: 10.1007/s40279-013-0137-7.
- Paulsen G, Cumming KT, Holden G, Hallén J, Rønnestad BR, Sveen O, Skaug A, Paur I, Bastani NE, Østgaard HN, Buer C, Midttun M, Freuchen F, Wiig H, Ulseth ET, Garthe I, Blomhoff R, Benestad HB, Raastad T. Vitamin C and E supplementation hampers cellular adaptation to endurance training in humans: a double-blind, randomised, controlled trial. *J Physiol*. 2014;592(8):1887-1901. doi: 10.1113/jphysiol.2013.267419.
- Pranskunas A, Pranskuniene Z, Bernatoniene J, Vaitkaitiene E, Brazaitis M. Microcirculatory effects of L-arginine during acute anaerobic exercise in healthy men: A pilot study. *J ExercSci Fit*. 2015;13(2):57-62. doi: 10.1016/j.jesf.2015.04.001.
- Rowell AE, Aughey RJ, Hopkins WG, Esmaeili A, Lazarus BH, Cormack SJ. Effects of Training and Competition Load on Neuromuscular Recovery, Testosterone, Cortisol, and Match Performance During a Season of Professional Football. *Front Physiol*. 2018;9:668. doi: 10.3389/fphys.2018.00668.
- Sale C, Saunders B, Hudson S, Wise JA, Harris RC, Sunderland CD. Effect of beta-alanine plus sodium bicarbonate on high-intensity cycling capacity. *Med. Sci. Sports Exerc*. 2011;43(10):1972-1978. doi: 10.1249/MSS.0b013e3182188501.
- Tinsley GM, Urbina S, Mullins J, Outlaw J, Hayward S, Stone M, Foster C, Wilborn C, Taylor L. Influence of A Thermogenic Dietary Supplement on Safety Markers, Body Composition, Energy Expenditure, Muscular Performance and Hormone Concentrations: A Randomized, Placebo-Controlled, Double-Blind Trial. *J Sports Sci Med*. 2017;16(4):459-467.

## **Promoting and supporting physical activity and sport among young people in the Republic of Moldova**

*Promovarea și susținerea activităților fizice și sportului printre tinerii din Republica Moldova*

**Serghei Cebanu<sup>1,2</sup>, Mariana Tutunaru<sup>2</sup>, Raisa Deleu<sup>1</sup>, Angela Cazacu-Stratu<sup>1,2</sup>, Grigore Friptuleac<sup>1,2</sup>**

<sup>1</sup> *Nicolae Testemitanu State University of Medicine and Pharmacy, Chisinau, Republic of Moldova*

<sup>2</sup> *National Agency for Public Health, Chisinau, Republic of Moldova*

### **Abstract**

*Background.* The health status of the young generation is an important indicator of the well-being for the society and the state, which reflects not only the current situation, but also the prospects for the future. The practice of physical activity and sport must ensure the formation of healthy and dynamic youth, capable of creative activities, in order to form an integral, creative and autonomous personality.

*Aims.* Health status assessment of children, adolescents and conditions of practicing physical exercise and sport.

*Methods.* A longitudinal descriptive study of pupils' health status and conditions of practicing physical exercises and sport within the pre-university institutions in the Republic of Moldova was carried out.

*Results.* The complex assessment of pupils' health status dynamics following the results of prophylactic medical examinations reveals the presence of some deficiencies in physical development. The provision of pre-university institutions with sports halls and additional sanitary facilities for practicing sport is precarious, registering significant territorial differences. General schools in the Republic of Moldova are provided with sports halls in a proportion of 84.6%. But the possibilities of practicing physical exercise and sport in extracurricular activities are limited.

*Conclusions.* Against the background of an unstable socio-economic situation, characteristic for the development of the Republic of Moldova over the last two decades, negative trends in the health status of children and adolescents in all age groups have been formed. There is still a problem with the provision of sports halls and sports grounds for practicing physical activities in schools in the Republic of Moldova.

**Keywords:** health status, physical exercises, pre-university institutions, children and adolescents

### **Rezumat**

*Premize.* Starea de sănătate a generației tinere este un indicator important al bunăstării societății și a statului, care reflectă nu numai situația actuală, ci și perspectivele pentru viitor. Practicarea activităților fizice și sportului trebuie să asigure formarea unui tineret sănătos și dinamic, capabil de activități creative, în vederea formării unei personalități integrale, creative și autonome.

*Obiective.* Evaluarea stării de sănătate a copiilor și adolescenților și a condițiilor de practicare a exercițiilor fizice și sportului.

*Metode.* A fost efectuat un studiu descriptiv, longitudinal al stării de sănătate a elevilor și condițiilor de practicare a exercițiilor fizice și sportului în instituțiile preuniversitare din Republica Moldova.

*Rezultate.* Evaluarea complexă a dinamicii stării de sănătate a elevilor, după rezultatele examenelor medicale profilactice, atestă existența unor deficiențe în dezvoltarea fizică. Asigurarea instituțiilor preuniversitare cu săli sportive și dotări sanitare adiționale practicării sportului este precară, înregistrându-se diferențe teritoriale semnificative. Școlile generale din Republica Moldova sunt asigurate cu săli sportive în proporție de 84,6%. Dar, posibilitățile de practicare a exercițiului fizic și sportului în activități extrașcolare sunt limitate.

*Concluzii.* Pe fondul situației socio-economice instabile, caracteristică pentru dezvoltarea Republicii Moldova în ultimele două decenii, s-au format tendințe negative privind starea de sănătate a copiilor și adolescenților din toate grupele de vârstă. În școlile din Republica Moldova există încă problema asigurării cu săli sportive și terenuri sportive pentru practicarea activităților fizice.

**Cuvinte cheie:** stare de sănătate, exerciții fizice, instituții preuniversitare, copii și adolescenți

---

Received: 2018, July 24; Accepted for publication: 2018, August 8

Address for correspondence: Nicolae Testemitanu State University of Medicine and Pharmacy, Chisinau, Republic of Moldova, 165, Ștefan cel Mare și Sfânt MD-2004, Chisinau, Republic of Moldova

E-mail: serghei.cebanu@usmf.md

Corresponding author: Serghei Cebanu; serghei.cebanu@usmf.md

<https://doi.org/10.26659/pm3.2018.19.3.158>

## Introduction

During childhood and adolescence, physical education in school offers an excellent opportunity to learn and practice the skills necessary for the improvement of physical and health status throughout life. Early acquisition of basic skills makes it crucial for children and adolescents to practice and better understand the value of these activities in their later education.

The continuous unfavorable trend of aggravation of children's health status in the Republic of Moldova has become stable enough to pose a real threat to the national security of the country. A decrease in the birth rate, an increase in infant mortality, a significant reduction in the proportion of healthy children at birth, an increase in the number of people with childhood disabilities and patients with chronic pathology have been reported. The natural growth rate for over 15 years has been a negative one.

Undoubtedly, the marked and persistent tendency of deterioration of children's health will cause a deterioration of health status in all age groups and will inevitably affect the quality of work resources, the reproduction of future generations, and implicitly the sustainable development of the state (Iziumov et al., 2010; Manole et al., 2015).

The analysis of the current situation shows that the main reasons are the social and economic instability of society, the precarious health condition of children's living environment, the unfavorable ecological situation, the reckless reform of the education and health system, the reduced activity of health promotion and education of the population, the decrease of preventive measures, etc. (Pattison & Boderscova, 2012; Dumitrache et al., 2013; Cazacu-Stratu et al., 2015).

Many epidemiological studies show that increasing morbidity in the young population is also associated with a constant increase in educational burden, psychoemotional overstrain and hypodynamics, as well as the refusal to lead a healthy lifestyle (which begins in the family) (Bucșa, 2011; Gustiuc, 2015; Leșco, 2015).

In this context, increasing the life expectancy of the citizens of the country is a primary task of the state. In order to achieve it, it is necessary to strengthen the population's health status, primary and secondary disease prevention and the formation of a healthy lifestyle among people of all ages.

In all policy papers elaborated over the last years, special attention is paid to physical activity and sport practice (2); (3); (4); (5); (6).

The current study aimed to assess the health status of children, adolescents and conditions of practicing physical exercise and sport in order to develop a system of measures to promote health, physical education and sport in the Republic of Moldova.

## Hypothesis

Physical activity is one of the indispensable conditions of a healthy lifestyle for the formation and strengthening of health throughout the whole life, and the education of the need to practice physical exercise must be grounded since childhood and adolescence. This requires an adequate infrastructure, both at curricular and logistic level. The

existence of an interdependent connection was supposed between the presence of conditions for practicing physical exercise, the training program and the health status of pupils in the Republic of Moldova.

## Material and methods

A longitudinal descriptive study of pupils' health status and conditions for practicing physical exercises and sport within pre-university institutions in the Republic of Moldova was carried out, according to the protocol approved by the Ethics Committee of the Nicolae Testemitanu State University of Medicine and Pharmacy.

### *Research protocol*

#### *a) Period and place of the research*

The research was carried out during the period January-June 2018, and comprised 35 first level administrative territorial units.

#### *b) Subjects and groups*

The pupils' health status was assessed based on the results of the medical examination performed annually in all pre-university institutions in the country. The general health status, basic anthropometric indices and neuropsychological developmental indices were evaluated during the examination. The results of the medical examination of 371,253±269.17 pupils (98.6-99.7% out of the total number of pupils) were analyzed.

The pupils' morbidity was studied according to the statistical report f-12A/e "Report on pupils' morbidity" submitted quarterly by pre-university institutions to the Territorial Public Health Centers, the annual data being centralized at the National Agency for Public Health.

The health groups were assessed based on physical development, frequency and duration of illnesses.

The hygienic assessment of the content and educational conditions of the physical culture classes in the pre-university institutions was conducted based on the results of the current sanitary surveillance presented by the Territorial Public Health Centers. The presence of sports halls, social-sanitary facilities, functionality and hygienic conditions for practicing physical exercises was evaluated.

#### *c) Methods applied*

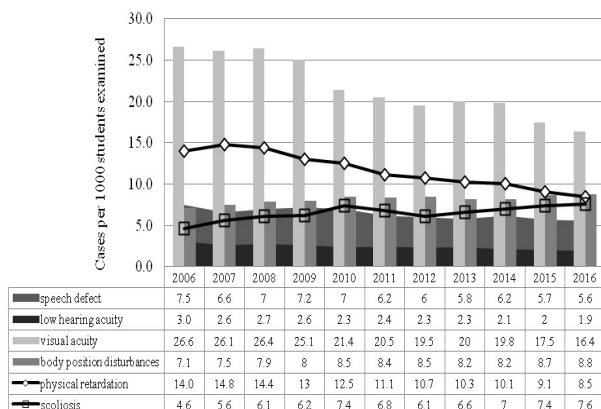
The reports on the results of medical examinations, on pupils' morbidity were collected within the current research. For the hygienic feature of the sports halls of pre-university institutions in the Republic of Moldova, a questionnaire consisting of 5 open questions and 15 closed questions was drawn up, after which the results of the current sanitary surveillance conducted by the Territorial Public Health Centers were totalized.

#### *d) Statistical processing*

The intensive and extensive indices of the incidence and prevalence of physical and neuropsychiatric development deficiencies, general morbidity and health groups of pupils, depending on sex, primary and gymnasium levels, were determined in their dynamics during the years 2006-2016. The overall morbidity assessment was carried out according to the International Classification of Diseases, WHO 10<sup>th</sup> revision. The analysis of the obtained results was conducted by applying the sanitary statistical methods for small random selections, using the software *Microsoft Excel*, *EpiInfo - 3.5.4*, *EpiMax Table*.

## Results

The complex assessment of pupils' health status dynamics according to the results of the prophylactic medical examinations attests the existence of some physical development deficiencies. The structure of the registered deficiencies is dominated by low visual acuity (26.6-16.4 cases in 1000 examined children), followed by physical retardation (14.8-8.5 cases in 1000 examined children), behavioral disorders (7.1-8.8 cases in 1000 examined children), scoliosis (4.6-7.6 cases in 1000 examined children), speech defects (7.5-5.8 cases in 1000 examined children), and low hearing acuity (2.1-3.0 cases in 1000 examined children) (Fig. 1).



**Fig. 1** – The health status evolution of children in the Republic of Moldova according to the results of medical examinations

The high prevalence of low visual acuity is characteristic for 2<sup>nd</sup>-4<sup>th</sup> and 5<sup>th</sup>-8<sup>th</sup> form pupils, especially in urban environment; physical retardation - for pupils in rural environment; behavioral disorders - among pupils in urban environment, and speech defects - among school pupils in urban environment, at the level of municipalities,

especially in primary school pupils. Low hearing acuity rates are higher in rural environment, especially in 2<sup>nd</sup>-4<sup>th</sup> form pupils.

Physical inactivity is one of the determinant factors of physical retardation and behavioral disorders, which is why we will further elucidate the evolution of these two deficiencies.

Thus, the number of physical retardation cases gradually decreases throughout the estimated period, from 14.8 in 2007 to 8.5 in 1000 examined cases - in 2016. The highest rates are registered at the level of districts, among 1<sup>st</sup> form pupils (25.7-35.1‰). Values below the average republican level are attested among 9<sup>th</sup>-12<sup>th</sup> form pupils (12.2-8.0‰).

At the same time, behavioral disorders show a gradual and constant increase, from 7.1 in 1000 examined children in 2006 to 8.8 in 2016. This dynamics is found in all age groups. The highest rates are characteristic of 1<sup>st</sup> form pupils (13.6‰-18.2‰), followed by 2<sup>nd</sup>-4<sup>th</sup> form pupils (10.2‰ and 12.8‰) and 5<sup>th</sup>-9<sup>th</sup> form pupils (9.8‰ and 12.7‰). As for the evolution recorded in high school pupils, it is worth mentioning the doubling of the number of retarded people in the last year of the observation period, which equals 6.8‰ in 2006 and 14.2‰ in 2016.

No less important in the health status assessment of children and adolescents is the evaluation of the physical development degree. In the current study, the mean body mass was estimated at 79.8±2.42% for 10-14-year-old children and 81.7±1.89% for 15-17-year-old children. Body mass deviations in both adolescence periods were significantly more frequently reported as underweight (14±2.36% and 11.3±1.80%, respectively), especially in people aged 10-14, living in urban environment, of both sexes – 15.6±3.45% and 13.4±1.20% for females and males, respectively.

Normal height occurred with the same frequency in both age groups (79.9±3.24%). Among deviations, low height was registered more frequently: 12.3±1.74% and

**Table I**  
Level and structure of general morbidity of pupils, average data, years 2006-2016

Disease	Morbidity indications, M±m				Rank	
	Incidence		Prevalence		Incidence	Prevalence
	per 1000 pupils	%	per 1000 pupils	%		
General morbidity	464.0±13.11	100	724.0±28.31	100		
Including chronic morbidity	100.2±23.02	26.9±2.70	324.1±36.80	44.8±7.15		
Infectious diseases (A00-B64)	4.7±1.89	1.1±0.44	39.3±2.48	5.4±1.48	XIII	IX
Parasitic diseases (B65-B83)	40.3±6.73	8.3±1.13	36.6±9.84	5.1±1.40	IV	X
Diseases of the blood, hematopoietic organs and disorders of the immune mechanism (D50-D89)	33.5±5.46	7.1±1.16	57.9±4.36	8.0±2.13	V	V
Iron deficiency anemia (D50)	32.8±6.12	6.9±1.35	69.1±4.23	9.5±2.48	VI	III
Endocrine, nutrition and metabolism disorders (E00-E90)	8.3±7.72	11.0±1.37	13.4±6.80	1.9±0.54	II	XIV
Obesity (E66)	12.0±1.64	2.5±0.32	28.3±2.12	3.9±1.08	XIII	XII
Mental and behavioral disorders (F00-F99)	4.9±0.62	1.0±0.17	29.6±2.51	4.1±1.14	XIV	XI
Diseases of the nervous system (G00-G99)	37.7±3.99	8.1±0.82	57.3±2.48	7.9±2.10	V	VI
Diseases of the respiratory system (J00-J99)	97.4±8.78	21.0±1.86	395.4±5.23	54.6±7.16	I	I
Diseases of the eye and its appendages (H00-H59)	41.3±2.26	9.0±0.60	72.6±5.74	10.0±2.60	III	II
Diseases of the ear and mastoid apophysis (H60-H95)	6.8±0.27	1.5±0.05	9.2±0.46	1.3±0.37	XIV	XVI
Diseases of the circulatory system (I00-I99)	34.1±3.63	7.4±0.99	19.2±2.58	2.7±0.76	VI	VIII
Diseases of the digestive system (K00-K99)	47.9±9.95	11.0±1.89	68.2±4.30	9.4±2.46	II	IV
Gastritis, duodenitis (K29)	23.2±5.86	5.3±1.34	46.1±2.21	6.4±1.73	IX	VIII
Skin and subcutaneous tissue diseases (L00-L99)	4.4±1.08	3.2±0.83	6.5±1.54	0.9±0.26	XII	XVII
Diseases of the genitourinary system (N00-N99)	17.8±2.39	4.0±0.40	39.4±2.32	5.4±1.48	XI	IX
Diseases of the osteoarticular system (M00-M99)	23.6±5.45	4.8±1.10	56.1±2.54	7.7±2.05	X	VII
Injuries (T00-T98)	7.5±1.31	1.5±0.16	11.6±2.30	1.6±0.46	XIV	XV

7.8±1.36% ( $p<0.05$ ), in pupils aged 10-14 and 15-17, respectively. Among children aged 10-14, low height levels were more frequently found in those from urban environment, and for children aged 15-17 – in those from rural environment, both males and females (15.8±0.73% and 11.3±1.02%).

In general, the multiannual dynamics of the general morbidity of pupils in the Republic of Moldova is characterized by a peak of maximum incidence and prevalence in 2007 (484.5‰ and 246.3‰) and by close values in the other years.

The mean level of the general morbidity incidence of pupils is 464.0±13.11 cases in 1000 pupils and that of the general morbidity prevalence is 724.0±28.31 cases in 1000 pupils (Table I), being determined in a proportion of 21.6±4.70% and 44.8±7.15%, respectively, of chronic pathology. Among pathology classes with a maximum level of incidence are listed respiratory system diseases (J00-J99) – 97.4±8.78‰, endocrine, nutritional and metabolic diseases (E00-E90) – 48.3±7.72‰, diseases of the eye and its appendages (H00-H59) – 41.3±2.26 ‰ and parasitic diseases (B65-B83) – 40.3±6.73‰. At the same time, the prevalence of general morbidity is preponderantly determined by respiratory system diseases (J00-J99) – 54.6±7.16‰, diseases of the eye and its appendages (H00-H59) – 72.6±5.74 ‰, iron deficiency anemia (D50) – 69.1±4.23‰ and digestive system diseases (K00-K99) – 68.2±4.30‰.

A higher prevalence is found in upper form pupils – 820.3‰ versus 558.2‰ in primary form pupils ( $p<0.05$ ). It is worth mentioning that the spread of chronic diseases increases with age, registering insignificantly higher shares in pupils from rural environment – 28.5% versus 25.2% in urban environment ( $p>0.05$ ).

The structure of the main disease classes is of interest. Thus, respiratory pathology is represented by chronic diseases of tonsils (43.4±13.38%) and chronic bronchitis (15.6±4.39%); digestive system pathology - by gastritis, duodenitis (48.4±1.34%), ophthalmologic pathology - by decreased visual acuity (82.8±0.04%), disorders of the blood and hematopoietic organs - by anaerobic anemia (97.9±12.02%), endocrine diseases - by obesity (24.8±4.11). Although the pathology of the circulatory system ranks only 6<sup>th</sup> in the structure of general morbidity, a very alarming fact was highlighted – 32.9±21.97% of disease cases are represented by chronic rheumatic cardiopathy. The analysis of the correlation between the registration level of chronic tonsillitis and rheumatic cardiac disease revealed the existence of an obvious direct positive connection ( $r=0.73$ ).

The proportion of healthy children during the analyzed period is 28.9±2.13%, that of children with functional deviations – 45.3±4.26%, with chronic diseases – 25.8±3.23%. The smallest share of healthy pupils was recorded in the late adolescence period – 2.7±1.21% ( $p<0.05$ ). 20-27% of pupils were certified with two or more comorbidities (depending on age and the place of residence).

On average, 55.0±3.45% of pupils are considered healthy and trained (health group I), 41.0±2.36% are healthy and untrained (health group II) and 4.1±2.08% are

sick frequently and for a long time (health group III).

With regard to physical development, 79.8±2.42% of children aged 10-14 and 81.7±1.89% of children aged 15-17 possess an average body mass. In both adolescence periods, a reduced body mass is significantly more frequently encountered (14±2.36% and 11.3±1.80%, respectively). Body mass deficiency is more typical for urban environment, for both sexes at the age of 10-14 years – 15.6±3.45% and 13.4±1.20% for females and males, respectively.

By integrating the results of the study on pupils' health status in the Republic of Moldova, we can affirm the formation and maintenance over the last two decades of the negative tendencies in the health status of children and adolescents in all age groups.

One of the causes of health problems in children is insufficient physical activity, insufficient sports facilities and hygienic conditions in them.

Because it is generally acknowledged that physical education is a universal mechanism to recover the population's health, a self-achievement and development form as well as a means of fighting anti-social phenomena, we considered important to analyze the situation in the respective area in general pre-university institutions. The criterion used for assessing the physical activity level was the WHO definition, which considers that "*physically active children are those who practice physical exercise for 60 minutes during the day, more than 5 days a week*".

Traditionally, in the Republic of Moldova, the training process of physical education of pupils is carried out, after all, in the form of classes and to a certain extent - within additional familial, extra-curricular, special education and self-education.

According to specialists in the field, the need of the pupils' body with regard to the specially organized motor activity is at least 12-16 hours per week. At present, only 4 hours per week are planned for the national pre-university curriculum. The content of physical culture classes has a training and biological characteristic that, according to the practice of physical education, is less effective, even if their number in the weekly cycle increased. Given that the mean values of the motor density of such classes are 12-15 minutes, it is unlikely to obtain direct cumulative effects, which are the basis and strategy of the training classes.

At the same time, the solution to many problems related to the organization of the physical education methodology according to the scientific-theoretical recommendations is hampered by some gaps which concern: the technical-material, information, didactic provision, as well as professional specialists (including the lack of manuals); the complex and systemic exam of the psychophysical health of children and the qualitative assessment of the didactic process of physical education.

General schools in the Republic of Moldova are provided with sports halls in a proportion of 84.6% (Fig. 2). The general schools in Bălți municipality, Dubăsari, Ceadar-Lunga and Vulcănești districts have a 100% level of sports hall provision. The general schools in Soldănești and Rezina districts have the lowest level of sports hall provision (43.5% and 53.3%, respectively).



Union (Gorobets, 2015).

The study carried out by Bean et al. (2014) shows a broad participation of children and young people in sports activities - 75% in USA and 76.4% in Canada.

In Great Britain, about 40% of the males and females aged 16 or more participate at least in a sport each week. Large-scale cohort studies prove that mortality among persons practicing regular physical activity is 20-40% lower than among those who do not practice sport (Khan et al., 2012).

Children and youth are the main beneficiaries of physical education and sport practice. Early childhood is the time when motor activity is vitally important for socializing. At the beginning of life, the child is sensitive to cognitive and moral development, assumes different roles, learns to distinguish from others, and especially learns to build relations with others (Chahar, 2014). Giving the proper importance to play and games in childhood represents the premise of healthy development on a motor, social and cognitive level. The physical activity required for play and games allows children to gradually adopt different social roles that enable them to acquire competences, habits and skills necessary later in wider contexts. The games create bridges between spontaneous play and institutionalized sport (Nieman, 2002; Bailey, 2006).

An important role in this respect is that of parents. It is wrong to think that children "are energetic anyway" and they do not need to perform physical exercise or to practice a sport. In these cases, the chosen forms of movement are those episodically offered by school holidays: skiing, skating, swimming, playing with the ball, etc. Most of the times (it is also the case of adults), it is the environment that mobilizes them for a certain sports activity, determined by the geographical area (mountain, sea) in which they spend their spare time (Matheson et al., 2013).

An essential role in practicing a type of sport is the theory of social learning which has proved that socialization is best done in a sport environment. The practice of physical activity and sport creates the premises for the development of this environment, recognized as favoring socialization (Bean et al., 2014).

Physical education and sport are considered a means to influence and form the human character with regard to correctness, modesty, courage and last but not least, teamwork (\*\*\*, 2013; Cebanu, 2015; Merkel, 2013). In society, individuals acquire the ability to adapt their attitudes, habits and rules assimilated in sports activities to the specificity of other activities in different fields. The socializing effect of physical activity and sport generates a multitude of positive effects on several categories of beneficiaries.

## Conclusions

1. Against the background of an unstable socio-economic situation, characteristic for the development of the Republic of Moldova over the last two decades, negative trends in the health status of children and adolescents in all age groups have been formed.

2. According to WHO criteria, the majority (about 80%) of pupils in pre-university institutions are physically inactive because they perform physical exercise less than 5

hours a week. Hypodynamics has become one of the basic problems with an unfavorable impact on health status.

3. The provision of general culture institutions with sports halls and additional sanitary facilities for practicing sport is precarious, registering significant territorial differences.

4. The possibilities of extra-curricular practice of physical exercise and sport are limited. The number of sports facilities has a decreasing trend. Extra-curricular sports facilities are few in number, particularly in the private sector, often being inaccessible to many families.

5. In promoting and strengthening the health status of children and adolescents, intersectoral collaboration and permanent relations between professionals in the field of education and health are indispensable for regulation of the requirements of the teaching process, creation of favorable environmental conditions in children's institutions, health promotion activities, etc.

## Conflict of interest

There were no conflicts of interest.

## References

- Agans JP, Champine RB, Johnson SK, Erickson K, Yalin C. Promoting Healthy Lifestyles Through Youth Activity Participation: Lessons from Research. In: Bowers E. et al. (eds) Promoting Positive Youth Development. Advancing Responsible Adolescent Development. Springer, Cham, 2015,137-158.
- Bailey R. Physical education and sport in schools: a review of benefits and outcomes. *J Sch Health*. 2006;76(8):397-401. doi:10.1111/j.1746-1561.2006.00132.x.
- Bean C, Fortier M, Post C, Chima K. Understanding How Organized Youth Sport May Be Harming Individual Players within the Family Unit: A Literature Review. *Int J Environ Res Public Health*. 2014;11(10):10226-10268. doi: 10.3390/ijerph111010226.
- Bucșa D. Aspecte ale stării de sănătate a copiilor și adolescenților din municipiul și județul Botoșani. Rezumatul tezei de doctorat. UMF. Gr. T. Popa Iași, 2011.
- Cazacu-Stratu A, Cojocaru I, Gherciu-Tutuescu S, Ostalep T, Babin L, Hăbășescu I. Evaluarea stării de sănătate a elevilor din instituțiile preuniversitare din municipiul Chișinău în relație cu condițiile de instruire. *Săn Publ Econ Manag Med*. 2015;3(60):31-33.
- Cebanu S. The state of health of athletes-actual problem of public health. *Public Health, Economy and Management in Medicine*. 2015;3(60):33-38.
- Chahar PS. Physiological basis of Growth and Development among Children and Adolescents in Relation to Physical Activity. *Am J Sports Sci Med*, 2014;2(5A):17-22. doi: 10.12691/ajssm-2-5A-5.
- Dumitrache C, Stănescu CT, Kassai V, Nicolescu R, Ursu C, Drost M. Evaluarea nivelului de dezvoltare fizica si a starii de sanatate pe baza examenelor medicale de bilant la copiii si tinerii din colectivitatile scolare din mediul urban si rural. Available at: <http://insp.gov.ro/sites/cnepss/wp-content/uploads/2014/12/Raport-BILANT-2013.pdf>. Accessed online: June 2018.
- Gorobets A. Promotion of sports, physical activity, and a healthy lifestyle in Russia. *The Lancet*, 2015;385(9986):2459-2459.
- Guștiuc V. Factorii mediului de instruire din instituțiile de învățământ preuniversitar și impactul lor asupra sănătății

- elevilor. *Săn Publ Econ Manag Med.* 2015;3(60):52-54.
- Iziumov N, Dănilă T, Cășuneanu E. Aprecierea nivelului dezvoltării fizice a adolescenților de 15-18 ani conform standardelor dezvoltării fizice a adolescenților de vârstă premilitară și a recruților din Republica Moldova. În: *Materialele Conferinței științifice "Sănătatea în relație cu mediul"*, Chișinău, 2010,135-140.
- Khan KM, Thompson AM, Blair SN, Sallis JF, Powell KE, Bull FC, Bauman AE. Sport and exercise as contributors to the health of nations. *Lancet* 2012;380(9836):59-64. doi: 10.1016/S0140-6736(12)60865-4.
- Leșco G. Sănătatea adolescenților, factorii determinanți comportamentali și sociali. Raport sumar al studiului de evaluare a comportamentelor de sănătate ale copiilor de vârstă școlară în Republica Moldova. Chișinău, 2015.
- Manolachi V, Cebanu I, Bodișteanu O. *Strategia de dezvoltare a culturii fizice și sportului în Republica Moldova*. Ed. USEFS Chișinău, 2012.
- Manole V, Zaporozhan A, Lîsenco V, Carp V. Aspectele dezvoltării fizice a elevilor din familiile complete și familiile temporar dezintegrate. *Săn Publ Econ Manag Med.* 2015;3(60):58-61.
- Matheson GO, Klügl M, Engebretsen L, Bendiksen F, Blair SN, Börjesson M, Budgett R, Derman W, Erdener U, Ioannidis JP, Khan KM, Martinez R, van Mechelen W, Mountjoy M, Sallis RE, Schwellnus M, Shultz R, Soligard T, Steffen K, Sundberg CJ, Weiler R, Ljungqvist A. Prevention and Management of Non-Communicable Disease: The IOC Consensus Statement, Lausanne 2013. *Sports Med* 2013;43(11):1075-1088. doi: 10.1007/s40279-013-0104-3.
- Merkel D. Youth sport: positive and negative impact on young athletes. *Open Access J Sports Med.* 2013; 4:151-160. doi: 10.2147/OAJSM.S33556.
- Nieman P. Psychosocial aspects of physical activity. *Paediatr Child Health*, 2002;7(5):309-312.
- Pattison D, Boderscova L. *Child and adolescence health service in the Republic of Moldova*, WHO, 2012.
- Raudsepp L, Ööpik V, Lusmägi P. In: Hallmann K, Petry K. (eds). *Comparative Sport Development*. Sports Economics, Management and Policy, Vol 8. Springer, New York, 2013, 33-45.
- Sandu P, Baba C, Rus D, Bozdog E. Influența factorilor de mediu la nivel comunitar asupra activității fizice la adolescenți și tineri. *Rev Trans St Admin* 2014;2(35):130-140.
- \*\*\*. Comisia Europeană/EACEA/Eurydice. *Educația fizică și sportul în școlile din Europa Raport Eurydice*. Luxemburg: Oficiul pentru publicații al Uniunii Europene, 2013. Available at: <https://vdocuments.mx/educatia-fizica-si-sportul-in-scolile-din-europa-raport-eurydice.html>. Accessed online: July 2018.

#### Websites

- (1) WHO. Global action plan on physical activity 2018–2030: more active people for a healthier world. Geneva, 2018. Available at: <http://www.who.int/ncds/prevention/physical-activity/global-action-plan-2018-2030/en/>. Accessed online: July 2018.
- (2) National Program on nutrition for 2014-2020. Republic of Moldova, 2014a. Available at: <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=354645>. Accessed online: June 2018.
- (3) National Health Policy for 2007-2021. Republic of Moldova, 2007. Available at: <https://www.mindbank.info/item/3887>. Accessed online: June 2018.
- (4) National Public Health Strategy 2014-2020. Republic of Moldova, 2013. Available at: [http://www.nationalplanningcycles.org/sites/default/files/planning\\_cycle\\_repository/moldova/moldova\\_national\\_public\\_health\\_strategy\\_2014-2020.pdf](http://www.nationalplanningcycles.org/sites/default/files/planning_cycle_repository/moldova/moldova_national_public_health_strategy_2014-2020.pdf). Accessed online: June 2018.
- (5) National Program on Health promotion 2016-2020. Republic of Moldova, 2016. Available at: <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=366387>. Accessed online: June 2018.
- (6) National Program for the Prevention and Control of Cardiovascular Diseases, 2014-2020. Republic of Moldova, 2014b. Available at: <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=352739>. Accessed online: June 2018.

## **Study of the physiotherapist – patient relationship**

### *Studiu privind relația fizioterapeut – pacient*

**Alexandra-Camelia Gliga, Nicolae Neagu, Tiberiu Bătagă**

*Department of Functional and Complementary Sciences, University of Medicine and Pharmacy of Târgu Mureș, Romania*

*\* All authors have equal contributions to this study*

#### **Abstract**

*Background.* Research on communication and interaction in physiotherapy highlights the importance of focusing on the patient and adapting the rehabilitation program, taking into account professional ethical issues. In rehabilitation institutions, whether private or public, the objectives, training of the staff and their approach to patients should be similar.

*Aims.* This paper aims to record the differences between the opinions of physiotherapists and patients regarding occupational standards and professional deontology, as well as the level of their satisfaction with communication and interaction.

*Methods.* The study was conducted over a period of six weeks (11 June – 20 July 2018) in 7 private rehabilitation institutions in Târgu Mureș, Romania, on a total of 130 patients and 13 physiotherapists, to whom a 28 item questionnaire was applied.

*Results.* Concerning the comparative analysis of the differences between the negative and positive responses given by physiotherapists and patients, a statistically significant difference can be seen, “*t*” = 3.042 and  $R^2 = 0.159$ . Furthermore, the difference between negative and neutral responses is statistically significant, “*t*” = 2.42 and  $R^2 = 0.1336$ . On the other hand, the difference between positive and neutral responses is statistically insignificant, “*t*” = 0.2859 and  $R^2 = 0.002146$ .

*Conclusions.* After investigating, interpreting and analyzing the recorded results, it can be observed that certain aspects of daily practice, mentioned in the national occupational standards, are not applied.

**Keywords:** communication, interaction, physiotherapy, private practice

#### **Rezumat**

*Premize.* Cercetările privind comunicarea și relaționarea în fizioterapie subliniază importanța centrării pe pacient și adaptării programului recuperator, ținându-se cont de aspectele deontologice profesionale. Fie că este vorba de instituții recuperatorii private sau de stat, obiectivele, pregătirea personalului și aplecarea acestuia spre pacient sunt similare.

*Obiective.* Această lucrare urmărește înregistrarea diferențelor dintre opiniile fizioterapeuților și ale pacienților, vizând standardele ocupaționale și deontologia profesională, dar și satisfacția acestora privind comunicarea și relaționarea în cadrul procesului recuperator.

*Metode.* Studiul a fost realizat pe o perioadă de șase săptămâni (11 iunie - 20 iulie 2018) la un număr total de 7 instituții recuperatorii din Târgu Mureș, România, pe un lot total de 130 de pacienți și 13 fizioterapeuți, cărora li s-a aplicat un chestionar cu 28 de itemi.

*Rezultate.* În ceea ce privește analiza comparativă a semnificației diferențelor dintre răspunsurile negative și cele pozitive date de fizioterapeuți și pacienți, putem observa o diferență puternic semnificativă din punct de vedere statistic, „*t*” fiind 3,042 și  $R^2 = 0,1958$ . Mai mult de atât, diferența dintre răspunsurile negative și cele neutre este puternic semnificativă din punct de vedere statistic, valoarea „*t*” fiind 2,42 și  $R^2 = 0,1336$ . Pe de altă parte, diferența dintre răspunsurile pozitive și cele neutre este nesemnificativă din punct de vedere statistic, valoarea „*t*” fiind 0,2859 și  $R^2 = 0,002146$ .

*Concluzii.* În urma investigării, interpretării și analizei rezultatelor înregistrate, observăm că anumite aspecte concrete ale practicii de zi cu zi, menționate în standardele ocupaționale naționale, nu sunt îndeplinite.

**Cuvinte cheie:** comunicare, relaționare, fizioterapie, sistem privat

---

*Received:* 2018, August 7; *Accepted for publication:* 2018, August 20

*Address for correspondence:* University of Medicine and Pharmacy, Târgu Mureș, Gheorghe Marinescu Str. No. 38, PC 540139, Romania

*E-mail:* neagu.nicolae@umftgm.ro

*Corresponding author:* Alexandra-Camelia Gliga; alexandracamelia@yahoo.com

<https://doi.org/10.26659/pm3.2018.19.3.165>

## Introduction

A freshly graduated physiotherapist, at the beginning of his/her career, can see this profession as one exclusively focused on precise measurements, rigorous objectives and strictly performed treatments. This perception of medical rehabilitation is the result of intensive training and courses oriented towards this direction (Parry & Brown, 2009; Lattanzi & Pechak, 2012). The multitude of information to which we have access during university is predominantly aimed at building the knowledge required for therapy and is less centered on aspects involving communication and interaction with patients in rehabilitation institutions (Włoszczak-Szubzda et al., 2013; Odebiyi et al., 2008).

The way we communicate and interact with our patients deeply influences the quality of medical rehabilitation sessions for both the patient/client and the physiotherapist (Woodward-Kron et al., 2012; Ajjawi & Higgs, 2012). Medical research regarding the interaction with the patient highlights the importance of a patient oriented approach (Parry et al., 2004; Pinto et al., 2012; Lonsdale et al., 2012).

It can be said that physiotherapy involves other aspects in addition to the relationship between the therapist and the patient (Øien et al., 2011), while other health professionals (nutritionists, psychologists, physicians, speech therapists, etc.), the families and legal tutors participate in this process (Paşca, 2012). Physiotherapeutic treatment should include an adequate periodic evaluation of the patient's functional state (taking into consideration medical history and examination), the implementation of the rehabilitation program, patient counseling and, not least, a correct and objective presentation of the evaluation results and the functional state at the end of the program concerned (Schoeb et al., 2014; Talvitie & Reunanen, 2002).

Although this profession is a specific one across the globe, the initial training of physiotherapists and a number of aspects related to daily practice in rehabilitation services vary from one country to another depending on the social, economic and political context (Muhammad et al., 2015; Moffat, 2012). National occupational standards are also different. The position of physiotherapists in society is well known due to their education and experience, elements that give them self-confidence, entailing the responsibility to comply with conduct and behavior standards. The principles and values of the physiotherapist's activity are established by the deontological code and mentioned in occupational standards (Praestegaard, 2012). Thus, for the appropriate functioning of physiotherapeutic services, a series of requirements have been formulated which guide the entire rehabilitation process (Adam et al., 2012). These requirements refer to the presence of an individual patient file, obtaining an informed consent, respecting the patient's privacy, conducting history taking and the initial interview under optimal conditions, the confidentiality of the recorded data, the physiotherapist's transparency, the presentation of therapeutic options, objectives and effects, etc.

When patients present to physiotherapy services, they are most frequently deeply affected, scared and skeptical about the procedures to be performed (Albu et al., 2012). The key to therapeutic success is the behavior

of the physiotherapist, who must understand the patient, the patient's family and the situations they face. It is desirable for the patient to meet an open-minded person, with a kind, understanding and good-humored attitude, which influences the patient's willingness to communicate various personal aspects, without feeling embarrassed.

Training of the staff and their approach to patients and to solving their different deficiencies are similar (Hiller et al., 2015). In Romania, private and public systems coexist to such a degree that it is difficult to draw a line between them. The state reimburses part of the procedures of private rehabilitation institutions, and some physiotherapists work in both the public and private sector.

## Hypothesis

This study aims to compare the results recorded based on questionnaires administered to patients and physiotherapists. The main hypothesis from which we started in this study is that the results obtained from the patients' questionnaires are in full agreement with the results obtained from physiotherapists in terms of quality of the provided services and satisfaction with interaction and communication in private rehabilitation institutions.

## Material and methods

The study was carried out over a period of six weeks (11 June - 20 July 2018) in 7 private rehabilitation institutions in Târgu Mureş, Romania, on a group of 130 patients and 13 physiotherapists.

All subjects included in this study were informed about the purpose of this research and gave their consent for the use of their personal data, while they remained anonymous. Data regarding age, sex, experience as a physiotherapist were recorded (Table I). Also, in the case of patients, the number of rehabilitation sessions performed, their age and sex were taken into consideration (Table II).

**Table I**  
The physiotherapists included in the study and their distribution depending on age, sex and experience

Number of physiotherapists	Mean age (years)	Experience as a physiotherapist (years)	Women (no)	Men (no)
13	30.5	7.7	6 ↓ 46.15%	7 ↓ 53.85%

**Table II**  
The patients included in the study and their distribution depending on age, sex and the sessions performed

Number of patients	Mean age (years)	Number of sessions performed	Women (no)	Men (no)
130	42.3	43.1	80 ↓ 61.54%	50 ↓ 38.46%

The study was conducted using two questionnaires, one for physiotherapists and the other for patients, with items evaluating the same aspects for patients and physiotherapists. The questionnaires comprised 28 items, each having three answer variants. Depending on the

responses provided for each item, these were grouped into three categories: negative, neutral and positive responses. Following a preliminary analysis, it was found that for some items, the answers were not statistically relevant. Consequently, 8 of the 28 items were eliminated. This exclusion was aimed at orienting the research towards its analytical qualitative and statistically validated component, to the detriment of quantitative aspects, with a sometimes lower significance level.

**Results**

The aspects assessed by the 20 items applied to patients and physiotherapists and the distribution of the recorded answers are presented in Table III.

The comparative analysis, statistically processed using the *GraphPad Prism 6* software, of the statistical significance of the differences between the *negative and positive responses* given by physiotherapists and patients to the 20 items and the calculation of the “*t*” test show the following:

At a probability threshold of  $P < 0.05$ , the difference between the two rows of data is *highly statistically significant*, the calculated value of “*t*” being 3.042 and that of  $R^2 = 0.1958$ , with a 95% confidence interval ranging between 3.830 and 19.22 (Table IV).

**Table IV**  
Comparative analysis of negative and positive responses given by physiotherapists and patients

Statistical indicators	Values
Significantly different? t, df	Yes t=3.042 df=38
Mean ± SEM of column A	9.808 ± 2.430, n=20
Mean ± SEM of column B	21.35 ± 2.912, n=20
Difference between means	11.54 ± 3.793
95% confidence interval	3.860 to 19.22
R squared	0.1958

The comparative analysis, statistically processed using the *GraphPad Prism 6* software, of the statistical significance of the differences between the *negative and neutral responses* given by physiotherapists and patients to the 20 items and the calculation of the “*t*” test evidence the following:

At a probability threshold of  $P < 0.05$ , the difference between the two rows of data is *highly statistically significant*, the calculated value of “*t*” being 2.42 and that of  $R^2 = 0.1336$ , with a 95% confidence interval ranging between 1.676 and 18.81 (Table V).

**Table III**  
Distribution of responses to the 20 questions

n	Item	Negative responses			Neutral responses			Positive responses		
		F %	P %	$\Delta$ R <sub>F</sub> R <sub>P</sub>	F %	P %	$\Delta$ R <sub>F</sub> R <sub>P</sub>	F %	P %	$\Delta$ R <sub>F</sub> R <sub>P</sub>
1	Interest in the physiotherapist’s identity	30.77	3.85	<b>26.92</b>	30.77	28.46	<b>2.31</b>	38.46	67.69	<b>29.23</b>
2	History taking by the physiotherapist	15.38	10.77	<b>4.61</b>	15.38	26.15	<b>10.77</b>	69.23	63.08	<b>6.15</b>
3	Environmental privacy during history taking and the initial interview	30.77	37.69	<b>6.92</b>	53.85	32.31	<b>21.54</b>	15.38	30.00	<b>14.62</b>
4	The patient’s or the family’s informed consent regarding the rehabilitation procedures	69.23	26.92	<b>42.31</b>	30.77	55.38	<b>24.61</b>	0.00	17.69	<b>17.69</b>
5	Informing the patient about the possibility of rejecting some components of the rehabilitation program	23.08	28.46	<b>5.38</b>	30.77	10.00	<b>20.77</b>	46.15	61.54	<b>15.39</b>
6	Patient consent regarding the presence of student practitioners in the rehabilitation room	30.77	33.08	<b>2.31</b>	23.08	19.23	<b>3.85</b>	46.15	47.69	<b>1.54</b>
7	Explaining the objectives and procedures of the rehabilitation program	7.69	0.77	<b>6.92</b>	33.77	17.69	<b>16.08</b>	61.54	81.54	<b>20.00</b>
8	The answers given by the physiotherapist were clarifying	0.00	0.77	<b>0.77</b>	46.15	6.92	<b>39.23</b>	53.85	92.31	<b>38.46</b>
9	Continuity of the rehabilitation program, number of physiotherapists involved in the rehabilitation of a patient	7.69	15.38	<b>7.69</b>	76.92	37.38	<b>39.54</b>	15.38	46.92	<b>31.54</b>
10	Respect for the patient	0.00	0.00	<b>0.00</b>	30.77	3.85	<b>26.92</b>	69.23	96.15	<b>26.92</b>
11	Satisfaction with patient-physiotherapist communication	7.69	0.00	<b>7.69</b>	23.08	6.15	<b>16.93</b>	69.23	93.85	<b>24.62</b>
12	Presence of a multidisciplinary team	15.38	16.92	<b>1.54</b>	53.85	25.38	<b>28.47</b>	30.77	57.69	<b>26.92</b>
13	Communication difficulties because of the language (Hungarian)	7.69	4.62	<b>3.07</b>	53.85	11.54	<b>42.31</b>	38.46	83.85	<b>45.39</b>
14	Facing uncomfortable situations regarding the communication of various personal aspects	0.00	4.62	<b>4.62</b>	69.23	10.77	<b>58.46</b>	30.77	65.38	<b>34.61</b>
15	Supporting the patients at moments of sadness and mental depression	0.00	8.46	<b>8.46</b>	30.77	18.46	<b>12.31</b>	69.23	73.08	<b>3.85</b>
16	Motivation of the patients	15.38	44.62	<b>29.24</b>	15.38	19.23	<b>3.85</b>	69.23	36.15	<b>33.08</b>
17	Bias regarding the quality of private institutions compared to public institutions	69.23	74.62	<b>5.39</b>	23.08	16.15	<b>6.93</b>	7.69	9.23	<b>1.54</b>
18	Continuous evaluation and the patient’s individual file	30.77	18.46	<b>12.31</b>	38.46	20.77	<b>17.69</b>	30.77	60.77	<b>30.00</b>
19	Influence of giving small gifts to the physiotherapist (chocolate, flowers, etc.)	7.69	2.31	<b>5.38</b>	7.69	9.23	<b>1.54</b>	84.62	88.46	<b>3.84</b>
20	Influence of the limited time of the rehabilitation session on the quality of communication and interaction	23.08	8.46	<b>14.62</b>	23.08	16.15	<b>6.93</b>	53.85	75.38	<b>21.53</b>
	<b>Mean</b>	-	-	<b>9.81</b>	-	-	<b>20.05</b>	-	-	<b>21.35</b>

**Legend :** F = physiotherapists; P = patients; R<sub>F</sub> = responses from physiotherapists; R<sub>P</sub> = responses from patients;  $\Delta$  = difference

**Table V**  
Comparative analysis of negative and neutral responses given by physiotherapists and patients

Statistical indicators	Values
Significantly different?	Yes
t, df	t=2.420 df=38
Mean ± SEM of column A	9.808 ± 2.430, n=20
Mean ± SEM of column B	20.05 ± 3.466, n=20
Difference between means	10.24 ± 4.233
95% confidence interval	1.676 to 18.81
R squared	0.1336

The comparative analysis, statistically processed using the *GraphPad Prism 6* software, of the statistical significance of the differences between the *positive and neutral responses* given by physiotherapists and patients to the 20 items and the calculation of the “t” test evidence the following:

At a probability threshold of  $P < 0.05$ , the difference between the two rows of data is *statistically insignificant*, the calculated value of “t” being 0.2859 and that of  $R^2 = 0.002146$ , with a 95% confidence interval ranging between -10.46 and 7.870 (Table VI).

**Table VI**  
Comparative analysis of positive and neutral responses given by physiotherapists and patients

Statistical indicators	Values
Significantly different?	No
t, df	t=0.2859 df=38
Mean ± SEM of column A	21.35 ± 2.912, n=20
Mean ± SEM of column B	20.05 ± 3.466, n=20
Difference between means	-1.294 ± 4.527
95% confidence interval	-10.46 to 7.870
R squared	0.002146

In order to extend the qualitative and the statistical validity components, we detected 10 items, defined by us as *great contrariness* items – great differences between the responses of physiotherapists and those of patients – ( $\Delta R_F - R_p = 13.08 \leftrightarrow 42.32$ ) and *small contrariness* items – small differences between the responses of physiotherapists and those of patients – ( $\Delta R_F - R_p = 0.77 \leftrightarrow 10.01$ ).

The comparative analysis, using the *GraphPad Prism 6* software, of the differences between the *negative and positive responses* given by physiotherapists and patients to the 10 items with *great contrariness* answers (items 4,5,7,8,9,10,11,12,13,14) and the 10 items with *small contrariness* (items 1,2,3,6,15,16,17,18,19,20) shows the following:

Regarding the *great contrariness* responses, at a probability threshold of  $P < 0.05$ , the difference between the two rows of data is *highly statistically significant*, the calculated value of “t” being 4.086 and that of  $R^2 = 0.4812$ , with a 95% confidence interval ranging between 9.791 and 30.52 (Table VII).

Concerning the *small contrariness* responses, at a probability threshold of  $P < 0.05$ , the difference between the two rows of data is *statistically insignificant*, the calculated value of “t” being 0.58 and that of  $R^2 = 0.01835$ , with a 95% confidence interval ranging between -7.662 and 13.51 (Table VII).

**Table VII**  
Comparative analysis of positive and negative responses with great and small contrariness

Statistical indicators	Great contrariness responses	Small contrariness responses
Significantly different?	Yes	No
t, df	t=4.086 df=18	t=0.58 df=18
Mean ± SEM of column A	7.999 ± 3.915, n=10	11.62 ± 2.981, n=10
Mean ± SEM of column B	28.15 ± 3.002, n=10	14.54 ± 4.061, n=10
Difference between means	20.16 ± 4.933	2.922 ± 5.038
95% confidence interval	9.791 to 30.52	-7.662 to 13.51
R squared (eta squared)	0.4812	0.01835

## Discussions

The comparative analysis of the differences between the *negative and positive responses* given by physiotherapists and patients shows that at a probability threshold of  $P < 0.05$ , there is a *highly statistically significant difference*, the calculated value of “t” being 3.042 and that of  $R^2 = 0.1958$ , with a 95% confidence interval ranging between 3.830 and 19.22. Furthermore, the difference between *negative and neutral responses* is highly statistically significant, the calculated value of “t” being 2.42 and that of  $R^2 = 0.1336$ , with a 95% confidence interval ranging between 1.676 and 18.81, at a probability threshold of  $P < 0.05$ . On the other hand, the difference between positive and neutral responses is statistically insignificant, the calculated value of “t” being 0.2859 and that of  $R^2 = 0.002146$ , with a 95% confidence interval ranging between -10.46 and 7.870.

Some important aspects of the rehabilitation process are interpreted differently by patients and physiotherapists, with a major contrariness between their opinions. Following statistical analysis it was found that for some items, the answers showed a *highly statistically significant difference*, the calculated value of “t” being 4.086 and that of  $R^2 = 0.4812$ , with a 95% confidence interval ranging between 9.791 and 30.52, at a probability threshold of  $P < 0.05$ . Thus, the following results are emphasized:

- Item no. 4. By interpreting the results regarding the request for the patient’s or the family’s informed consent, the difference between the negative responses of physiotherapists and patients is  $\Delta R_F - R_p = 42.31$ , while the difference between positive responses is  $\Delta R_F - R_p = 17.69$ ;
- Item no. 5. With respect to informing the patient about the possibility of rejecting some components of the rehabilitation program, the difference between the negative responses of physiotherapists and patients is  $\Delta R_F - R_p = 5.38$ , while the difference between positive responses is  $\Delta R_F - R_p = 15.39$ ;
- Item no. 7. Concerning the explanation of the objectives and procedures of the rehabilitation program, there is a difference between the negative responses of physiotherapists and patients of  $\Delta R_F - R_p = 6.92$ , while the difference between positive responses is  $\Delta R_F - R_p = 20.00$ ;
- Item no. 8. By interpreting the results regarding the clarity of the answers provided by physiotherapists, the difference between the negative responses of physiotherapists and patients is  $\Delta R_F - R_p = 0.77$ , while the difference between positive responses is  $\Delta R_F - R_p = 38.46$ ;
- Item no. 9. Regarding the number of physiotherapists involved in the rehabilitation of a patient and the continuity of the rehabilitation program, the difference between the negative responses of physiotherapists and patients is  $\Delta R_F -$

$R_p = 7.69$ , while the difference between positive responses is  $\Delta R_F - R_p = 31.54$ ;

- Item no. 10. When it comes to respect for the patient, there is a difference between the negative responses of physiotherapists and patients of  $\Delta R_F - R_p = 0.00$ , while the difference between positive responses is  $\Delta R_F - R_p = 26.92$ ;

- Item no. 11. In terms of satisfaction with patient-physiotherapist communication, the difference between the negative responses of physiotherapists and patients is  $\Delta R_F - R_p = 7.69$ , while the difference between positive responses is  $\Delta R_F - R_p = 24.62$ ;

- Item no. 12. The existence of a multidisciplinary team is controversial, the difference between the negative responses of physiotherapists and patients being  $\Delta R_F - R_p = 1.54$ , while the difference between positive responses is  $\Delta R_F - R_p = 26.92$ ;

- Item no. 13. Regarding communication difficulties because of the Hungarian language, there is a difference between the negative responses of physiotherapists and patients of  $\Delta R_F - R_p = 3.07$ , while the difference between positive responses is  $\Delta R_F - R_p = 45.39$ ;

- Item no. 14. By interpreting the results of facing uncomfortable situations related to the communication of various personal aspects, the difference between the negative responses of physiotherapists and patients is  $\Delta R_F - R_p = 4.62$ , while the difference between positive responses is  $\Delta R_F - R_p = 34.61$ .

## Conclusions

1. Following the investigation, interpretation and statistical analysis of the results, it can be said that the hypothesis was rejected. The results recorded using the patients' questionnaires do not correspond to the results obtained from physiotherapists in terms of quality of the provided services and satisfaction with interaction and communication in the private rehabilitation institutions.

2. Aspects such as the presence of an individual patient file, obtaining the informed consent, respecting the patient's privacy, conducting history taking and the initial interview under optimal conditions, etc. were identified to be interpreted differently by physiotherapists and patients, which led to the conclusion that certain aspects of daily practice mentioned in national occupational standards are not fulfilled.

3. We consider it imperative that physiotherapy services be provided at higher education and practice standards, so that we wish the results presented in this study to represent a red flag. The area of action of physiotherapy is not limited to treating the patient and involves a number of factors that we attempted to highlight in this paper.

## Conflicts of interest

No conflict to declare.

## References

Adam K, Peters S, Chipchase L. Knowledge, skills and professional behaviours required by occupational therapist and physiotherapist beginning practitioners in work-related practice: a systematic review. *Aust Occup Ther J.* 2013;60(2):76-84. doi: 10.1111/1440-1630.12006.

Ajjawi R, Higgs, J. Core components of communication of clinical reasoning: a qualitative study with experienced Australian physiotherapists. *Advances in Health Sci Educ* 2012;17(1):107-119. doi: 10.1007/s10459-011-9302-7.

Albu C, Armbruster TL, Albu M. *Kinetoterapie. Metodologia poziționării și mobilizării pacientului.* Ed. Polirom Iași, 2012,11.

Hiller A, Guillemin M, Delany C. Exploring healthcare communication models in private physiotherapy practice. *Patient Educ Couns.* 2015;98(10):1222-1228. doi: 10.1016/j.pec.2015.07.029.

Lattanzi JB, Pechak C. Educating Globally Minded Physical Therapist Students: Curriculum Strategies to Equip the Next Generation. *J Phys Ther Educ.* 2012;26(1):55-60.

Lonsdale C, Hall AM, Williams GC, McDonough SM, Ntoumanis N, Murray A, Hurley DA. Communication style and exercise compliance in physiotherapy (CONNECT): a cluster randomized controlled trial to test a theory-based intervention to increase chronic low back pain patients' adherence to physiotherapists' recommendations: study rationale, design, and methods. *BMC Musculoskelet Disord.* 2012;13:104. doi: 10.1186/1471-2474-13-104.

Moffat M. A History of Physical Therapist Education around the World. *J Phys Therapy Educ.* 2012;26(1):13-23.

Muhammad TK, Muhammad FS, Muhammad HS, Muhammad S. Current Role of Physiotherapy in Response to Changing Healthcare Needs of the Society. *Int J Educ Inform Technol.* 2015;1(3):105-110.

Odebiyi DO, Omotunde AO, Aiyejusunle CB, Olalekan TA. Knowledge and perception of physiotherapy by final year medical students of a Nigerian university. *Nig Q J Hosp Med.* 2008;18(3):156-161.

Øien AM, Steihaug S, Iversen S, Råheim M. Communication as negotiation processes in long-term physiotherapy: a qualitative study. *Scand J Caring Sci.* 2011;25(1):53-61. doi: 10.1111/j.1471-6712.2010.00790.x.

Parry RH, Brown K. Teaching and learning communication skills in physiotherapy: What is done and how should it be done? *Physiotherapy.* 2009;95(4):294-301. doi: 10.1016/j.physio.2009.05.003.

Parry RH. Communication during goal-setting in physiotherapy treatment sessions. *Clin Rehabil.* 2004;18(6):668-682. doi:10.1191/0269215504cr745oa.

Pașca MD. *Comunicarea în relația medic – pacient.* Ed. University Press, Tîrgu Mureș, 2012, 231-232.

Pinto RZ, Ferreira ML, Oliveira VC, Franco MR, Adams R, Maher CG, Ferreira PH. Patient-centred communication is associated with positive therapeutic alliance: a systematic review. *J Physiother.* 2012;58(2):77-87. doi: 10.1016/S1836-9553(12)70087-5.

Praestegaard J, Gard G. Ethical issues in physiotherapy - reflected from the perspective of physiotherapists in private practice. *Physiother Theory Pract.* 2013;29(2):96-112. doi:10.3109/09593985.2012.700388.

Schoeb V, Staffoni L, Parry R, Pilnick A. "What do you expect from physiotherapy?": a detailed analysis of goal setting in physiotherapy. *Disabil Rehabil.* 2014;36(20):1679-1686. doi: 10.3109/09638288.2013.867369.

Talvitie U, Reunanen M. Interaction between physiotherapists and patients in stroke treatment. *Physiotherapy.* 2002;88(2):77-88. DOI:https://doi.org/10.1016/S0031-9406(05)60931-5.

Włoszczak-Szubzda A, Jarosz MJ. Professional communication competences of physiotherapists - Practice and educational perspectives. *Ann Agric Environ Med.* 2013;20(1):189-194.

Woodward-Kron R, van Die D, Webb G, Pill J, Elder C, McNamara T, Manias E. Perspectives from physiotherapy supervisors on student-patient communication. *Int J Med Educ.* 2012;3:166-174. doi: 10.5116/ijme.502f.6e18.

## Six-minute walk test outcome in COPD patients

### Rezultatele testului de mers de șase minute în rândul pacienților cu BPOC

Ana Florica Chiș<sup>1,2</sup>, Ruxandra Mioara Râjnoveanu<sup>1,2</sup>, Milena Adina Man<sup>1,2</sup>, Doina Adina Todea<sup>1,2</sup>, Bogdan Augustin Chiș<sup>1</sup>, Carmen Monica Pop<sup>1,2</sup>

<sup>1</sup> “Iuliu Hațieganu” University of Medicine and Pharmacy, Department of Pneumology, Cluj-Napoca, Romania

<sup>2</sup> “Leon Daniello” Clinical Hospital of Pneumology, Cluj-Napoca, Romania

#### Abstract

**Background.** In Chronic Obstructive Pulmonary Disease (COPD) patients, Six-Minute Walk Test (6MWT) represents a validated tool in evaluating the functional status.

**Aims.** Our study aims to establish the role of demographic features, COPD degree of severity and risk groups in the 6MWT results.

**Methods.** We conducted a randomized study on 60 COPD patients without major comorbidities, admitted to the “Leon Daniello” Clinical Hospital of Pneumology, Cluj-Napoca. We collected data regarding age, gender, Body Mass Index (BMI), smoking history, and we performed the 6MWT in accordance with the American Thoracic Society (ATS) guidelines. The investigated parameters of the effort capacity test were: the distance (meters), the percentage of the predicted values of 6MWT and the SpO<sub>2</sub> (peripheral blood oxygen saturation) decrease.

**Results.** The BMI correlated with the number of years since smoking cessation ( $p=0.04$ ,  $r=0.26$ ). The walking distance decreased with higher severity stages (383.8±68.3 meters in stage 2 COPD versus 212.8±83.1 meters in stage 4 of the disease,  $p<0.0001$ ). SpO<sub>2</sub> decreased more in stage 4 (4%±0.6) than in stage 3 (2.6%±1.2) and stage 2 of COPD (1.6%±1.2) ( $p<0.001$ ,  $F=18.560$ ). When evaluating the outcomes of the 6MWT based on the risk group of COPD (A to D), we found correlations between the risk group and the walked distance ( $p=0.001$ ), the percentage of the predicted value of the test ( $p=0.009$ ), and the desaturation index ( $p<0.0001$ ). No correlation was found between the outcomes of the 6MWT and gender, age, smoking history ( $p>0.05$ ).

**Conclusions.** 6MWT is influenced by the COPD risk group, disregarding age or the smoking history, in the absence of comorbidities; thus, it could be used as a tool in the staging and monitoring of the evolution of the disease. BMI in COPD patients is positively correlated with the number of years since smoking cessation.

**Keywords:** COPD, smoking, obesity, Six-Minute Walk Test.

#### Rezumat

**Premize.** În rândul pacienților cu BPOC (bronhopneumopatie cronică obstructivă), 6MWT (testul de mers de 6 minute) este un instrument validat în investigarea capacității funcționale.

**Obiective.** Studiul nostru își propune să stabilească rolul pe care îl au caracteristicile demografice și stadiile de severitate, precum și clasele de risc în rezultatele testului de mers de 6 minute.

**Metode.** Studiul nostru este unul randomizat, realizat pe 60 pacienți cu BPOC, fără comorbidități majore în evidență, admiși în Spitalul Clinic de Pneumoftiziologie „Leon Daniello”, Cluj-Napoca. Au fost analizate date precum: vârsta, genul, IMC (indice de masă corporală), istoricul de fumat și s-a efectuat 6MWT conform ghidurilor ATS (American Thoracic Society). Parametrii capacității de efort investigați au fost: distanța parcursă (în metri), procentajul din valorile prezise, scăderea SpO<sub>2</sub> (saturația în oxigen în sângele periferic).

**Rezultate.** IMC se corelează cu anii de sevraj tabagic ( $p=0,04$ ,  $r=0,26$ ). Când severitatea BPOC a fost analizată, distanța parcursă a scăzut direct proporțional cu severitatea bolii (383,8±68,3 metri, în stadiul 2 de BPOC, versus 212,8±83,1 metri în stadiul 4 al bolii,  $p<0,0001$ ). SpO<sub>2</sub> a scăzut mai mult în stadiul 4 (4%±0,6), decât în stadiul 3 (2,6%±1,2) și stadiul 2 de BPOC (1,6%±1,2), ( $p<0,001$ ,  $F=18,560$ ). Când am evaluat valorile 6MWT bazându-ne pe grupele de risc (A la D), am descoperit corelații între grupa de risc și distanța parcursă ( $p=0,001$ ), procentajul testului din valoarea prezisă ( $p=0,009$ ) și indicele de desaturare ( $p<0,0001$ ). Nu au fost găsite corelații între valorile 6MWT și gen, vârstă, istoricul de fumat ( $p>0,05$ ).

**Concluzii.** IMC-ul pacienților cu BPOC se corelează pozitiv cu numărul anilor de sevraj tabagic. 6MWT este influențat de clasa de risc a BPOC, indiferent de vârstă, istoricul de fumat, în absența comorbidităților, astfel putând fi folosit ca instrument de stadializare și monitorizare a evoluției bolii.

**Cuvinte cheie:** BPOC, fumat, obezitate, test de mers de 6 minute.

---

Received: 2018, June 9; Accepted for publication: 2018, June 20

Address for correspondence: “Iuliu Hațieganu” University of Medicine and Pharmacy, Cluj-Napoca, Department of Pneumology, B.P.Hașdeu Street, no. 6, Cluj-Napoca, PC 400332

E-mail: anna\_f\_rebrean@yahoo.com

Corresponding author: Chiș Ana Florica, anna\_f\_rebrean@yahoo.com

<https://doi.org/10.26659/pm3.2018.19.3.170>

---

Copyright © 2010 by “Iuliu Hațieganu” University of Medicine and Pharmacy Publishing

## Introduction

Chronic Obstructive Pulmonary Disease (COPD) represents a major health problem worldwide. Although WHO (World Health Organization) estimated that by 2030, COPD will be the third leading cause of death, the disease is already in the top 3 major causes of death, after ischemic heart disease and stroke, according to Global Burden of Disease (GBD) (Quaderi & Hurst, 2018). More than 320 million people suffer from COPD worldwide (Eisner et al., 2010), and approximately 90% of COPD-related deaths occur in underdeveloped or developing countries (Alwan, 2010). COPD is a multifactorial disease, but cigarette smoking along with indoor and outdoor pollution represent the major risk factors in the development of the disease (Mannino & Buist, 2007). COPD is characterized by progressive and partially reversible airflow limitation, dyspnea being the most debilitating symptom. This translates into a reduced exercise capacity, impaired ability to work, limited overall mobility, anxiety, leading to a reduced quality of life (Lopez-Campos, 2017). These factors have a major effect on the economic aspect of the disease, for both the patient and society. In 2010, the National Heart, Lung, and Blood Institute evaluated that the annual cost of COPD in the United States of America was 49.9 billion USD, with almost 30 billion USD in direct medical costs (medication, hospitalization), and 20 billion USD in indirect morbidity and mortality (decreased productivity due to the illness or early death).

Limited exercise capacity is a serious problem for the patient and for the patient's family. Progressive effort dyspnea occurs at early stages of the disease, and COPD patients present dyspnea at rest in stage IV of the disease (forced expiratory volume in 1st second - FEV<sub>1</sub> below 30% of the predicted value).

The actual classification of COPD uses GOLD (Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease. Updated 2018) criteria to evaluate the functional capacity of the lungs (stages I-IV, depending on the FEV<sub>1</sub> value), and also the risk group classification (groups A, B, C and D, based on combined symptoms and exacerbation risk assessment). According to the GOLD 2018 Report, Stage I includes patients with FEV<sub>1</sub>  $\geq$ 80% of the predicted value, Stage II – FEV<sub>1</sub>  $<$ 80% and  $\geq$ 50%, Stage III – FEV<sub>1</sub>  $<$ 50% and  $\geq$ 30%, and Stage IV – FEV<sub>1</sub>  $<$ 30%. Group A – Modified Medical Research Council (mMRC) Dyspnea Scale score 0-1 or COPD Assessment Tool (CAT) score  $<$ 10 with 0-1 exacerbations/year, not leading to hospital admission; Group B - mMRC score  $\geq$ 2 or CAT score  $\geq$ 10 with 0-1 exacerbations/year, not leading to hospital admission; Group C - mMRC score 0-1 or CAT score  $<$ 10 with  $\geq$ 2 exacerbations/year or  $\geq$ 1 exacerbation leading to hospital admission; Group D - mMRC score  $\geq$ 2 or CAT score  $\geq$ 10 with  $\geq$ 2 exacerbations/year or  $\geq$ 1 exacerbation leading to hospital admission (Kim et al., 2013).

Exercise impairment can be observed in a reduction of the self-paced walking distance (Singh et al., 2014) or by performing incremental exercise testing in a laboratory (Bolton et al., 2013). The Six-Minute Walk Distance Test (6MWT) is a simple, non-invasive, low cost, repeatable

tool in the evaluation of functional capacity of COPD patients (Moreira et al., 2015). The test assesses the maximum distance a patient can walk during 6 minutes, and is highly used in evaluating the outcomes of pulmonary rehabilitation programs (Maddocks et al., 2015), or could be used as a mortality prediction tool (Waschki, 2011). Another benefit of the 6MWT is the ability to predict an acute exacerbation of the disease (Andrianopoulos et al., 2015), and a walking distance shorter than 350 m was considered a predictor of exacerbation in previous studies (Zanori & ZuWallack, 2013). A cut-off point of 80% of the predicted value is considered valid in many previous researches (Casanova et al., 2011; Soares & Pereira, 2011).

## Hypothesis

The six-minute walk distance test is a useful tool in evaluating the exercise capacity of a COPD patient and can be used as a staging tool in selected patients (without major comorbidities).

## Objectives

The purpose of this study was to evaluate exercise capacity in COPD patients, and to establish a possible association between the outcomes of the 6-minute walk test and the demographic characteristics, severity stage and risk group classification.

## Material and methods

The study was approved by the Research Ethics Committee of "Iuliu Hațieganu" University of Medicine and Pharmacy, Cluj-Napoca, no. 298/29.06.2016, and all patients included in this study signed an informed consent to participate in this research.

### Research protocol

Duration and location: The study was conducted on COPD patients admitted to the "Leon Daniello" Clinical Hospital of Pneumology, Cluj-Napoca, Romania, between 2016 and 2017.

### a) Subjects and groups

Initially, 356 patients with COPD were enrolled in this study, but after using the exclusion criteria, 60 patients were included in the research. The inclusion criteria were: signing the informed consent, age  $>$ 40 years and  $<$ 90 years, Tiffeneau index (forced expiratory volume in the first second (FEV<sub>1</sub>) to forced vital capacity (FVC)  $<$ 0.7. The exclusion criteria were: age  $<$ 40 years or  $>$ 90 years, refusal to sign the informed consent, FEV<sub>1</sub>/FVC  $\geq$ 0.7, presence of any of the following: chronic obliterative arteriopathy of the lower limbs, chronic venous insufficiency, leg pain, leg injuries, asthma, chronic bronchitis, allergies, pneumonia, heart failure, pulmonary hypertension, myocardial infarction, alpha-1 antitrypsin deficiency, interstitial lung disease, oral anticoagulant therapy, recent revascularization, thoracic surgery, acute renal failure, neoplasia, autoimmune diseases. Smoking status was evaluated as follows: group 0 – never smokers, group 1 – current smokers, group 2 – former smokers.

### b) Assessment methods

The patients were assessed on the first day of admission

to hospital and on the seventh day of hospitalization. The methods used for the assessment were: collecting anamnestic data regarding the smoking history and calculating the pack-year index, performing the 6MWT in accordance with the standard ATS protocol (\*\*\*, 2002), indoors, on a flat, ventilated corridor 18 m in length, supervised by a physician. At the beginning and at the end of each test, we evaluated blood pressure (BP), heart rate (HR), peripheral blood oxygen saturation (SpO<sub>2</sub>, with the Nonin digital pulse oximeter). Each patient was asked to walk as far as possible around the course in a six-minute period of time, and to signal if dyspnea, extreme fatigue, pain or dizziness occurred during the test. SpO<sub>2</sub> was evaluated every 20 seconds, and the test was stopped if desaturation greater than 5% occurred.

The predicted value for the distance of the 6MWT was calculated with the formula:

Male patient: Predicted 6 MWD=361 – (age in years x 4) + (height in cm x 2) + (HRmax/HRmax%pred x 3) – (weight in kg x 1.5)

Female patient: Predicted 6 MWD=361 – (age in years x 4) + (height in cm x 2) + (HRmax/HRmax%pred x 3) – (weight in kg x 1.5) – 30 for female subjects (Casanova et al., 2011).

The predicted max Heart Rate was calculated with the formula: HRmax= 220-age.

After applying the formula, we evaluated the outcome in % of the predicted value.

Performing ≥80% of the predicted value was considered as a normal effort capacity.

*c) Statistical analysis*

Statistical analysis was conducted by using IBM Statistical Package for the Social Sciences (SPSS), version 20 for Windows, and Microsoft Excel 2010. The variables are expressed as mean ± standard deviation. For each data item, the minimum, maximum, standard deviation, skewness and kurtosis were computed. Logarithmic transformation of values was used for non-Gaussian distribution data. T-test and ANOVA test were used to compare the means. Spearman test was applied for correlations. Confidence interval levels of 95% and alpha<0.05 were considered for statistical significance.

**Results**

*Overall analysis*

The study group included 60 patients (54 males and 6 females), previously diagnosed with moderate to severe COPD, according to 2018 COPD GOLD Criteria. The mean age was 67 years old, with a SD of 9.2. The median BMI was 29.4. Out of the study population, 20 (33.3%) were current smokers, 28 (46.6%) were former smokers, and 12 patients never smoked cigarettes (20%). The mean distance walked during the 6MWT was 303.97 meters (m), with a mean percentage of the predicted value of 78%±19.1 and a minimum of 70 meters and a maximum of 450 m, and also a decrease in the peripheral blood transcutaneous oxygen saturation of 2.7±1.4, with a minimum of 1% and a maximum of 5%.

Patient characteristics are presented in Table I.

**Table I**

General characteristics of the study population	
Indicators	Total (n=60)
Age, years	67±9.2
Number (percent) of females	6 (10%)
Number (percent) of males	54 (90%)
BMI (mean ± SD)	29.4±6.3
Number (percent) of smokers	20 (33.3%)
Number (percent) of former smokers	28 (46.6%)
Number (percent) of never smokers	12 (20%)
Smoking status, pack-year index mean ± SD	29.5±18.2
Years since smoking cessation, mean ± SD	4.9±7.2
6MWT distance (meters), mean ± SD	303.9±97.7
6MWT percent of the predicted value, mean ± SD	78±19.1
Desaturation during 6MWT percent, mean ± SD	2.7±1.4

**Legend:** Results expressed as median ± standard deviation (SD), BMI=Body Mass Index; 6MWT=Six-Minute Walk Test.

The distribution of the study population according to the 2018 COPD GOLD Stages of severity classification was: 18 (30%) patients in stage II, 26 (43%) in stage III, and 16 (27%) in stage IV of the disease. When risk groups were considered, 4 (7%) patients were in Group A, 13 (22%) in Group B, 5 (8%) in Group C and 38 (63%) in Group D.

Out of all 60 patients, a proportion of 38.3% (n=23) patients were classified as obese, with a BMI>30 kg/m<sup>2</sup>.

**Table II**

Overall correlations between the studied parameters

Indicators		Age	BMI	PYI	SC	6MWT D	6MWT % PV	6MWT Des
Age	Correlation coefficient	1.000	-.088	.045	.100	-.065	-.106	-.038
	Sig. (2-tailed)	.	.502	.730	.449	.623	.418	.772
BMI	Correlation coefficient	-.088	1.000	.009	.261	.122	.139	-.041
	Sig. (2-tailed)	.502	.	.946	.044	.351	.290	.755
PYI	Correlation coefficient	.045	.009	1.000	.293	.035	.079	-.028
	Sig. (2-tailed)	.730	.946	.	.023	.789	.547	.831
SC	Correlation coefficient	.100	.261	.293	1.000	-.219	-.231	.189
	Sig. (2-tailed)	.449	.044	.023	.	.093	.075	.149
6MWT D	Correlation coefficient	-.065	.122	.035	-.219	1.000	.930	-.604
	Sig. (2-tailed)	.623	.351	.789	.093	.	.000	.000
6MWT % PV	Correlation coefficient	-.106	.139	.079	-.231	.930	1.000	-.575
	Sig. (2-tailed)	.418	.290	.547	.075	.000	.	.000
6MWT Des	Correlation coefficient	-.038	-.041	-.028	.189	-.604	-.575	1.000
	Sig. (2-tailed)	.772	.755	.831	.149	.000	.000	.

**Legend:** BMI = Body Mass Index; 6MWT = Six-Minute Walk Test; PYI = Pack-Year Index; SC = smoking cessation; 6MWT D = 6MWT Distance; 6MWT % PV = 6MWT percent of predicted value; Des = Desaturation; 2-tailed significance cutoff = 0.05.

Out of the obese patients, 39.1% were classified, based on severity, as stage II COPD, 43.4% as stage III, and 21.73% as stage IV COPD.

BMI positively correlated with the number of years since smoking cessation ( $p=0.04$ ,  $\rho=0.261$ ). No correlation was found when comparing the 6MWT parameters (distance, percentage of the predicted value, SpO<sub>2</sub> decrease), age, BMI and smoking history. The results are presented in Table II.

#### Severity stages of COPD

When severity stages were considered, the walked distance during the 6MWT was influenced by the severity of the disease, as a higher severity index was associated with a lower distance in 6MWT ( $p<0.0001$ ). Patients with mild COPD (stage 2,  $n=18$ ) walked  $383.8\pm 68.3$  meters, while patients with a severe stage of disease (stage 4,  $n=16$ ) walked  $212.8\pm 83.18$  meters. Subjects with stage 3 COPD had a distance of  $311.5\pm 79.6$ . Also, the percentage of the predicted value of 6MWT achieved by patients in stage 2 was higher compared to that of patients in stage 4:  $90.6\pm 14$  versus  $62.2\pm 17.2$  ( $p<0.0001$ ) (Table III).

**Table III**

Anova analysis of distance, percent of the predicted value of 6MWT, desaturation, age, BMI and the severity grade of COPD

Indicators	F	Sig.
6MWT D - COPD grade	18.56	<b>0.0001</b>
6MWT % PV - COPD grade	13.285	<b>0.0001</b>
6MWT Des - COPD grade	18.63	<b>0.0001</b>
Age - COPD grade	0.306	0.737
BMI - COPD grade	1.356	0.266

**Legend:** BMI=Body Mass Index; 6MWT=Six-Minute Walk Test; 6MWT D = 6MWT Distance; 6MWT % PV = 6MWT percent of predicted value; Des = Desaturation; F = F test = between group variability/within group variability; Sig = significance cutoff = 0.05.

#### Risk groups

The ANOVA statistical analysis of the walked distance, percent of the predicted value of 6MWT and desaturation considering risk groups indicated a statistical significance between risk groups (Table IV). No statistically significant differences were found when considering the group risk and age or BMI.

**Table IV**

Anova analysis of distance, percent of the predicted value of 6MWT, desaturation, age, BMI and the risk groups of COPD patients

Indicators	F	Sig.
6MWT D - RG	6.003	<b>0.001</b>
6MWT % PV - RG	4.286	<b>0.009</b>
6MWT Des - RG	7.703	<b>0.0001</b>
Age - RG	0.392	0.759
BMI - RG	1.115	0.351

**Legend:** RG = risk group; BMI=Body Mass Index; 6MWT=Six-Minute Walk Test; 6MWT D = 6MWT Distance; 6MWT % PV = 6MWT percent of predicted value; Des = Desaturation; F = F test = between group variability/within group variability; Sig = significance cutoff = 0.05.

#### Smoking status

The 6MWT % of predicted value was higher in group 1 (86%) compared to group 0 and group 2 (73%) ( $p=0.048$

on ANOVA test). Considering smoking status, no statistical significance was found for the walked distance and the desaturation level.

## Discussions

In our study group, we found a proportion of 38.3% obese patients, which is higher than the incidence cited in the literature - 10-28% (Finucane et al., 2011). A possible explanation could be the small group of patients investigated in our research. Out of the 23 obese patients, only 5 (21.73%) were diagnosed with severe COPD (FEV<sub>1</sub>s <30% of predicted value). These results are consistent with the currently available international epidemiological data (Park et al., 2017). Obesity represents a major health problem, with an impact on the pathophysiology of respiration, in obesity-hypoventilation syndrome, or in obesity-COPD overlap syndrome. The presence of obesity in a COPD patient represents a potential indicator of Obstructive Sleep Apnea Syndrome (OSAS), adding the last "O" to what is called the Triple O Syndrome - COPD + Obesity + Hypoventilation + OSAS (Drummond et al., 2012).

BMI moderately correlated with years since smoking cessation. It is known that weight gain occurs after smoking cessation (hyperphagia, stress) (Faeh et al., 2018). The reason for this might be the removal of the effect of nicotine on the central nervous system (Komiyama et al., 2013), or the increase in calories intake, due to the "hand to mouth" gesture (Veldheer et al., 2015). Also, the percent of the predicted value of 6MWT was higher in group 1 versus group 0 and group 2 based on the smoking status.

6MWT was not influenced by age, BMI, smoking history. Our results disagree with other studies, which reported a positive correlation between age, distance and overall performance on 6MWT (Liu et al., 2016). In our opinion, the explanation can be found in the multitude of exclusion criteria that we used, having a group without major comorbidities that could influence the test results (heart failure, peripheral artery disease, uncontrolled diabetes). Currently, there are no universally accepted equations for predictive values of the 6MWT. This is due to the small cohort data, lack of multicenter studies, differences between regions, inconsistent methodology of the test (i.e. corridor length). We selected the equation provided by Casanova et al., as it results from an international multicenter study evaluating geographic variations in a large cohort of adults, following the ATS guidelines.

The average walked distance during the 6MWT was shorter than the reported values  $445\pm 92.9$  meters (Saglam, 2015). We believe that one reason for this is the possible influence of the corridor's length with multiple turns. Other published studies used a corridor of 15 or less meters long and found similar results to those of our study - average distance 391 meters (Hernandes et al., 2011). A possible solution for these differences could be the Sit-To-Stand Test, which could be more accurate in evaluating the functional capacity of COPD patients (Reychler et al., 2018); more studies are needed before validating this tool in the assessment of COPD. We discovered a high statistical significance between the walked distance and the severity of COPD, in accordance with the literature data

(Enfield et al., 2010), and also with the risk group. This last association had contradictory results in the literature (Celli et al., 2016), but our findings suggest that 6MWT could serve as a predictive tool in a COPD population without major comorbidities.

The desaturation index is positively associated with the risk group, indicating a marker for oxygen therapy according to the risk group in addition to spirometric values and arterial blood gas analysis. This could impact the intermittent oxygen therapy at home indicated for patients with severe COPD (a potential condition for reimbursement of oxygen therapy), with a major impact on the healthcare system, reducing the financial costs of both the patient and the system.

Most of the studies found correlations between age or BMI and the risk groups of COPD. Divo et al. (2015) found that the higher the BMI, the lower the risk group, giving obesity a protective value - the obesity paradox of COPD. However, we discovered no statistical significance between these characteristics, meaning that obese and non-obese patients have a similar incidence of exacerbations.

## Conclusions

1. Our findings suggest that in a COPD population without major comorbidities, the outcome of 6MWT could serve as a predictive tool for further exacerbations and might contribute to a better management of the disease, in terms of pharmaceutical and non-pharmaceutical treatment, including pulmonary rehabilitation programs.

2. Furthermore, 6MWT could represent, for this category of patients, an important criterion in the classification of COPD.

## Conflicts of interest

I have no real or perceived, direct or indirect conflicts of interest that relate to this article.

## Acknowledgments

“Iuliu Hațieganu” University of Medicine and Pharmacy, Cluj-Napoca, Romania, PhD Research Project no. 7690/97/15.04.2016.

## References

- Alwan A. Global Status Report on Non-Communicable Diseases. WHO, 2010. Available online at [http://www.who.int/nmh/publications/ncd\\_report\\_full\\_en.pdf](http://www.who.int/nmh/publications/ncd_report_full_en.pdf). Accessed on 2018, May 18.
- Andrianopoulos V, Wouters EF, Pinto-Plata VM, Vanfleteren LE, Bakke PS, Franssen FM, Agusti A, MacNee W, Rennard SI, Tal-Singer R, Vogiatzis I, Vestbo J, Celli BR, Spruit MA. Prognostic value of variables derived from the six-minute walk test in patients with COPD: Results from the ECLIPSE study. *Respir Med*. 2015;109(9):1138-1146. doi: 10.1016/j.rmed.2015.06.013.
- Bolton CE, Bevan-Smith EF, Blakey JD, Crowe P, Elkin SL, Garrod R, Greening NJ, Heslop K, Hull JH, Man WD, Morgan MD, Proud D, Roberts CM, Sewell L, Singh SJ, Walker PP, Walmsley S; British Thoracic Society Pulmonary Rehabilitation Guideline Development Group; British Thoracic Society Standards of Care Committee. British Thoracic Society guideline on pulmonary rehabilitation in adults. *Thorax*. 2013;68(Suppl 2):ii1-ii30. doi: 10.1136/thoraxjnl-2013-203808.
- Casanova C, Celli BR, Barria P, Casas A, Cote C, de Torres JP, Jardim J, Lopez MV, Marin JM, Montes de Oca M, Pinto-Plata V, Aguirre-Jaime A; Six Minute Walk Distance Project (ALAT). The 6-min walk distance in healthy subjects: reference standards from seven countries. *Eur Respir J*. 2011;37(1):150-156. doi: 10.1183/09031936.00194909.
- Celli B, Tetzlaff K, Criner G, Polkey MI, Sciurba F, Casaburi R, Tal-Singer R, Kawata A, Merrill D, Rennard S, COPD Biomarker Qualification Consortium. The 6-Minute-Walk Distance Test as a Chronic Obstructive Pulmonary Disease Stratification Tool. Insights from the COPD Biomarker Qualification Consortium. *Am J Resp Crit Care Med*. 2016;194(12):1483-1493. doi:10.1164/rccm.201508-1653OC.
- Divo MJ, Cabrera C, Casanova C, Marin JM, Pinto-Plata VM, de Torres JP, Zulueta J, Zagaceta J, Sanchez-Salcedo P, Berto J, Cote C, Celli BR. Comorbidity Distribution, Clinical Expression and Survival in COPD Patients with Different Body Mass Index. *Chronic Obstr Pulm Dis*. 2014;1(2):229-238. doi: 10.15326/jcopdf.1.2.2014.0117.
- Drummond M, Santos A, Pinto T, Gonçalves M, Marinho A, Súcena M, Almeida J, Winck J. Triple O - a new respiratory syndrome? *Eur Resp J* 2012;40:P2071, available online at [http://erj.ersjournals.com/content/40/Suppl\\_56/P2071](http://erj.ersjournals.com/content/40/Suppl_56/P2071). Accessed on 10 January 2018.
- Eisner MD, Anthonisen N, Coultas D, Kuenzli N, Perez-Padilla R, Postma D, Romieu I, Silverman EK, Balmes JR; Committee on Nonsmoking COPD, Environmental and Occupational Health Assembly. An official American Thoracic Society public policy statement: Novel risk factors and the global burden of chronic obstructive pulmonary disease. *Am J Respir Crit Care Med*. 2010;182(5):693-718. doi: 10.1164/rccm.200811-1757ST.
- Enfield K, Gammon S, Floyd J, Falt C, Patrie J, Platts-Mills TA, Truwit JD, Shim YM. Six-minute walk distance in patients with severe end-stage COPD: association with survival after inpatient pulmonary rehabilitation. *J Cardiopulm Rehabil Prev*. 2010;30(3):195-202. doi: 10.1097/HCR.0b013e3181c565e4.
- Faeh D, Kaufmann M, Haile SR, Bopp M. BMI-mortality association: shape independent of smoking status but different for chronic lung disease and lung cancer. *Int J Chron Obstruct Pulmon Dis*. 2018;13:1851-1855. doi: 10.2147/COPD.S157629.
- Finucane MM, Stevens GA, Cowan MJ, Danaei G, Lin JK, Paciorek CJ, Singh GM, Gutierrez HR, Lu Y, Bahalim AN, Farzadfar F, Riley LM, Ezzati M; Global Burden of Metabolic Risk Factors of Chronic Diseases Collaborating Group (Body Mass Index). National, regional, and global trends in body-mass index since 1980: systematic analysis of health examination surveys and epidemiological studies with 960 country-years and 9·1 million participants. *Lancet*. 2011;377(9765):557-567. doi: 10.1016/S0140-6736(10)62037-5.
- Global Initiative for Chronic Obstructive Lung Disease (GOLD): Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease. Updated 2018. Available at: [https://goldcopd.org/wp-content/uploads/2017/11/GOLD-2018-v6.0-FINAL-revised-20-Nov\\_WMS.pdf](https://goldcopd.org/wp-content/uploads/2017/11/GOLD-2018-v6.0-FINAL-revised-20-Nov_WMS.pdf), Accessed on 15 June 2018.
- Hernandes NA, Wouters EFM, Meijer K, Annegarn J, Pitta F, Spruit MA. Reproducibility of 6-minute walking test in patients with COPD, *Eur Resp J* 2011;38:261-267; DOI: 10.1183/09031936.00142010
- Kim S, Oh J, Kim YI, Ban HJ, Kwon YS, Oh IJ, Kim KS, Kim

- YC, Lim SC. Differences in classification of COPD group using COPD assessment test (CAT) or modified Medical Research Council (mMRC) dyspnea scores: a cross-sectional analysis. *BMC Pulm Med*. 2013;13:35. doi: 10.1186/1471-2466-13-35.
- Komiyama M, Wada H, Ura S, Yamakage H, Satoh-Asahara N, Shimatsu A, Koyama H, Kono K, Takahashi Y, Hasegawa K. Analysis of factors that determine weight gain during smoking cessation therapy. *PLoS One*. 2013;8(8):e72010. doi: 10.1371/journal.pone.0072010.
- Liu WY, Meijer K, Delbressine JM, Willems PJ, Franssen FM, Wouters EF, Spruit MA. Reproducibility and Validity of the 6-Minute Walk Test Using the Gait Real-Time Analysis Interactive Lab in Patients with COPD and Healthy Elderly. *PLoS One*. 2016;11(9):e0162444. doi:10.1371/journal.pone.0162444.
- López-Campos JL, Tan W, Soriano JB. Global burden of COPD. *Respirology*. 2016;21(1):14-23. doi: 10.1111/resp.12660. Available online at <https://onlinelibrary.wiley.com/doi/abs/10.1111/resp.12660>. Accessed on 18 July 2018.
- Maddocks M, Kon SS, Singh SJ, Man WD. Rehabilitation following hospitalization in patients with COPD: can it reduce readmissions? *Respirology*. 2015;20(3):395-404. doi: 10.1111/resp.12454.
- Mannino DM, Buist AS. Global burden of COPD: risk factors, prevalence, and future trends. *Lancet*. 2007;370(9589):765-773. doi: 10.1016/S0140-6736(07)61380-4.
- Moreira GL, Donária L, Furlanetto KC, Paes T, Sant'Anna T, Hernandez NA. GOLD B-C-D groups or GOLD II-III-IV grades: Which one better reflects the functionality of patients with chronic obstructive pulmonary disease? *Chron Respir Dis*. 2015;12(2):102-110. doi: 10.1177/1479972315573528.
- Park J-H, Lee J-K, Heo EY, Kim DK, Chung HS. The effect of obesity on patients with mild chronic obstructive pulmonary disease: results from KNHANES 2010 to 2012. *Int J Chron Obstr Pulm Dis*. 2017;12:757-763. doi:10.2147/COPD.S126192.
- Quaderi SA, Hurst JR. The unmet global burden of COPD. *Glob Health Epidemiol Genom*. 2018;3:e4. doi:10.1017/ghg.2018.1. Available online at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5921960/>. Accessed on 18 July 2018.
- Reychler G, Boucard E, Peran L, Pichon R, Le Ber-Moy C, Oukssel H, Liistro G, Chambellan A, Beaumont M. One minute sit-to-stand test is an alternative to 6MWT to measure functional exercise performance in COPD patients. *Clin Respir J*. 2018;12(3):1247-1256. doi: 10.1111/crj.12658.
- Saglam M, Vardar-Yagli N, Savci S, Inal-Ince D, Calik-Kutukcu E, Arikan H, Coplu L. Functional capacity, physical activity, and quality of life in hypoxemic patients with chronic obstructive pulmonary disease. *Int J Chron Obstruct Pulmon Dis*. 2015;10:423-428. doi: 10.2147/COPD.S78937.
- Singh SJ, Puhan M. A., Andrianopoulos V., Hernandez N. A., Mitchell K. E., Hill C. J., et al. (2014). An official systematic review of the European Respiratory Society/American Thoracic Society: measurement properties of field walking tests in chronic respiratory disease. *Eur. Respir. J*. 44 1447-1478, available at <http://erj.ersjournals.com/content/44/6/1447>. long. Accessed on 10 January 2018.
- Soares MR, Pereira CA. Six-minute walk test reference values for healthy adults in Brazil. *J Bras Pneumol*. 2011;37(5):576-583.
- Veldheer S, Yingst J, Zhu J, Foulds J. Ten-year weight gain in smokers who quit, smokers who continued smoking and never smokers in the United States, NHANES 2003-2012. *Int J Obes (Lond)*. 2015;39(12):1727-1732. doi: 10.1038/ijo.2015.127.
- Waschki B, Kirsten A, Holz O, Müller KC, Meyer T, Watz H, Magnussen H. Physical activity is the strongest predictor of all-cause mortality in patients with COPD: a prospective cohort study. *Chest*. 2011;140(2):331-342. doi: 10.1378/chest.10-2521.
- Zanoria SJ, ZuWallack R. Directly measured physical activity as a predictor of hospitalizations in patients with chronic obstructive pulmonary disease. *Chron Respir Dis*. 2013;10(4):207-213. doi: 10.1177/1479972313505880.
- \*\*\*ATS statement: guidelines for the six-minute walk test. *Am J Respir Crit Care Med*. 2002;166(1):111-117.

#### Websites

- (1) Trends in COPD (chronic bronchitis and emphysema): morbidity and mortality. American Lung Association website. Available online at <http://www.lung.org/finding-cures/our-research/trend-reports/copd-trend-report.pdf>. Accessed on 2018, May 18.
- (2) Global Initiative for Chronic Obstructive Lung Disease (GOLD): Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease. Updated 2018. Available at: [https://goldcopd.org/wp-content/uploads/2017/11/GOLD-2018-v6.0-FINAL-revised-20-Nov\\_WMS.pdf](https://goldcopd.org/wp-content/uploads/2017/11/GOLD-2018-v6.0-FINAL-revised-20-Nov_WMS.pdf), Accessed on 2018, May 15.

## Menu structure for children and youth swimmers during micro-cycle training

*Particularități alimentare la cadeții înotători pe parcursul unui microciclu de pregătire*

Alexandru Maftai<sup>1</sup>, Roxana Maria Hadmaș<sup>2</sup>, Ștefan Adrian Martin<sup>3</sup>

<sup>1</sup> Licensed dietician, H2O Team Târgu Mureș, Romania

<sup>2</sup> Pediatrics I Department, University of Medicine and Pharmacy Târgu Mureș, Romania

<sup>3</sup> Department of Physiology, University of Medicine and Pharmacy Târgu Mureș, Romania

### Abstract

**Background.** Menu structure is an important element in swimmers' specific activity in order to maintain an optimal physical development pattern and to facilitate the recovery process between training sessions.

**Aims.** The aim of the study was to identify swimmers' nutritional knowledge and to establish a relationship between food ingestion and specific physical activity.

**Methods.** A cross sectional study was conducted in Târgu Mureș, Romania, between 19th of March and 20th of July 2018, on a sample of 24 athletes consisting of 11 female and 13 male swimmers enrolled in national competitions. In order to determine swimmers' food intake and preferences we applied a 19-item questionnaire and a 5 day food diary.

**Results.** Statistically significant differences were recorded regarding the increased intake of processed meat foods ( $p=0.014$ ,  $r=0.4947$ ,  $CI=0.1014$  to  $0.7542$ ) and sweets ( $p=0.0425$ ,  $r=-0.4173$ ,  $CI=-0.7088$  to  $0.003916$ ) both at breakfast and during lunch. Also, the results showed an increase of refined products and sweets consumption in snacks during a day ( $p=0.0305$ ,  $r=0.4422$ ,  $CI=0.03446$  to  $0.7237$ ). At the same time, significant statistical associations were identified between the athletes' age and fruit intake both before ( $p=0.0207$ ,  $r=0.4693$ ,  $CI=0.06862$  to  $0.7396$ ) and after the training session ( $p=0.007$ ,  $r=0.5356$ ,  $CI=0.1562$  to  $0.7773$ ).

**Conclusions.** The obtained results will influence physical activity in energy terms, providing a higher training session difficulty due to an inappropriate food intake before the practice and an increased fatigue level reported by the athletes. Establishing a nutritional scheme for the athletes during different training phases of the season is required.

**Keywords:** swimming, food intake, food preferences, age

### Rezumat

**Premize.** Structura planificării alimentare reprezintă un element important în activitatea sportivă specifică în vederea dezvoltării fizice optime și pentru facilitarea procesului de refacere fizică între ședințele de pregătire.

**Obiective.** S-a urmărit identificarea cunoștințelor nutriționale în rândul înotătorilor, stabilindu-se o relație între aportul alimentar și activitatea sportivă specifică.

**Metode.** S-a desfășurat un studiu transversal observațional, în Târgu Mureș, România, în perioada 19 martie – 20 iulie 2018, pe un eșantion format din 11 subiecți de gen feminin și 13 subiecți de sex masculin, activând în competiții la nivel național. În vederea determinării aportului și preferințelor alimentare, am aplicat un chestionar format din 19 întrebări și un jurnal alimentar desfășurat pe parcursul a 5 zile.

**Rezultate.** Au fost identificate diferențe semnificative din punct de vedere statistic între vârsta înotătorilor și consumul crescut de produse procesate de origine animală ( $p=0.014$ ,  $r=0.4947$ ,  $CI=0.1014$  to  $0.7542$ ) și consumul de dulciuri ( $p=0.0425$ ,  $r=-0.4173$ ,  $CI=-0.7088$  to  $0.003916$ ) atât în cadrul micului dejun, cât și la prânz. S-a constatat o creștere a consumului în rândul produselor rafinate și al dulciurilor în cadrul gustărilor ( $p=0.0305$ ,  $r=0.4422$ ,  $CI=0.03446$  to  $0.7237$ ). Au fost identificate asocieri semnificative din punct de vedere statistic între vârsta sportivilor și consumul de fructe, atât înainte ( $p=0.0207$ ,  $r=0.4693$ ,  $CI=0.06862$  to  $0.7396$ ), cât și după finalizarea ședinței de pregătire ( $p=0.007$ ,  $r=0.5356$ ,  $CI=0.1562$  to  $0.7773$ ).

**Concluzii.** Activitatea fizică este influențată din punct de vedere energetic prin creșterea percepției gradului de dificultate a ședinței de pregătire din cauza unui aport alimentar inadecvat înaintea efortului fizic. Necesitatea dezvoltării unui plan alimentar în rândul sportivilor pe parcursul diferitelor perioade de pregătire din cadrul unui sezon este confirmată prin rezultate.

**Cuvinte cheie:** înot, aport alimentar, preferințe alimentare, vârstă

---

Received: 2018, July 2; Accepted for publication: 2018, July 20

Address for correspondence: H2O Team Târgu Mureș, Călărașilor Str. No. 7, ap. 2, Târgu Mureș, Romania

E-mail: alex8ynwa@yahoo.com

Corresponding author: Alexandru Maftai; alex8ynwa@yahoo.com

<https://doi.org/10.26659/pm3.2018.19.3.176>

## Introduction

Nutritional background is an effective factor regarding adolescent swimmers' physical activity and development. Alongside the nutritional scheme, different parameters such as the daily training schedule, training period and intensity of physical effort will dictate swimmers' evolution (Papadopoulou et al., 2002; Mujika et al., 2014).

Nutritional support for competitive swimming will represent a critical element of the athlete's preparation in order to meet daily energy and nutrient demands as a result of the specific sporting activity. Thus, swimmers' schedule requires rigorous training and practice in order to develop biomechanical and physiological skills specific to aquatic sports (Pyne et al., 2014). Swimming is a sport that aims to develop both the aerobic and anaerobic capacity in order to increase strength and technical efficiency in athletes. Therefore, physical performance can be optimized with an adequate meal plan that includes a proper macronutrient distribution, as well as with a hydration plan and periodization of supplements (Domínguez et al., 2017). Moreover, these features can provide a favorable impact on swimmers' performances as described by Stellingwerf et al. (2014). However, adolescent and youth swimmers are advised to adapt their food intake towards a well-planned menu in order to enhance training performance. Sufficient energy will have to be provided through food intake, otherwise swimmers might develop energetic and micronutrient deficiencies during growth and development periods (Shaw et al., 2014).

Swimmers' food intake will be fulfilled according to the macro-cycle training periodization. Food ingestion will be adapted to every training period requirement (Shaw et al., 2014; Pyne et al., 2014).

Particularly, swimmers are advised to adapt their menu according to the training and the physical effort structure (Trakman et al., 2016). A dense nutrient food intake will fulfill both the athletes' quality and quantity nutritional requirements. As a result, the composition and the structure of the menu will overcome swimmers' energy requirements in both physical development phases, having a direct impact on the general physical activity (Shaw et al., 2014).

## Hypothesis

Based on our hypothesis, negative nutritional habits can affect sports performance. Our main objective is to identify the nutritional knowledge of swimmers with active participation in national competitions in order to assess a relationship between nutrition practice, knowledge and effort perception.

## Material and methods

### *Research protocol*

A cross-sectional study was conducted after obtaining the written consent of the legal tutors of the subjects.

### *a) Period and place of the research*

The study was conducted in Târgu Mureș, Romania, between March-May 2018.

### *b) Subjects and groups*

The study group was formed by 24 subjects, of which 11 females and 13 males. Both groups were active participants in regional and national competitions. Data usage was

obtained by written approvals of the legal guardians of the subjects.

### *c) Tests applied*

The analyses were performed during the general training cycle of the swimmers. The inclusion criteria were: healthy subject who signed up for the swimming club, with a reported age between 7 and 14 years. The athletes who did not participate in at least 3 swimming practices during the analysis week were excluded.

### *Food questionnaire development*

Data extraction was conducted through a 19-item multiple choice questionnaire. Also, a food diary was completed by athletes in order to identify food ingestion over a 5 day period. The main purpose of the questionnaire was to identify swimmers' food intake and preferences. Through the food diary we followed the predominant food choices of the swimmers according to the daily training schedule. Within the food questionnaire, data regarding the number of meals and snacks, along with liquid ingestion were incorporated. Pre- and post-training information about food intake and food content was extracted.

### *Physical exercise data monitoring*

Exercise activity, such as daily training session difficulty and physical stress level, was individually reported. A characterization scale was used, by applying values between 1, which represented the minimum effort difficulty, and 5, which represented the maximum effort difficulty, in order to characterize physical effort. The data regarding swimmers' training sessions, including total effort time (minutes) and total swim distance (meters), were monitored as well.

### *Anthropometric analysis*

Through anthropometric measurements we identified the athletes' height (m), determining weight (kg) and the body mass index (BMI) using an Omron BF511 (Kyoto, Japan) body composition scale.

### *d) Statistical processing*

The statistical analyses were performed using GraphPad Prism 6.0 software. We used mean values, median values and standard deviations to describe our data. Data normalization was done with the D'Agostino-Pearson normality test. We used the Spearman rank correlation test and Wilcoxon matched pairs test to analyze a possible association between two items or a difference in evolution. The confidence test was set at 95%, so a p value lower than 0.05 was considered significant.

## Results

Through the anthropometric analysis, we identified a median of 1.39 m height (between 1.32 m and 1.61 m) and 32.7 kg body weight (between 27.2 kg and 48.2 kg). The median BMI value of swimmers was 16.95, with a minimum of 14.4 and a maximum of 20.7.

### *Training analysis*

Physical stress, reported by subjects as fatigue, was associated with a higher swimming session difficulty ( $p=0.007$ ,  $r=0.5352$ ,  $95\%CI=0.1557$  to  $0.7770$ ).

Statistical data showed significant associations between daily training sessions and different food intake ( $p=0.0078$ ). The conducted swimming sessions lasted 90 minutes. In association with the physical effort, while the median value provided a number of 6 swimming sessions (between 4 and 10), during the micro-cycle training,

swimmers' food choices changed. The increased number of swimming sessions during a week (6) was significantly associated with an elevated intake of cereals represented by white bread ( $p=0.0078$ ). However, we did not identify any associations between the median number of swimming sessions and an increased intake of pastry products, oleaginous plants or fruits, as shown in Table I.

**Table I**  
Statistical associations regarding weekly training sessions and the studied parameters

Weekly swimming sessions (6)					
Reported data	Bread	Pastry products	Nuts	Peanuts	Fruits
<i>p</i>	0.0078	0.0143	0.0294	0.0294	0.01
<i>r</i>	0.5297	-0.4934	-0.4448	-0.4448	-0.5148
95%CI Lower	0.1482	-0.7535	-0.7252	-0.7252	-0.7657
95%CI Upper	0.7740	-0.0997	-0.0376	-0.0376	-0.1281

**Breakfast**

Through the obtained results, the predominant food products consumed during breakfast were represented by "dairy products" (66.6%), "refined cereals" (66.6%) and "eggs" (41.6%). Within this meal, food products with a high processing rate such as precooked meat products (62.5%) and white bread (58.3%) were identified.

By analyzing breakfast composition, we found significant correlations between athletes' age, processed meat products intake ( $p=0.014$ ) and white bread intake ( $p=0.0497$ ), as shown in Table II.

**Table II**  
Statistical correlations between athletes' age and food consumption during breakfast

Breakfast					
Reported data	Processed meat products	Bread	Cereals	Dairy products	Eggs
<i>p</i>	0.014	0.0497	0.4658	0.9038	0.1747
<i>r</i>	0.4947	0.4048	-0.1563	-0.02605	0.2865
95%CI Lower	0.1014	-0.01107	-0.5357	-0.4354	-0.1447
95%CI Upper	0.7542	0.7013	0.2755	0.3922	0.6262

**Lunch**

Swimmers' food intake, during lunch, was predominantly based on soups (95.8%) and animal products such as meat (95.8%). Also, food intake was completed by vegetables such as carrots, pumpkins, broccoli, green peas and tomatoes, steamed potatoes or pasta.

Increased refined products consumption, such as sweets and simple carbohydrates (chocolate, biscuits, cakes, jams and pastry products) at the lunch meal was correlated with athletes' age ( $p=0.0425$ ) according to Table III.

**Table III**  
Statistical correlations between age and food consumption during lunch meal

Lunch					
Reported data	Sweets/simple CHO	Steamed/mashed potatoes	Soups	Meat	Pasta
<i>p</i>	0.0425	0.0455	0.3128	0.4735	0.4388
<i>r</i>	-0.4173	-0.4119	-0.2151	0.1536	-0.1658
95%CI Lower	-0.7088	-0.7056	-0.5777	-0.2781	-0.5426
95%CI Upper	0.0039	0.0025	0.2184	0.5337	0.2665

**Snacks**

Athletes' secondary food intake was predominantly represented by processed meat products (45.8%) and white bread (75%). Also, dairy products such as cheese or melted cheese (37.5%) and high saturated fat products, such as pastry (54.1%), were consumed as daily snacks. Nutritive products with a high level of unsaturated fats, such as oleaginous products including nuts, almonds or peanuts, had a low consumption percentage (4%).

Snacks intake showed a significant statistical association between the increased consumption of refined products, sweets ( $p=0.0305$ ) and the increased age of swimmers ( $r=0.4422$ , 95%CI=0.03446 to 0.7237), according to Table IV.

**Table IV**  
Statistical associations between swimmers' age and food consumption during snacks

Snacks					
Reported data	Refined products	Seeds	Nuts	Fruit juices	Fruits
<i>p</i>	0.0305	0.9432	0.9432	0.4364	0.8831
<i>r</i>	0.4422	0.01536	0.01536	0.1666	0.03171
95%CI Lower	0.03446	-0.4012	-0.4012	-0.2657	-0.3874
95%CI Upper	0.7237	0.4267	0.4267	0.5432	0.4400

**Dinner**

Athletes' food intake during dinner was predominantly based on red and white meat (50%), white bread (66.6%) and processed meat products such as cold cuts (58.3%). Alongside those foods, dinner included butter (50%), vegetables (41.6%) and yogurts (41.6%).

Regarding athletes' dinner intake ( $p>0.05$ ), we could not identify correlations between any specific products and swimmers' age (Table V).

**Table V**  
Statistical associations between swimmers' age and dinner food intake

Dinner					
Reported data	Meat	Pasta	Rice	Vegetables	Dairy products
<i>p</i>	0.1283	0.6926	0.4885	0.6225	0.9531
<i>r</i>	-0.3193	-0.08509	-0.1485	-0.1059	-0.01268
95%CI Lower	-0.6477	-0.4821	-0.5300	-0.4981	-0.4245
95%CI Upper	0.1091	0.3409	0.2829	0.3223	0.4035

The extracted data highlight significant statistical associations between athletes' age and food choices. Older age was associated with an increased consumption of dairy products ( $p=0.038$ ), but was not correlated with a high intake of chips ( $p=0.0349$ ). According to Table VI data, the conducted analyses evidenced significant statistical associations between the age of the subjects and an increased fruit intake, both before and after the training session. According to Table VII, athletes' food preferences were identified.

**Table VI**  
Statistical associations regarding athletes' age and fruit intake

Fruit intake		
Reported data	Before the swimming session	After the swimming session
<i>p</i>	0.0207	0.007
<i>r</i>	0.4693	0.5356
95%CI Lower	0.06862	0.1562
95% CI Upper	0.7396	0.7773

**General food intake**

**Table VII**  
Food intake summary in the study group

Food	Many times/ day (%)	Daily (%)	Few times/ week (%)	Rarely/never (%)
Milk	25	45.8	25	4
Yoghurt	4	25	45	20
Fruit yoghurt	0	25	12.5	5
Kefir	4	8	12.5	75
Cheese/Melted cheese/ Cottage cheese	12.5	50	25	12.5
Butter	16.6	37.5	33	12.5
Margarine	4	8	29	58
Liver pate	4	8	33	54
Pork meat	0	16	37.5	45
Beef meat	0	8	12.5	79
Chicken meat	0	25	70	4
Sausages	0	12.5	41	45
Bacon	0	12.5	16.6	66.6
Meat based processed products	16.6	54	25	4
Fish	0	0	50	45.8
Eggs	0	20	62.5	16.6
Bread	50	37.5	12.5	0
Cereals	4	37.5	54.1	4.1
Refined cereals	4.1	33.3	45.8	16.6
Rice	0	12.5	58.3	29.1
Pasta	0	4.1	54	41
Pastry products	0	37.5	45.8	16.6
Sun flower seeds	0	4.1	37.5	58.3
Pistachio	0	0	33.3	62.5
Peanuts	0	12.5	29.1	58.3
Chips	0	0	29.1	70.8
Biscuits	0	29.1	45.8	25
Carrots/pumpkins/ potatoes/vegetables	8.3	58.3	33.3	0
Fruits	20.8	66.6	12.5	0
Oranges/bananas/ apples/kiwis	12.5	62.5	25	0
Fruit and vegetable juices	0	4.1	45.8	45.8
Popcorn	0	8.3	33.3	58.3
Nuts	0	8.3	29.1	62.5
Fried chips	0	0	58.3	41.6
Pizza	0	4.1	29.1	66.6

Daily water intake (1.25 l) was significantly associated with the swimmers' age ( $p=0.0089$ ,  $r=0.5217$ ,  $95\%CI=0.1373$  to  $0.7695$ ) and also with the number of daily meals ( $p=0.0081$ ,  $r=0.5271$ ,  $95\%CI=0.1447$  to  $0.7725$ ). According to the obtained results, it can be noted that athletes' liquid intake was not correlated with the anthropometric parameters ( $p>0.05$ ) and the number of daily snacks ( $p>0.05$ ), Table VIII.

**Table VIII**  
Statistical associations between daily water intake and the analyzed parameters

Reported data	Daily water intake (1.25 l)				
	Age (10 years old)	Meals/day (3)	Anthropometric parameters		
			Height (1.39 m)	Weight (31.7 kg)	Snacks/day (2)
<i>p</i>	0.0089	0.0081	0.1594	0.1843	0.8492
<i>r</i>	0.5217	0.5271	0.2965	0.2805	-0.04099
95%CI Lower	0.1373	0.1447	-0.1339	-0.1511	-0.4474
95%CI Upper	0.7695	0.7725	0.6328	0.6223	0.3795

## Discussions

During physical training periods, a slight change in macronutrient distribution can be seen according to Pyne & Sharp (2014). Alongside reaching proper energy requirements, the athletes can maintain their physical

activity at a top level, ensuring optimal body development. Therefore, the recovery process of swimmers will take place properly, without facing energetic issues (Pyne et al., 2014; Smith et al., 2016).

### General food intake

Food intake and timing in the case of athletes will include meals and snacks distribution during daily physical activity, meeting both macro and micronutrient requirements. Young athletes, such as children and youth swimmers, will need to take care of physical development energy requirements, alongside the energy expenditure of the specific physical activity dictated by effort intensity and total training time (Unnithan et al., 2004). The hydration status of the athletes involved in competitions will be monitored in order to recover the sensitive and insensitive fluid losses and electrolyte deficiency (Petrie et al., 2004). However, swimmers will need to learn the defining elements of specific nutritional terms in order to improve physical performances. From a practical standpoint, these are defined as the choice of the proper food or dishes and timing of their ingestion during the training sessions, as well as before and after them (Purcell, 2013). Swimmers' food choices will indicate their capacity to meet the nutritional requirements in order to recover after the physical effort.

### Breakfast

According to our results, swimmers' food intake at breakfast was predominantly based on processed foods such as precooked meat products (62.5%) and white bread (58.3%), dairy products (66.6%) and refined cereals (66.6%). Many scientific papers highlight the fact that consumption of high nutritional value foods such as whole grains, fruit juices and dairy products will satisfy the daily energetic requirements by achieving macronutrient balance, as stated by O'Neil et al. (2015) and O'Neil et al. (2014).

### Snacks

In our study group, two daily snacks were reported by the athletes. Some similarities were mentioned by Burke et al. (2003) in a paper where athletes had three meals and two snacks during an ordinary training day. The chosen food for snacks, selected by athletes, was represented by sources higher in simple carbohydrates and lower in protein and fat, such as sports drinks and bars, similarly to Burke et al. (2003).

### Lunch

Based on the obtained results, the athletes tended to consume refined products and foods rich in carbohydrates at lunch. According to the hypothesis that energy demand is predominantly overcome by refined food intake, athletes should reconsider daily food ingestion towards products with a high amount of nutrients and a low processing rate (Ward et al., 2017; Chacko et al., 2018).

### Dinner

In our study group, the athletes tended to have a rich protein and carbohydrate meal at dinner. Thus, swimmers' food intake was based on animal and dairy products (milk, yoghurt, cheese) alongside vegetables. Such similarities are presented by Carlsohn et al. (2012) in a study on athletes who gained most of the macronutrients during the main meals of the day. However, even if in our study group no statistical correlations between the studied parameters

and dinner intake were identified, swimmers still need to minimize their intake of precooked meat products and white bread in order to meet the nutritional requirements and to recover after physical effort.

## Conclusions

1. The daily food intake of athletes was represented by fruits (66%), vegetables (58%) and dairy products (45%). In addition to these, swimmers chose to eat different refined foods, such as meat-based processed products (54%) and pastry (37.5%).

2. According to our results, young swimmers preferred to eat refined products during daily snacks. An important element in swimmers' choices regarding highly nutritional daily food intake is represented by their age. However, older age in the case of athletes did not provide a positive background regarding nutrient dense food choices, such as whole grains, dairy products or fruits at breakfast.

3. Swimmers showed a slightly increased tendency to consume refined and processed foods, having a low daily intake of whole grains, which represents an inadequate aspect of the general physical activity.

## Conflicts of interest

There are no conflicts of interest regarding the study group, methodology, results and conclusions drawn.

## References

Chacko TV, Ganesan S. A tool for quickly identifying gaps in diet of school children for nutritional educational interventions. *Indian J Public Health*. 2018 Apr-Jun;62(2):146-149. doi:10.4103/ijph.IJPH\_23\_17.

Burke LM, Slater G, Broad EM, Haukka J, Modulon S, Hopkins WG. Eating patterns and meal frequency of elite Australian athletes. *Int J Sport Nutr Exerc Metab*. 2003;13(4):521-538.

Carlssohn A, Nippe S, Heydenreich J, Mayer F. Carbohydrate intake and food sources of junior triathletes during a moderate and an intensive training period. *Int J Sport Nutr Exerc Metab*. 2012;22(6):438-443. <https://doi.org/10.1123/ijsnem.22.6.438>.

Domínguez R, Jesús-Sánchez-Oliver A, Cuenca E, Jodra P, Fernandes da Silva S, Mata-Ordóñez F. Nutritional needs in the professional practice of swimming: a review. *J Exerc Nutrition Biochem*. 2017;21(4):1-10. doi: 10.20463/jenb.2017.0030.

Mujika I, Stellingwerff T, Tipton K. Nutrition and training

adaptations in aquatic sports. *Int J Sport Nutr Exerc Metab*. 2014;24(4):414-424. doi: 10.1123/ijsnem.2014-0033.

O'Neil CE, Nicklas TA, Fulgoni VL 3<sup>rd</sup>. Nutrient intake, diet quality, and weight/adiposity parameters in breakfast patterns compared with no breakfast adults: National Health and Nutrition Examination Survey 2001-2008. *J Acad Nutr Diet*. 2014 Dec;114(12 Suppl):S27-S43.

O'Neil CE, Nicklas TA, Fulgoni VL 3<sup>rd</sup>. Nutrient intake, Diet Quality, and Weight Measures in Breakfast Patterns Consumed by Children Compared with Breakfast Skippers: NHANES 2001-2008, *AIMS Public Health*. 2015;2(3):441-468. doi: 10.3934/publichealth.2015.3.441.

Papadopoulou SK, Papadopoulou SD, Gallos GK. Macro- and micro-nutrient intake of adolescent Greek female volleyball players. *Int J Sport Nutr Exerc Metab*. 2002;12(1):73-80.

Petrie HJ, Stover EA, Horswill CA. Nutritional concerns for the child and adolescent competitor. *Nutrition*. 2004;20(7-8):620-631. DOI:10.1016/j.nut.2004.04.002

Purcell LK. Sport nutrition for young athletes. *Paediatr Child Health*. 2013;18(4):200-205.

Pyne DB, Sharp RL. Physical and energy requirements of competitive swimming events. *Int J Sport Nutr Exerc Metab*. 2014;24(4):351-359. doi: 10.1123/ijsnem.2014-0047.

Pyne DB, Verhagen EA, Mountjoy M. Nutrition, illness, and injury in aquatic sports. *Int J Sport Nutr Exerc Metab*. 2014;24(4):460-469. doi: 10.1123/ijsnem.2014-0008.

Shaw G, Boyd KT, Burke LM, Koivisto A. Nutrition for swimming. *Int J Sport Nutr Exerc*, 2014;24(4):360-372. doi: 10.1123/ijsnem.2014-0015.

Smith DR, Jones B, Sutton L, King RF, Duckworth LC. Dietary Intakes of Elite 14- to 19- Year-Old English Academy Rugby Players during a Pre-Season Training Period. *Int J Sport Nutr Exerc Metab*. 2016;26(6):506-515. doi: 10.1123/ijsnem.2015-0317.

Stellingwerff T, Pyne DB, Burke LM. Nutrition considerations in special environments for aquatic sports. *Int J Sport Nutr Exerc Metab*. 2014;24(4):470-479. doi: 10.1123/ijsnem.2014-0014.

Trakman GL, Forsyth A, Devlin BL, Belski R. A Systematic Review of Athletes' and Coaches' Nutrition Knowledge and Reflections on the Quality of Current Nutrition Knowledge Measures. *Nutrients*. 2016 Sep 16;8(9). pii: E570. doi: 10.3390/nu8090570.

Unnithan VB, Goulopoulou S. Nutrition for the pediatric athlete. *Curr Sports Med Rep*. 2004;3(4):206-211.

Ward S, Bélanger M, Donovan D, Vatanparast H, Engler-Stringer R, Leis A, Carrier N. Lunch is ready...but not healthy: An analysis of lunches served in childcare in two Canadian provinces. *Can J Public Health*. 2017; 108(4):e342-e347. doi: 10.17269/cjph.108.5688.

## REVIEWS

# Physical activity in colorectal cancer

## *Activitatea fizică în cancerul colorectal*

Laura Ioana Gavrița<sup>1</sup>, Corina Ionescu<sup>2</sup>, Ovidiu Bălăcescu<sup>3</sup>, Daniel Cruțeriu<sup>3,4</sup>,  
Lorena Filip<sup>1\*</sup>, Doina Miere<sup>1</sup>

*“Iuliu Hațieganu” University of Medicine and Pharmacy, Cluj-Napoca, Romania*

<sup>1</sup> *Department of Bromatology, Hygiene, Nutrition*

<sup>2</sup> *Department of Pharmaceutical Biochemistry and Clinical Laboratory*

<sup>3</sup> *Department of Functional Genomics, Proteomics and Experimental Pathology, “Prof. Dr. Ion Chiriacu” Oncology Institute, Cluj-Napoca, Romania*

<sup>4</sup> *Department of Molecular Biology and Biotechnology, Faculty of Biology and Geology, “Babes – Bolyai” University, Cluj-Napoca, Romania*

### Abstract

Extensive epidemiological and experimental investigations have linked lifestyle and environmental factors to the risk of colorectal neoplasia. Protective factors include: a balanced diet based on whole grains, non-starchy vegetables and dairy products, maintenance of a healthy weight and regular physical activity, while excessive intake of red and processed meat, alcohol consumption and a sedentary behavior are frequently associated with carcinogenesis. These lifestyle factors are equally important even after a diagnosis of colorectal cancer. Both diet and physical activity can boost physical and physiological function, enhance the quality of life and reduce mortality among oncologic patients. The aim of this paper is to present the most relevant biological mechanisms linking physical activity with colorectal cancer in the context of prevention and cancer outcomes. Furthermore, we emphasize the importance of physical activity alone or in association with other modifiable lifestyle factors, as a reliable tool for prevention and/or improved prognosis in diagnosed patients.

**Keywords:** colorectal cancer, physical activity, prevention, prognosis, quality of life

### Rezumat

Studiile epidemiologice alături de cercetările experimentale au evidențiat de-a lungul timpului importanța elementelor stilului de viață și a factorilor de mediu în cancerul colorectal. Cei mai importanți factori care conferă protecție includ o dietă sănătoasă bazată pe consum de cereale integrale, legume fără amidon și produse lactate, alături de menținerea unui indice de masă corporală normal și practicarea cu regularitate a activității fizice. Pe de altă parte, consumul excesiv de carne roșie și carne procesată, alcool și o viață sedentară contribuie la carcinogenază. Acești factori sunt la fel de importanți și după diagnosticul de cancer colorectal. Atât dieta cât și activitatea fizică ajută la îmbunătățirea funcțiilor fizice și cognitive, îmbunătățesc calitatea vieții și contribuie la reducerea mortalității în rândul pacienților oncologici. Scopul acestei lucrări este de a prezenta cele mai relevante mecanisme biologice care explică măcar parțial efectele benefice ale activității fizice în prevenție și prognostic. În plus, în această lucrare de sinteză vom evidenția importanța activității fizice, ca factor singular sau în combinație cu alți factori ai stilului de viață, ca fiind un instrument important în prevenție și/sau în îmbunătățirea prognosticului la pacienții diagnosticați.

**Cuvinte cheie:** cancer colorectal, activitate fizică, prevenție, prognostic, calitatea vieții

---

Received: 2018, July 5; Accepted for publication: 2018, July 20

Address for correspondence: “Iuliu Hațieganu” University of Medicine and Pharmacy, Cluj-Napoca, Romania, Department of Bromatology, Hygiene, Nutrition, 23 Gheorghe Marinescu Street, Cluj-Napoca, Romania

E-mail: [lorenafilip@yahoo.com](mailto:lorenafilip@yahoo.com)

Corresponding author: Lorena Filip; e-mail: [lorenafilip@yahoo.com](mailto:lorenafilip@yahoo.com)

<https://doi.org/10.26659/pm3.2018.19.3.181>

---

Copyright © 2010 by “Iuliu Hațieganu” University of Medicine and Pharmacy Publishing

## Introduction

Worldwide, colorectal cancer (CRC) is the third most diagnosed type of cancer among men and the second most frequently diagnosed cancer in women. Incidence is higher in more industrialized countries and trends are on the rise in Asia and Eastern Europe, especially in regions marked by a recent transition to a Western lifestyle. As for mortality, rates have decreased in most developed countries due to efficient screening and improved treatment (Ferlay et al., 2014); (1). However, in Eastern European countries, including Romania, mortality rates continue to grow and may reflect diagnosis in advanced stages and poorer response to treatment (2).

The etiology of CRC is multifactorial, including both hereditary conditions and lifestyle factors (Gryfe, 2009; Yamagishi et al., 2016); (3). There is strong evidence that consuming whole grains, foods containing dietary fiber and dairy products decreases the risk of colorectal cancer. Likewise, maintaining a healthy weight and being physically active is equally important. In addition, high intake of red and processed meat and drinking more than two alcoholic beverages per day was associated with increased risk (Schwingshackl et al., 2018; Tantamango et al., 2011); (3). Furthermore, these lifestyle factors are relevant even after a diagnosis of colorectal cancer and are associated with an improved quality of life and a reduced risk of recurrence or mortality (Van Blarigan et al., 2018; Van Vulpen et al., 2016; Lee et al., 2018a).

Physical activity as defined by the World Health Organization (WHO) refers to “any bodily movement produced by skeletal muscles that requires energy expenditure” (4). Regular physical activity in healthy individuals has highly recognized health benefits. Also, in the most recent paper by the World Cancer Research Fund, the panel of experts concluded that there is convincing evidence that physical activity of all types (occupational, household, transport and recreational) is associated with reduced risk of colon cancer. However, no conclusion was drawn for rectal cancer (3). Additionally, recent research points out that cancer patients and survivors who engage in regular physical activity experience an improved quality of life, have fewer chances of recurrence or onset of comorbidities, as well as reduced treatment-related side effects (Detroye et al., 2018; Van Vulpen et al., 2016). Several biological mechanisms have been postulated to support such beneficial outcomes, including changes in body composition, decreased insulin levels and insulin resistance and epigenetic modifications (Friedenreich et al., 2017; Schoenberg, 2016; Hughes et al., 2017). In this review, we present the most relevant biological mechanisms and pathways in relation to physical activity and colorectal cancer. We also highlight the importance of regular physical activity for prevention of colorectal carcinogenesis as well as for improved outcomes after diagnosis.

### The mechanism of physical activity in colorectal cancer

CRC is a complex disease characterized by the accumulation of several genetic and epigenetic changes

in epithelial cells that transform the normal colonic mucosa into adenocarcinoma (Hanahan & Weinberg, 2011; Yamagishi et al., 2016). It is widely acknowledged that genetic heritage is an important determinant of CRC risk. However, the majority of colorectal cancers occur sporadically as a result of epigenetic events mainly derived from exposure to environmental and lifestyle risk factors (Yamagishi et al., 2016; Fearon, 2011). The well-known lifestyle factors associated with colorectal cancer development include an unbalanced diet, smoking, alcohol intake, physical inactivity and being overweight or obese. Diet-related risk factors such as frequent consumption of red and processed meat, cooking meat at high temperature, as well as low intake of fruits, vegetables and whole grains have been associated with colorectal carcinogenesis, while a healthy diet reflected by a Mediterranean dietary pattern can protect from developing colorectal cancer (3). The most common strategies for prevention aim to change dietary habits. Likewise, physical activity represents an important modifiable lifestyle factor with reported benefits in primary prevention of colorectal cancer, as well as in improving prognosis and quality of life in cancer survivors (Van Vulpen et al., 2016; Lee et al., 2018a).

There are several proposed mechanisms by which physical activity can prevent colorectal cancer or improve the prognosis and quality of life of diagnosed patients. These mechanisms are not fully elucidated, although research advances over the past few years have generated useful insights. One proposed mechanism is related to counteracting obesity and the downstream cascade of negative effects. Obesity arises as a consequence of unhealthy eating habits and sedentary behavior, leading to a chronic state of positive energy balance. Excessive body fat mass favors high levels of insulin and insulin resistance, which promote cell growth and inhibit apoptosis, these being major risk factors of colorectal carcinogenesis (Tsugane & Inoue, 2010). Sustained physical activity can reduce body fat mass and therefore insulin levels and insulin resistance (Schoenberg, 2016; Friedenreich et al., 2017). Obese patients develop a chronic condition characterized by low-grade inflammation which promotes carcinogenesis through biologic activity of pro-inflammatory mediators such as cyclooxygenase-2 (COX-2) and prostaglandin E2 (PGE2) (Schoenberg, 2016; Pohl et al., 2018; Shawki et al., 2018). In animal studies, exercise training had impressive anti-proliferative and anti-inflammatory effects in the colon mucosa, suggesting that this mechanism may be a valid explanation of how physical activity prevents colorectal cancer (Demarzo et al., 2008). Furthermore, a group of researchers analyzed COX-2 and PGE2 status in 605 human colorectal cancer tissue samples using the molecular database from two prospective cohort studies and showed that post-diagnosis physical activity was associated with better survival only among COX-2 positive patients (Yamauchi et al., 2013). Although physical activity is beneficial for both the prevention and the improvement of prognosis, their findings support the new approach of personalized lifestyle recommendations after a diagnosis of CRC.

Another physiological pathway illustrating the beneficial effects of physical activity is related to

exercise-responsive gene expression. Enhanced nutrient metabolism in skeletal muscle influences key proteins and metabolic enzymes which are responsible for the activation and/or the inhibition of different signaling pathways that regulate transcription and translation (Booth et al., 2002; Hughes et al., 2017). A gene expression study reported low levels of vascular endothelial growth factor, angiopoietin-2 and calcium-independent phospholipase A2 in the colon of exercising rats, suggesting that physical activity can influence markers of metastasis (Buehlmeier et al., 2008). However, few studies assessed the interaction between physical activity and gene expression in CRC among humans. One example is illustrated by a recent Korean case-control study which identified a correlation between regular physical activity, CRC risk and PITX1 polymorphism. The authors showed that subjects with the PITX1 rs647161 polymorphism are at high risk of CRC if they do not exercise regularly (Gunathilake et al., 2018).

Physical activity can modify DNA methylation patterns. In the colon of exercising rats, physical activity leads to down-regulation of the BHMT2 gene, known to be involved in aberrant methylation (Buehlmeier et al., 2008). However, data from human studies are limited due to the inherent complexity of this type of investigations and, to our knowledge, there is no human study evaluating the effects of physical activity on DNA methylation in colon tissue. Nevertheless, in two observational studies, physical activity was correlated with enhanced methylation in peripheral blood (Luttrupp et al., 2013; White et al., 2013); also, an intervention study showed that physical activity modulates DNA methylation in adipose tissue (Rönn et al., 2013). Furthermore, in an observational study, patients diagnosed with gastric adenocarcinoma practicing higher levels of physical activity presented less frequent CACNA2D3 methylation (Yuasa et al., 2009).

A growing body of evidence indicates that the enhanced levels of myokines generated in response to physical exercise can explain in part its positive effects. Myokines are proteins secreted by skeletal muscle cells, having multiple health benefits including metabolic improvement and anti-inflammatory effects in organs, in a paracrine, endocrine and autocrine manner. Aoi et al. showed that regular exercise prevents the onset of colon cancer in mouse models by inhibiting the formation of precursor lesions. Furthermore, the same authors discovered a novel myokine named secreted protein acidic and rich in cysteine (SPARC) secreted in both humans and mice that contributes to the prevention of colon tumorigenesis. Using an azoxymethane colon cancer mouse model, they demonstrated that in wild-type mice, regular low-intensity exercise reduced the formation of aberrant crypt foci and enhanced apoptosis in the colon mucosa. These antitumorigenic effects were not observed in SPARC-null mice (Aoi et al., 2013). Surprisingly, these results could not be replicated by a small clinical trial (10 participants) in humans (Songsorn et al., 2017). Other interrelated cancer-physical activity mechanisms include: DNA damage caused by oxidative stress and an impaired immune function (Friedenreich et al., 2017; Schoenberg, 2016).

## Physical activity in colorectal cancer prevention

Convincing evidence shows that there is an inverse association between the risk of developing colon cancer and physical activity, whereas the relationship with rectal cancer is still elusive (3). Several studies of different designs and characterization (diverse population, BMI, various levels of physical activity, etc.) suggested that the relationship is unlikely due to confounding bias and concluded that regular physical activity is protective against both proximal and distal colon cancer.

In a meta-analysis using data prior to 2000, WHO highlighted that physical inactivity may account for 16% of the global colon cancer burden (Bull et al., 2004). Since then, a more recent meta-analysis including 52 cohort and observational studies showed that regular physical activity reduces overall risk of colon cancer by 24% in both men and women (Wolin et al., 2009). In addition, in a cohort of older adults (which due to age are at risk of developing colorectal cancer), recreational physical activity was inversely associated with the risk of colon cancer in a dose-response relationship. Some authors showed that 4–6 hours of weekly physical activity may reduce both colon and rectal cancer by 13% and 30%, respectively. Still, for colon cancer the beneficial effect was higher with increased hours of physical activity per week. Moreover, the beneficial outcome was present even if the subjects started physical activity later in life (Chao et al., 2004).

Strategies for counteracting the burden of CRC are highly desired and besides improving physical activity, other modifiable lifestyle factors can be targeted. Aleksandrova et al. (2014) developed a lifestyle index combining different factors such as: healthy weight, non-smoking, physical activity, a healthy diet and limited alcohol consumption. They demonstrated that the joint effects of multiple lifestyle factors provide better outcome in terms of prevention. Using the European Prospective Investigation into Cancer and Nutrition cohort database, they showed that participants complying with all five healthy lifestyle factors had a 37% lower risk of developing CRC compared to those with none of the healthy factors, whereas adhering to only one lifestyle factor (e.g. physical activity) decreased the risk by only 13%.

Contrary to the high amount of available data demonstrating the pivotal role of physical activity in colon cancer prevention, for rectal cancer the evidence generated conflicting results. There is a recent meta-analysis suggesting a protective effect of physical activity against rectal carcinogenesis (Moore et al., 2016). In addition, in a cohort of male workers, light and moderate/heavy occupational activity reduced the risk of rectal cancer (RR=0.71; CI: 0.36-1.37), while no association was found for leisure activity (Colbert et al., 2001). In line with the previous studies, Slattery et al. showed that vigorous physical activity was associated with a reduced risk of rectal cancer in both men (OR=0.6; 95%CI: 0.44-0.81) and women (OR=0.95; 95%CI: 0.40-0.86); also, participants engaged in vigorous activity over the past 20 years benefit from enhanced protection (Slattery et al., 2003). However, these positive results were not reported unanimously in the literature (Odegaard et al., 2013; Steindorf et al.,

2005). This controversy warrants future research and might elucidate different carcinogenic and/or protective mechanisms in the exercise-colorectal cancer interplay.

### Physical activity after diagnosis of colorectal cancer

Conventional treatment of colorectal cancer includes surgery, chemotherapy and in some cases radiation. Typical side effects such as anemia, nausea, vomiting, leukopenia and diarrhea, as well as cancer-related fatigue, weakness and frequently depression, worsen the quality of life and usually impair the patients' physical capabilities, leading to increased inactivity (Schoenberg, 2016). Recommendations regarding the type of physical activity after diagnosis of cancer include aerobic, resistance and flexibility exercise for a duration that suits the unique needs of the individual. Also, patients are advised to maintain intensity and to exercise as often as able (Detroye et al., 2018). Research done so far supports physical activity during adjuvant therapy and highlights its favorable outcome in improving the quality of life, prognosis, and in counteracting the side effects of oncologic treatment.

A randomized control trial (RCT) investigated the short and long-term effect of a supervised exercise program on fatigue, physical fitness and quality of life among colorectal cancer patients (Van Vulpen et al., 2016). Patients diagnosed with colon cancer and undergoing chemotherapy were assigned to either a usual care group, being instructed to maintain their habitual physical activity pattern, or to an interventional group receiving a supervised exercise program, individualized to the patients' preferences and fitness level. Participants in the intervention group reported significantly less physical fatigue and higher physical function compared with patients in the usual care group. The authors concluded that a supervised exercise program for colon cancer patients undergoing chemotherapy is feasible, safe, may improve quality of life and has short and long-term beneficial effects.

A more recent RCT investigated the efficacy and feasibility of a 6-week home-based, unsupervised program for colorectal cancer survivors. The program aimed to increase the physical activity level to 18 MET (metabolic equivalent task) hours per week. The authors reported that 73.5% of patients in the intervention group achieved the exercise goal, while the program significantly increased physical activity levels and improved physical fitness overall (Lee et al., 2018b). In addition, Meyerhardt et al. reported that 18 MET-hours per week appears to reduce the risk of cancer recurrence and mortality in colorectal cancer patients (Meyerhardt et al., 2006b). Furthermore, an initial trial investigating the efficacy of an exercise program during neoadjuvant chemotherapy in rectal cancer patients reported no adverse events related to training. Although physical activity was well tolerated, minimal change in quality of life and cancer-related fatigue was observed (Singh et al., 2018).

Several studies investigated whether the effect of post-diagnosis physical activity is related to pre-diagnosis levels. An observational prospective study including only female patients diagnosed with stage I to III colorectal

cancer reported that recreational physical activity after the cancer diagnosis may reduce cancer-specific and overall mortality. Surprisingly, patients who reported being less active before the diagnosis of cancer had better exercise-related outcomes after diagnosis, as compared to patients who used to be active before diagnosis (Meyerhardt et al., 2006a). Additionally, a more recent study evaluated the impact of recreational physical activity before and after the diagnosis of colorectal cancer on disease-specific and all-cause mortality. Pre-diagnosis physical activity levels of more than 18 MET-hours per week were associated with significantly lower colorectal-cancer specific mortality when compared with no pre-diagnosis recreational physical activity. However, the benefit in decreased mortality rates was also observed among formerly inactive patients if they reported the onset of physical activity after diagnosis (Kuiper et al., 2013).

There are studies suggesting that the beneficial effect of physical activity on prognosis is dose-dependent, even if obviously the duration of physical activities in cancer patients is limited. Previously, Meyerhardt et al. demonstrated that male patients exceeding 27 MET hours per week had a 50% better prognosis (Meyerhardt et al., 2009), while in another study, each additional post-diagnosis 10 MET hours per week (equivalent to 150 min/week of moderate physical activity) was associated with a 28% decrease in total mortality among colorectal cancer survivors (95%CI = 20-35%) (Schmid & Leitzmann, 2014). *In addition*, in a meta-analysis including 11 studies, higher levels of exercise were more beneficial *in terms of* survival compared to low levels (Wu et al., 2016).

### Conclusions

1. Colorectal cancer is preventable through a healthy diet, weight control and regular physical activity.
2. Physical activity is one of the most important modifiable lifestyle factors with highly protective effects against colon carcinogenesis.
3. Physical activity during oncologic treatment can improve the quality of life, acting on both physical function and fatigue.
4. Starting physical activity after colorectal cancer diagnosis can improve prognosis and reduce mortality regardless of pre-diagnostic levels.

### Conflicts of interest

There are no conflicts of interests

### References

- Aleksandrova K, Pischon T, Jenab M, Bueno-de-Mesquita HB, Fedirko V, Norat T, Romaguera D, Knüppel S, Boutron-Ruault MC, Borch KB, Rinaldi S, Romieu I, Kong J, Gunter MJ, Ward HA, Riboli E, Boeing H. Combined impact of healthy lifestyle factors on colorectal cancer: a large European cohort study. *BMC Med.* 2014;12(1):168. doi: 10.1186/s12916-014-0168-4.
- Aoi W, Naito Y, Takagi T, Tanimura Y, Takanami Y, Kawai Y, Sakuma K, Hang LP, Mizushima K, Hirai Y, Koyama R, Wada S, Higashi A, Kokura S, Ichikawa H, Yoshikawa T. A novel myokine, secreted protein acidic and rich in cysteine (SPARC), suppresses colon tumorigenesis via

- regular exercise. *Gut*. 2013;62(6):882-889. doi: 10.1136/gutjnl-2011-300776.
- Booth FW, Chakravarthy MV, Spangenburg EE. Exercise and gene expression: physiological regulation of the human genome through physical activity. *J Physiol*. 2002;543(Pt 2):399-411.
- Buehlmeier K, Doering F, Daniel H, Kindermann B, Schulz T, Michna H. Alteration of gene expression in rat colon mucosa after exercise. *Ann Anat*. 2008;190(1):71-80. doi: 10.1016/j.aanat.2007.04.002.
- Bull FC, Armstrong TP, Dixon T, Ham S, Neiman A, Pratt M. Physical inactivity. In *Comparative Quantification of Health Risks: Global and Regional Burden of Disease Attributable to Select Major Risk Factors, Vol. 1*. World Health Organization, Geneva. Ed. Ezzati M, Lopez AD, Rodgers A, Murray CJL. 2004, 729.
- Chao A, Connell CJ, Jacobs EJ, McCullough ML, Patel A V, Calle EE, Cokkinides VE, Thun MJ. Amount, type, and timing of recreational physical activity in relation to colon and rectal cancer in older adults: the Cancer Prevention Study II Nutrition Cohort. *Cancer Epidemiol Biomarkers Prev*. 2004;13(12):2187-2195.
- Colbert LH, Hartman TJ, Malila N, Limburg PJ, Pietinen P, Virtamo J, Taylor PR, Albanes D. Physical activity in relation to cancer of the colon and rectum in a cohort of male smokers. *Cancer Epidemiol Biomarkers Prev*. 2001;10(3):265-268.
- Demarzo MM, Martins LV, Fernandes CR, Herrero FA, Perez SEA, Turatti A, Garrica SB. Exercise Reduces Inflammation and Cell Proliferation in Rat Colon Carcinogenesis. *Med Sci Sport Exerc*. 2008;40(4):618-621. doi: 10.1249/MSS.0b013e318163274d.
- Detroye A, Christner M, Eganhouse D, Manning B, Sunkin E, Gregory T. The effects of physical activity on survival in patients with colorectal cancer. *JAAPA*. 2018;31(2):21-25. doi: 10.1097/01.JAA.0000529767.60402.00.
- Fearon ER. Molecular Genetics of Colorectal Cancer. *Annu Rev Pathol Mech Dis*. 2011;6(1):479-507. doi: 10.1146/annurev-pathol-011110-130235.
- Ferlay J, Soerjomataram I, Dikshit R, Eser S, Mathers C, Rebelo M, Parkin DM, Forman DD, Bray F. Cancer incidence and mortality worldwide: sources, methods and major patterns in GLOBOCAN 2012. *Int J Cancer*. 2014;136(5):E359-86. doi: 10.1002/ijc.29210.
- Friedenreich CM, Shaw E, Neilson HK, Brenner DR. Epidemiology and biology of physical activity and cancer recurrence. *J Mol Med*. 2017;95(10):1029-1041. doi: 10.1007/s00109-017-1558-9.
- Gryfe R. Inherited colorectal cancer syndromes. *Clin Colon Rectal Surg*. 2009;22(4):198-208. doi: 10.1055/s-0029-1242459.
- Gunathilake MN, Lee J, Cho YA, Oh JH, Chang HJ, Sohn DK, Shin A, Kim J. Interaction between physical activity, PITX1 rs647161 genetic polymorphism and colorectal cancer risk in a Korean population: a case-control study. *Oncotarget*. 2018;9(7):7590-7603. doi: 10.18632/oncotarget.24136.
- Hanahan D, Weinberg RA. Hallmarks of cancer: the next generation. *Cell*. 2011;144(5):646-674. doi: 10.1016/j.cell.2011.02.013.
- Hughes LAE, Simons CCJM, van den Brandt PA, van Engeland M, Weijenberg MP. Lifestyle, Diet, and Colorectal Cancer Risk According to (Epi)genetic Instability: Current Evidence and Future Directions of Molecular Pathological Epidemiology. *Curr Colorectal Cancer Rep*. 2017;13(6):455-469. doi: 10.1007/s11888-017-0395-0.
- Kuiper JG, Phipps AI, Neuhaus ML, Chlebowski RT, Thomson CA, Irwin ML, Lane, Dorothy S, Wactawski-Wende J, Jackson RD, Kampman E, Newcomb PA. Recreational physical activity, body mass index, and survival in women with colorectal cancer. *Cancer Causes Control*. 2013;23(12):1939-1948. doi: 10.1007/s10552-012-0071-2.
- Lee CF, Ho JWC, Fong DYT, MacFarlane DJ, Cerin E, Lee AM, Leung S, Chan WYY, Leung IPF, Lam SHS, Chu N, Taylor AJ, Cheng KK. Dietary and Physical Activity Interventions for Colorectal Cancer Survivors: A Randomized Controlled Trial. *Sci Rep*. 2018a;8(1):5731. doi: 10.1038/s41598-018-24042-6.
- Lee MK, Kim NK, Jeon JY. Effect of the 6-week home-based exercise program on physical activity level and physical fitness in colorectal cancer survivors: A randomized controlled pilot study. *PLoS One*. 2018b;13(4): e0196220.
- Luttropp K, Nordfors L, Ekström TJ, Lind L. Physical activity is associated with decreased global DNA methylation in Swedish older individuals. *Scand J Clin Lab Invest*. 2013;73(2):184-185. doi: 10.3109/00365513.2012.743166.
- Meyerhardt JA, Giovannucci EL, Holmes MD, Chan AT, Chan JA, Colditz GA, Fuchs CS. Physical Activity and Survival after Colorectal Cancer Diagnosis. *J Clin Oncol*. 2006a;24(22):3527-3534.
- Meyerhardt JA, Giovannucci EL, Ogino S, Kirkner GJ, Chan AT, Willett W, Fuchs CS. Physical Activity and Male Colorectal Cancer Survival. *Arch Intern Med*. 2009;169(22):2102-2108. doi: 10.1001/archinternmed.2009.412.
- Meyerhardt JA, Heseltine D, Niedzwiecki D, Hollis D, Saltz LB, Mayer RJ, Thomas J, Nelson H, Whittom R, Hantel A, Schilsky RL, Fuchs CS. Impact of Physical Activity on Cancer Recurrence and Survival in Patients With Stage III Colon Cancer: Findings From CALGB 89803. *J Clin Oncol*. 2006b;24(22):3535-3541.
- Moore SC, Lee I-M, Weiderpass E, Campbell PT, Sampson JN, Kitahara CM, Keadle, Sarah K, Arem H, Berrington de Gonzalez A, Hartge P, Adami HO, Blair CK, Borch KB, Boyd E, Check DP, Fournier A, Freedman ND, Gunter M, Johansson M, Khaw KT, Linet MS, Orsini N, Park Y, Riboli E, Robien K, Schairer C, Sesso H, Spriggs M, Van Dusen R, Wolk A, Matthews CE, Patel AV. Association of Leisure-Time Physical Activity with Risk of 26 Types of Cancer in 1.44 Million Adults. *JAMA Intern Med*. 2016;176(6):816-825. doi: 10.1001/jamainternmed.2016.1548.
- Odegaard AO, Koh W-P, Yuan J-M. Combined Lifestyle Factors and Risk of Incident Colorectal Cancer in a Chinese Population. *Cancer Prev Res*. 2013;6(4):360-367. doi: 10.1158/1940-6207.CAPR-12-0384.
- Pohl C, Hombach A, Kruis W. Chronic inflammatory bowel disease and cancer. *Hepatogastroenterology*. 2018;47(31):57-70.
- Rönn T, Volkov P, Davegårdh C, Dayeh T, Hall E, Olsson AH, Nilsson E, Tornberg A, Dekker Nitert M, Eriksson KF, Jones HA, Groop L, Ling C. A Six Months Exercise Intervention Influences the Genome-wide DNA Methylation Pattern in Human Adipose Tissue. *PLoS Genet*. 2013;9(6):e1003572. doi: 10.1371/journal.pgen.1003572.
- Schmid D, Leitzmann MF. Association between physical activity and mortality among breast cancer and colorectal cancer survivors: a systematic review and meta-analysis. *Ann Oncol*. 2014;25(7):1293-1311. doi: 10.1093/annonc/mdu012.
- Schoenberg MH. Physical activity and nutrition in primary and tertiary prevention of colorectal cancer. *Visc Med*. 2016;32(3):199-204. doi: 10.1159/000446492.
- Schwingshackl L, Schwedhelm C, Hoffmann G, Knüppel S, Laure Preterre A, Iqbal K, Bechthold A, De Henauw S, Michels N, Devleeschauwer B, Boeing H, Schlesinger S. Food groups and risk of colorectal cancer. *Int J Cancer*. 2018;142(9):1748-1758. doi: 10.1002/ijc.31198.
- Shawki S, Ashburn J, Signs SA, Huang E. Colon Cancer:

- Inflammation-Associated Cancer. *Surg Oncol Clin N Am*. 2018;27(2):269-287. doi: 10.1016/j.soc.2017.11.003.
- Singh F, Galvão DA, Newton RU, Spry NA, Baker MK, Taaffe DR. Feasibility and Preliminary Efficacy of a 10-Week Resistance and Aerobic Exercise Intervention during Neoadjuvant Chemoradiation Treatment in Rectal Cancer Patients. *Integr Cancer Ther*. 2018;1-8. doi: 10.1177/1534735418781736.
- Slattery ML, Edwards S, Curtin K, Ma K, Edwards R, Holubkov R, Schaffer D. Physical activity and colorectal cancer. *Am J Epidemiol*. 2003;158(3):214-224.
- Songsorn P, Ruffino J, Vollaard NBJ. No effect of acute and chronic supramaximal exercise on circulating levels of the myokine SPARC. *Eur J Sport Sci*. 2017;17(4):447-452. doi: 10.1080/17461391.2016.1266392.
- Steindorf K, Jedrychowski W, Schmidt M, Popiela T, Penar A, Galas A, Wahrendorf J. Case-control study of lifetime occupational and recreational physical activity and risks of colon and rectal cancer. *Eur J Cancer Prev*. 2005;14(4):363-371.
- Tantamango YM, Knutsen SF, Beeson WL, Fraser G, Sabate J. Foods and food groups associated with the incidence of colorectal polyps: The adventist health study. *Nutr Cancer*. 2011;63(4):565-572. doi: 10.1080/01635581.2011.551988.
- Tsugane S, Inoue M. Insulin resistance and cancer: Epidemiological evidence. *Cancer Sci*. 2010;101(5):1073-1079. doi: 10.1111/j.1349-7006.2010.01521.x.
- Van Blarigan EL, Fuchs CS, Niedzwiecki D, Zhang S, Saltz LB, Mayer RJ, Mowat RB, Whittom R, Hantel A, Benson AI, Atienza D, Messino M, Kindler H, Venook A, Ogino S, Giovannucci EL, Ng K, Meyerhardt JA. Association of Survival with Adherence to the American Cancer Society Nutrition and Physical Activity Guidelines for Cancer Survivors after Colon Cancer Diagnosis. : The CALGB 89803/Alliance Trial. *JAMA Oncol*. 2018; 4(6):783-790. doi: 10.1001/jamaoncol.2018.0126.
- Van Vulpen JK, Velthuis MJ, Steins Bisschop CN, Travier N, Van den Buijs BMJ, Backx FJG, Los M, Erdkamp FIG, Bloemendal HJ, Koopman M, De Roos MAJ, Verhaar MJ, Ten Bokkel-Huinink D, Van der Wall E, Peeters PHM, May AM. Effects of an Exercise Program in Colon Cancer Patients Undergoing Chemotherapy. *Med Sci Sport Exerc*. 2016;48(5):767-775. doi: 10.1249/MSS.0000000000000855.
- White AJ, Sandler DP, Bolick SCE, Xu Z, Taylor JA, DeRoo LA. Recreational and household physical activity at different time points and DNA global methylation. *Eur J Cancer*. 2013;49(9):2199-2206. doi: 10.1016/j.ejca.2013.02.013.
- Wolin KY, Yan Y, Colditz GA, Lee IM. Physical activity and colon cancer prevention: a meta-analysis. *Br J Cancer*. 2009;100(4):611-616. doi: 10.1038/sj.bjc.6604917.
- Wu W, Guo F, Ye J, Li Y, Shi D, Fang D, Guo J, Li L. Pre- and post-diagnosis physical activity is associated with survival benefits of colorectal cancer patients: a systematic review and meta-analysis. *Oncotarget*. 2016;7(32):52095-52103. doi: 10.18632/oncotarget.10603.
- Yamagishi H, Kuroda H, Imai Y, Hiraishi H. Molecular pathogenesis of sporadic colorectal cancers. *Chin J Cancer*. *BioMed Central*. 2016;35:4. doi: 10.1186/s40880-015-0066-y.
- Yamauchi M, Lochhead P, Imamura Y, Kuchiba A, Liao X, Qian ZR, Nishihara R, Morikawa T, Shima K, Wu K, Giovannucci E, Meyerhardt JA, Fuchs CS, Chan AT, Ogino S. Physical Activity, Tumor PTGS2 Expression, and Survival in Patients with Colorectal Cancer. *Cancer Epidemiol Biomarkers Prev*. 2013;22(6):1142-1152. doi: 10.1158/1055-9965.EPI-13-0108.
- Yuasa Y, Nagasaki H, Akiyama Y, Hashimoto Y, Takizawa T, Kojima K, Kawano T, Sugihara K, Imai K, Nakachi K. DNA methylation status is inversely correlated with green tea intake and physical activity in gastric cancer patients. *Int J Cancer*. 2009;124(11):2677-2682.

#### Websites

- (1) American Cancer Society, Global Cancer Facts & Figures, 3rd Edition, 2015. Available at: <https://www.cancer.org/content/dam/cancer-org/research/cancer-facts-and-statistics/global-cancer-facts-and-figures/global-cancer-facts-and-figures-3rd-edition.pdf>. Accessed online: 2018, June.
- (2) Cancer report in north-western region of Romania. 2014. Available from: <http://www.iocn.ro/Centrul-de-prevenire-si-control-al-cancerului/Registru-regional-de-cancer/Cancerul-in-regiunea-de-NordVest-a-Romaniei-in-anul-2014.html>. Accessed online: 2018, June.
- (3) World Cancer Research Fund International/American Institute for Cancer Research. Continuous Update Project Report: Diet, Nutrition, Physical Activity and Colorectal Cancer. 2017. Available at: [wcrf.org/colorectal-cancer-2017](http://wcrf.org/colorectal-cancer-2017). Accessed online: 2018, June.
- (4) World Health Organization. Physical Activity. 2014. Available at: <http://www.who.int/dietphysicalactivity/pa/en/>. Accessed online: 2018, June.

## RECENT PUBLICATIONS

### Book reviews

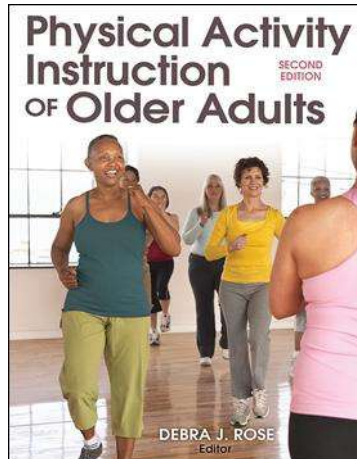
**Physical activity instruction of older adults. 2nd edition.**

(Instruirea adulților vârstnici în activitatea fizică)

Editor: *Debra J. Rose*

Human Kinetics, August 8<sup>th</sup>, 2018

432 pages; price: £ 89.99 (paper)/67.49 (pdf)



Less than 15 years have passed from the first edition of this special book, and we already have a second edition. Meantime, the prevalence of the old population has continuously increased, whereas its appetite for exercise has alarmingly collapsed, generating an increasingly urgent need for individuals to take a greater level of responsibility for their health and well-being. In other words, the need to attract old people to physical activity and to involve them in it has become a real global social problem, circumstances under which any book that may help fitness professionals in designing and implementing effective, safe, and fun physical activity programs for every older adult may only be considered welcomed.

As expected, the new edition comes with an updated review of the research and literature in the field, but at the same time it offers a new chapter - Chapter 9 - dedicated to the strategies enabling to integrate the six dimensions (physical, emotional, intellectual, vocational, spiritual, and social) of the whole-person wellness concept into the programs for older adults. The core sequence of this chapter demonstrates that the whole-person wellness and successful aging represent a winning combination. In fact, the entire text of the book is based on the *International Curriculum Guidelines for Preparing Physical Activity Instructors of Older Adults* and addresses within its 18 chapters all the nine training modules in accordance with the respective guidelines.

Part I has four chapters and starts speaking about the field of gerokinesiology, a new specialized area of study

that focuses on professional training and research in physical activity and aging. The next chapter (*Predictors of successful aging*) presents not only the biological but also the psychological and sociological theories of aging, and concludes that nowadays we can even speak about models of successful aging, within which physical activity can be considered one of the most important determinants. Psychological and sociocultural aspects of physical activity for older adults represent the substance of Chapter 3, whereas the physiological aspects of aging are developed in Chapter 4.

The next group of three chapters offers the readers the most essential and topical information about the pre-exercise health screenings and assessments of the subjects, and also about how clients are assisted in developing short- and long-term behavioral goals. In this respect, Chapter 7 pays special attention to both the theoretical frameworks for behavioral change and particular factors that influence older adults' exercise participation.

From a practical point of view, part III, entitled "*Core program principles and training methods*", represents the key sequence of the book. It is composed of seven chapters and, as expected, begins by drawing attention to the most important aspects (and especially to the great heterogeneity of older adults) to be taken into consideration when designing exercise programs for this particular segment of population (Chapter 8). Then, it continues by teaching us how to manage warm-up and cool-down (Chapter 10), flexibility (11), resistance (12), aerobic (13), and balance and mobility (14) training sessions.

The first chapter of the last part speaks to the readers about how the nervous and musculoskeletal systems change with age and how the respective modifications influence the motor learning process, whereas the next chapter teaches them how to develop leadership skills and style, as well as instructional methods, techniques and strategies. Considering that frequently older adult age comes with some medical conditions, the penultimate chapter provides physical activity professionals with the most topical information on exercise prescription in patients with cardiovascular, pulmonary, metabolic, etc., disorders. The book ends with aspects regarding "legal standards, risk management and professional ethics" that have to govern the physical activity instructor profession.

With this new edition, Debra J. Rose and her collaborators offer students and fitness professionals not only a comprehensive updated text, but also several other features (photos, figures, tables, study questions, etc.) that will certainly enhance the readers' understanding and learning retention.

**Gheorghe Dumitru**  
gdumitru@seanet.ro

<https://doi.org/10.26659/pm3.2018.19.3.187>

## SCIENTIFIC MANIFESTATIONS



UMF  
UNIVERSITATEA DE  
MEDICINĂ ȘI FARMACIE  
IULIU HAȚIEGANU  
CLUJ-NAPOCA



Societatea Medicală Română  
de Educație Fizică și Sport



INSPECTORATUL ȘCOLAR  
JUDEȚEAN CLUJ

### The 4<sup>th</sup> National Conference of Medicine Applied to Physical Education and Sports, Higher Quality

A patra Conferință Națională de medicină aplicată la educația fizică și sport, calitate superioară

On 13-14 September 2018, through the courtesy of the Management of “Iuliu Hațieganu” University of Medicine and Pharmacy, some of the generous university amphitheatres hosted the 4<sup>th</sup> National Conference of Medicine Applied to Physical Education and Sports, according to the model created in 1937 by Prof. Dr. Iuliu Hațieganu.

The scientific meeting was organized by *The Romanian Medical Society of Physical Education and Sports* under the aegis of “Iuliu Hațieganu” University of Medicine and Pharmacy in Cluj-Napoca, with the purpose of achieving a high scientific level.

The Conference had two main objectives derived from Prof. Iuliu Hațieganu’s thinking:

- Bringing physical and sports activities closer to the medical field, in order to increase the role of medical criteria and principles in organizing school and university physical education.
- Increasing the role of physical and sports activities in health prevention.

Many papers were presented in the 6 sections of the Conference, lectures on topical subjects were given in

plenary by renowned teaching staff from all over the country, and 8 workshops were held on current themes of interest.

The scientific program of the Conference was intended to be interesting and complex, based on a multidisciplinary approach of the presentations, with high topicality and great impact on the fields of medicine, physical education, sport and related areas.

A fact that guaranteed the scientific value of the meeting was the extremely prestigious composition of the Scientific Committee, as well as the participation of the *Palestrica of the Third Millennium – Civilization and Sport* journal, a journal indexed in many international databases, in which the presented scientific papers can be published.

The meeting was accredited by the *Romanian College of Physicians*, the *Romanian College of Pharmacists* and the *Teaching-Staff Resource Center* for pre-university participants.

**Traian Bocu**

*traian\_bocu@yahoo.com*



Participants during the Conference



Discussions during the coffee break



The President of the Scientific Committee - Prof. Dr. Simona Tache; Invited lecturer - Prof. Dr. Nicolae Neagu – in the middle; the Vice-President of the Romanian Athletics Federation, Prof. Dr. Vasile Bogdan



Invited lecturer - Șerban Damian



Invited lecturer - Prof. Dr. Doina Cosman



Invited lecturer Maria Vrînceanu



Prof. Dr. Leon Gomboș, Dean of the Faculty of Physical Education and Sport of Babeș-Bolyai University Cluj-Napoca



The Conference Organizing Committee: Assoc. Prof. Dr. Mihai Kiss, Instructor PhD student Sergiu David, Assist. Prof. Dr. Ciprian Kollos, Assist. Prof. Dr. Cornelia Popovici

## EVENTS

### Evocation of Professor Dr. Iuliu Hațieganu in Dârja (3)

#### *Evocarea Profesorului Dr. Iuliu Hațieganu la Dârja (3)*

The purpose of the *Old Fair* in Dârja village - Panteicu, Cluj county is to give an impulse to the village life and to revive crafts, as well as to bring the young urban generations closer to the more experienced rural generations.

Recently, in an editorial entitled *Promoting regional brands in sports and sports medicine*, published in the *Palestrica of the Third Millennium - Civilization and Sport* journal, it was shown that in Cluj county and in the North-Western region of Romania, there are insufficient local or regional brands supporting the country brands from various fields of activity (Bocu, 2015). That editorial highlighted only 3 regional brands specific to Cluj county: *Gheorghe Moceanu*, *Iuliu Hațieganu* and *Ion Moina*.

A brand can be a name. A brand distinguishes itself through several types of positive significances conveyed: attributes, benefits, values, culture, personality, targeted consumer type (Armstrong & Kotler, 2006). Brands can be proposed as annual projects to be financed from European funds, by the County Council, in partnership with the County School Inspectorate, the County Authority for Sport and Youth and the County Public Health Authority. These projects must include several compulsory elements: an attractive title, the justification of the need to implement the project, the general and specific objectives of the project, activities to achieve the objectives, and the mention of the beneficiaries of the project.

The 3rd edition of the *Old Fair* in Dârja, organized on Saturday 18 August 2018, evoked the personality of Professor Iuliu Hațieganu.

Iuliu Hațieganu was born in Dârja village in 1885, in the family of a Greek-Catholic priest. He attended the Superior Gymnasium in Blaj, then the Faculty of Medicine of Cluj and Vienna Universities.

He advocated the creation of sports parks and recreation places, according to the principle of *a healthy mind in a healthy body*. In fact, when he was appointed a State Secretary Minister in the Ministry of Labor, Health and Social Protection in the Iorga government (29 April - 14 July 1931), he resigned after his proposal to create a Physical Education department was rejected (Dr. Ion Cantacuzino was minister during that period). He also wished, through the *Medical Society of Physical Education and Sport* created by him in 1930, to reorganize physical education based on medical principles and criteria (Marin, 1999; Bârsu, 2014). Iuliu Hațieganu supported mass sport practice by youth, an idea expressed in relation to the sports park built by him: *This is not a stadium where 22 people do sport and 22,000 watch them, but he wants to reverse these figures so that 22,000 people do sport and 22 watch them* (Morariu & Almășan, 1969).

#### Bibliography

- Armstrong G, Kotler P. Marketing: An Introduction. Trade paperback. Prentice Hall, New Jersey, 2006.
- Bârsu C. Medico-historical aspects related to the foundation of the Medical Society of Physical Education from Bucharest. *Palestrica of the Third Millennium - Civilization and Sport*. 2014;15(2):152-157.
- Bocu T. Promoting regional brands in sports and sports medicine. *Palestrica of the Third Millennium - Civilization and Sport* 2015;16(3):205-206.
- Marin F. Iuliu Hațieganu. Ed. Med.Univ. Iuliu Hațieganu, Cluj-Napoca, 1999, 294.
- Morariu A, Almășan D. Iuliu Hațieganu și idea educației fizice în România. Ed. CNEFS București, 1969, 2.

Traian Bocu

[traian\\_bocu@yahoo.com](mailto:traian_bocu@yahoo.com)



The monument built in the old square of Dârja village, dedicated to the union of Transylvania with Romania in 1918



The tombstone of the Hațieganu family in the cemetery behind the church

<https://doi.org/10.26659/pm3.2018.19.3.190>

Copyright © 2010 by "Iuliu Hațieganu" University of Medicine and Pharmacy Publishing



The boys' folk dance group of the school in Panticeu



The girls' folk dance group of the school in Panticeu



A circle folk dance on the occasion of the same event



Playing a football match with teams formed on the spot



A moment of relaxation after the artistic program



## The annual meeting of veteran athletes of the „U” Cluj Club (24)

### Întâlnirea anuală a atleților veterani de la „U” Cluj (24)

On Saturday 1 September 2018, at 10:00 a.m., the 24<sup>th</sup> meeting of veteran athletes of the “U” Cluj Club took place. Like in the previous years, the meeting place was in front of the monument situated at the entrance to the athletics field, erected in memory of *Doctor Ioan Arnăut* and Prof. Ion Moina, a multiple national and Balkan champion in 100 and 200 m sprint.

Some of the celebrities present at the event were: Alexandra Taifas Sicoe, multiple national champion (27 titles), participant in the 1952 Helsinki Olympic Games, at

the venerable age of 86 years, Mircea Pop, Ilarie Măgdaș, Vasile Bogdan, Eva Zörgö, Ráduly Károly, Draga Comșa-Crișan.

The great absent this year was veteran Aurel Palade-Ursu, who did not participate in the meeting for objective reasons.

The next meeting will take place on 7 September 2019.

**Traian Bocu**

*traian\_bocu@yahoo.com*



The meeting place – the monument in memory of Dr. Ion Arnăut and Prof. Ion Moina



A group picture of participants in the annual meeting



A picture on the athletics track



In the middle - Alexandra Taifas Sicoe; left - Ilarie Măgdaș; right - Dumitru Oltean



Left - veteran Mircea Pop; middle - Gheorghe Monea; right - Mircea Alexei



Private discussions among female veteran athletes

## 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; psycho-neuroendocrinology 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, Obiective-Aims, Metode-Methods, Resultate-Results, Concluzii-Conclusions), in the Romanian language, of maximum 250 words, followed by 3-8 key words (if its possible from the list of established terms). All articles will have a summary in the English language. Within the summary (abstract) abbreviations, footnotes or bibliographic references should not be used.

*Premises and objectives.* Description of the importance of the study and explanation of premises and research objectives.

*Methods.* Include the following aspects of the study:

Description of the basic category of the study: of orientation and applicative.

Localization and the period of study. Description and size of groups, sex (gender), age and other socio-demographic variables should be given.

Methods and instruments of investigation that are used.

*Results.* The descriptive and inferential statistical data (with specification of the used statistical tests): the differences between the initial and the final measurement, for the investigated parameters, the significance of correlation coefficients are necessary. The specification of the level of significance (the value *p* or the dimension of effect *d*) and the type of the used statistical test etc are obligatory.

*Conclusions.* Conclusions that have a direct link with the presented study should be given.

Orientation articles and case studies should have an unstructured summary (without respecting the structure of experimental articles) to a limit of 150 words.

### 3. Text

Original articles should include the following chapters which will not be identical with the summary titles: Introduction (General considerations), Hypothesis, Materials and methods (including ethical and statistical informations), Results, Discussing results, Conclusions and suggestions. Other type of articles, as orientation articles, case studies, Editorials, do not have an obligatory format. Excessive abbreviations are not recommended. The first abbreviation in the text is represented first *in extenso*, having its abbreviation in parenthesis, and thereafter the short form should be used.

Authors must undertake the responsibility for the correctness of published materials.

### 4. Bibliography

The bibliography should include the following data:

For articles from journals or other periodical publications the international Vancouver Reference Style should be used: the name of all authors as initials and the surname, the year of publication, the title of the article in its original language, the title of the journal in its international abbreviation (italic characters), number of volume, pages.

*Articles:* Pop M, Albu VR, Vişan D et al. Probleme de pedagogie în sport. *Educație Fizică și Sport* 2000; 25(4):2-8.

*Books:* Drăgan I (coord.). *Medicina sportivă*, Editura Medicală, 2002, Bucureşti, 2002, 272-275.

*Chapters from books:* Hăulică I, Bălţatu O. Fiziologia senescenţei. In: Hăulică I. (sub red.) *Fiziologia umană*, Ed. Medicală, Bucureşti, 1996, 931-947.

Starting with issue 4/2010, every article should include a minimum of 15 bibliographic references and a maximum of 100, mostly journals articles published in the last 10 years. Only a limited number of references (1-3) older than 10 years will be allowed. At least 20% of the cited resources should be from recent international literature (not older than 10 years).

### Peer-review process

In the final stage all materials will be closely reviewed by at least two competent referees in the field (Professors, and Docent doctors) so as to correspond in content and form with the requirements of an international journal. After this stage, the materials will be sent to the journal's referees, according to their profiles. After receiving the observations from the referees, the editorial staff shall inform the authors of necessary corrections and the publishing requirements of the journal. This process (from receiving the article to transmitting the observations) should last about 4 weeks. The author will be informed if the article was accepted for publication or not. If it is accepted, the period of correction by the author will follow in order to correspond to the publishing requirements.

### **Conflict of interest**

The authors must mention all possible conflicts of interest including financial and other types. If you are sure that there is no conflict of interest we ask you to mention this. The financing sources should be mentioned in your work too.

### **Specifications**

The specifications must be made only linked to the people outside the study but which have had a substantial contribution, such as some statistical processing or review of the text in the English language. The authors have the responsibility to obtain the written permission from the mentioned persons with the name written within the respective chapter, in case the readers refer to the interpretation of results and conclusions of these persons. Also it should be specified if the article uses some partial results from certain projects or if these are based on master or doctoral theses sustained by the author.

### **Ethical criteria**

The Editors will notify authors in due time, whether their article is accepted or not or whether there is a need to modify texts. Also the Editors reserve the right to edit articles accordingly. Papers that have been printed or sent for publication to other journals will not be accepted. All authors should send a separate letter containing a written statement proposing the article for submission, pledging to observe the ethics of citation of sources used (bibliographic references, figures, tables, questionnaires).

For original papers, according to the requirements of the Helsinki Declaration, the Amsterdam Protocol, Directive 86/609/EEC, and the regulations of the Bioethical Committees from the locations where the studies were performed, the authors must provide the following:

- the informed consent of the family, for studies in children and juniors;
- the informed consent of adult subjects, patients and athletes, for their participation;
- malpractice insurance certificate for doctors, for studies in human subjects;
- certificate from the Bioethical Committees, for human study protocols;
- certificate from the Bioethical Committees, for animal study protocols.

The data will be mentioned in the paper, in the section Materials and Methods. The documents will be obtained before the beginning of the study. Will be mentioned also the registration number of the certificate from the Bioethical Committees.

Editorial submissions will be not returned to authors, whether published or not.

### **FOR THE ATTENTION OF THE SPONSORS**

Requests for advertising space should be sent to the Editors of the "Palestrica of the Third Millennium" journal, 1, Clinicilor St., 400006, Cluj-Napoca, Romania. The price of an A4 full colour page of advertising for 2012 will be EUR 250 and EUR 800 for an advert in all 4 issues. The costs of publication of a logo on the cover will be determined according to its size. Payment should be made to the Romanian Medical Society of Physical Education and Sports, CIF 26198743. Banca Transilvania, Cluj branch, IBAN: RO32 BTRL 0130 1205 S623 12XX (RON).

### **SUBSCRIPTION COSTS**

The "Palestrica of the Third Millennium" journal is printed quarterly. The subscription price is 100 EUR for institutions abroad and 50 EUR for individual subscribers outside Romania. For Romanian institutions, the subscription price is 120 RON, and for individual subscribers the price is 100 RON. Note that distribution fees are included in the postal costs.

Payment of subscriptions should be made by bank transfer to the Romanian Medical Society of Physical Education and Sports, CIF 26198743. Banca Transilvania, Cluj branch, IBAN: RO32 BTRL 0130 1205 S623 12XX (RON), RO07 BTRL 01,304,205 S623 12XX (EUR), RO56 BTRL 01,302,205 S623 12XX (USD). SWIFT: BTRLRO 22

Please note that in 2010 a tax for each article submitted was introduced. Consequently, all authors of articles will pay the sum of 150 RON to the Romanian Medical Society of Physical Education and Sport published above. Authors who have paid the subscription fee will be exempt from this tax. Other information can be obtained online at [www.pm3.ro](http://www.pm3.ro) "Instructions for Authors", at our e-mail address [palestrica@gmail.com](mailto: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 Hațieganu" 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 ATENȚIA COLABORATORILOR

### Tematica revistei

Ca tematică, revista are un caracter multidisciplinar orientat pe domeniile biomedical, sănătate, efort fizic, științe sociale, aplicate la activitățile de educație fizică și sport, astfel încât subiectele tratate și autorii aparțin mai multor specialități din aceste domenii. Principalele rubrici sunt: „Articole originale” și „Articole de sinteză”.

Exemplificăm rubrica „Articole de sinteză” prin temele importante expuse: stresul oxidativ în efortul fizic; antrenamentul mintal; psihoneuroendocrinologia efortului sportiv; cultura fizică în practica medicului de familie; sporturi extreme și riscuri; determinanți emoționali ai performanței; recuperarea pacienților cu suferințe ale coloanei vertebrale; sindroame de stres și psihosomatică; educația olimpică, aspecte juridice ale sportului; efortul fizic la vârstnici; tulburări ale psihomotricității; pregătirea sportivă la altitudine; fitness; biomecanica mișcărilor; testele EUROFIT și alte metode de evaluare a efortului fizic; reacții adverse ale eforturilor; endocrinologie sportivă; depresia la sportivi; dopajul clasic și genetic; Jocurile Olimpice etc.

Dintre articolele consacrate studiilor și cercetărilor experimentale notăm pe cele care vizează: metodică educației fizice și sportului; influența unor ioni asupra capacității de efort; profilul psihologic al studentului la educație fizică; metodică în gimnastica sportivă; selecția sportivilor de performanță.

Alte articole tratează teme particulare vizând diferite sporturi: înotul, gimnastica ritmică și artistică, handbalul, voleiul, baschetul, atletismul, schiul, fotbalul, tenisul de masă și câmp, luptele libere, sumo.

Autorii celor două rubrici de mai sus sunt medici, profesori și educatori din învățământul universitar și preuniversitar, antrenori, cercetători științifici etc.

Alte rubrici ale revistei sunt: editorialul, actualitățile editoriale, recenziile unor cărți - ultimele publicate în domeniu, la care se adaugă și altele prezentate mai rar (invenții și inovații, universitaria, preuniversitaria, forum, remember, calendar competițional, portrete, evenimente științifice).

Subliniem rubrica “Memoria ochiului fotografic”, unde se prezintă fotografii, unele foarte rare, ale sportivilor din trecut și prezent.

De menționat articolele semnate de autori din Republica Moldova privind organizarea învățământului sportiv, variabilitatea ritmului cardiac, etapele adaptării la efort, articole ale unor autori din Franța, Portugalia, Canada.

Scopul principal al revistei îl constituie valorificarea rezultatelor activităților de cercetare precum și informarea permanentă și actuală a specialiștilor din domeniile amintite. Revista își asumă și un rol important în îndeplinirea punctajelor necesare cadrelor didactice din învățământul universitar și preuniversitar precum și medicilor din rețeaua medicală (prin recunoașterea revistei de către Colegiul Medicilor din România), în avansarea didactică și profesională.

Un alt merit al revistei este publicarea obligatorie a cuprinsului și a câte unui rezumat în limba engleză, pentru toate articolele. Frecvent sunt publicate articole în extenso într-o limbă de circulație internațională (engleză, franceză).

Revista este publicată trimestrial iar lucrările sunt acceptate pentru publicare în limba română și engleză. Articolele vor fi redactate în format WORD (nu se acceptă articole în format PDF). Expedierea se face prin e-mail sau pe dischetă (sau CD-ROM) și listate, prin poștă pe adresa redacției. Lucrările colaboratorilor rezidenți în străinătate și ale autorilor români trebuie expediate pe adresa redacției:

### **Revista «Palestrica Mileniului III»**

Redactor șef: Prof. dr. Traian Bocu

Adresa de contact: palestrica@gmail.com sau traian\_bocu@yahoo.com

Adresa poștală: Str. Clinicilor nr.1 cod 400006, Cluj-Napoca, România

Telefon:0264-598575

Website: www.pm3.ro

### Obiective

Ne propunem ca revista să continue a fi o formă de valorificare a rezultatelor activității de cercetare a colaboratorilor săi, în special prin stimularea participării acestora la competiții de proiecte. Menționăm că articolele publicate în cadrul revistei sunt luate în considerare în procesul de promovare în cariera universitară (acreditare obținută în urma consultării Consiliului Național de Atestare a Titlurilor și Diplomelor Universitare).

Ne propunem de asemenea să încurajăm publicarea de studii și cercetări, care să cuprindă elemente originale relevante mai ales de către tineri. Toate articolele vor trebui să aducă un minimum de contribuție personală (teoretică sau practică), care să fie evidențiată în cadrul articolului.

În perspectivă ne propunem îndeplinirea criteriilor care să permită promovarea revistei la niveluri superioare cu recunoaștere internațională.

### STRUCTURA ȘI TRIMITEREA ARTICOLELOR

Manuscrisul trebuie pregătit în acord cu prevederile Comitetului Internațional al Editurilor Revistelor Medicale (<http://www.icmjee.org>).

Numărul cuvintelor pentru formatul electronic:

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

**Format pagină:** redactarea va fi realizată în format A4. Paginile listate ale articolului vor fi numerotate succesiv de la 1 până la pagina finală.

**Font:** Times New Roman, mărime 11 pt.; redactarea se va face pe pagina întreagă, cu diacritice, la două rânduri, respectând margini egale de 2 cm pe toate laturile.

#### **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 și 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 și mărimea loturilor, 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 măsurătoarea 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 directă 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:* Hăulică I, Bălțatu O. Fiziologia senescentei. În: Hăulică 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 interese**

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

fie menționate în lucrarea dumneavoastră.

### **Precizări**

Precizările trebuie făcute doar în legătură cu persoanele din afara studiului, care au avut o contribuție substanțială la studiul respectiv, cum ar fi anumite prelucrări statistice sau revizuirea textului în limba engleză. Autorii au responsabilitatea de a obține permisiunea scrisă din partea persoanelor menționate cu numele în cadrul acestui capitol, în caz că cititorii se referă la interpretarea rezultatelor și concluziilor acestor persoane. De asemenea, la acest capitol se vor face precizări în cazul în care articolul valorifică rezultate parțiale din anumite proiecte sau dacă acesta se bazează pe teze de masterat sau doctorat susținute de autor, alte precizări.

### **Criterii deontologice**

Redacția va răspunde în timp util autorilor privind acceptarea, neacceptarea sau necesitatea modificării textului și își rezervă dreptul de a opera modificări care vizează forma lucrărilor.

Nu se acceptă lucrări care au mai fost tipărite sau trimise spre publicare la alte reviste. Autorii vor trimite redacției odată cu articolul propus spre publicare, într-un fișier word separat, o declarație scrisă în acest sens, cu angajamentul respectării normelor deontologice referitoare la citarea surselor pentru materialele folosite (referințe bibliografice, figuri, tabele, chestionare).

Pentru articolele originale, în conformitate cu îndeplinirea condițiilor Declarației de la Helsinki, a Protocolului de la Amsterdam, a Directivei 86/609/EEC și a reglementărilor Comisiilor de Bioetică din locațiile unde s-au efectuat studiile, autorii trebuie să prezinte:

- acordul informat din partea familiei, pentru studiile pe copii și juniori;
- acordul informat din partea subiecților adulți, pacienți și sportivi, pentru participare;
- adeverință de Malpraxis pentru medici, pentru cercetările/studiile pe subiecți umani;
- adeverință din partea Comisiilor de Etică, pentru protocolul de studiu pe subiecți umani;
- adeverință din partea Comisiilor de Bioetică, pentru protocolul de studiu pe animale.

Datele vor fi menționate în articol la secțiunea Material și metodă. Documentele vor fi obținute înainte de începerea studiului. Se va menționa și numărul de înregistrare al adeverinței din partea Comisiilor de Etică.

Materialele trimise la redacție nu se restituie autorilor, indiferent dacă sunt publicate sau nu.

### **ÎN ATENȚIA SPONSORILOR**

Solicitările pentru spațiile de reclamă, vor fi adresate redacției revistei "Palestrica Mileniului III", Str. Clinicilor nr. 1, cod 400006 Cluj-Napoca, România. Prețul unei pagini de reclamă full color A4 pentru anul 2012 va fi de 250 EURO pentru o apariție și 800 EURO pentru 4 apariții. Costurile publicării unui Logo pe copertile revistei, vor fi stabilite în funcție de spațiul ocupat. Plata se va face în contul Societății Medicale Române de Educație Fizică și Sport, CIF 26198743. Banca Transilvania, sucursala Cluj Cod IBAN: RO32 BTRL 0130 1205 S623 12XX (LEI).

### **ÎN ATENȚIA ABONAȚILOR**

Revista "Palestrica Mileniului III" este tipărită trimestrial, prețul unui abonament fiind pentru străinătate de 100 Euro pentru instituții, și 50 Euro individual. Pentru intern, prețul unui abonament instituțional este de 120 lei, al unui abonament individual de 100 lei. Menționăm că taxele de difuzare poștală sunt incluse în costuri.

Plata abonamentelor se va face prin mandat poștal în contul Societății Medicale Române de Educație Fizică și Sport, CIF 26198743. Banca Transilvania, sucursala Cluj Cod IBAN: RO32 BTRL 0130 1205 S623 12XX (LEI); RO07 BTRL 01304205 S623 12XX (EURO); RO56 BTRL 01302205 S623 12XX (USD). SWIFT: BTRLRO 22

Precizăm că începând cu anul 2010 a fost introdusă taxa de articol. Ca urmare, toți autorii semnatari ai unui articol vor achita împreună suma de 150 Lei, în contul Societății Medicale Române de Educație Fizică și Sport publicat mai sus.

Autorii care au abonament vor fi scutiți de această taxă de articol.

Alte informații se pot obține online de pe [www.pm3.ro](http://www.pm3.ro) „Pentru autori” sau pe adresa de mail a redacției [palestrica@gmail.com](mailto:palestrica@gmail.com) sau pe adresa poștală: Str. Clinicilor nr.1 cod 400006, Cluj-Napoca, România, Telefon:0264-598575.

### **INDEXAREA**

Titlul revistei: Palestrica Mileniului III – Civilizație și sport

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

Profil: revistă de studii și cercetări interdisciplinare

Editor: Universitatea de Medicină și Farmacie „Iuliu Hațieganu” din Cluj-Napoca și Societatea Medicală Română de Educație Fizică și Sport, în colaborare cu Inspectoratul Școlar al Județului Cluj

Nivelul de atestare al revistei: revistă acreditată în categoria B+ de CNCS în perioadele 2007-2011 și atestată CMR din anul 2003 și în prezent

Revistă indexată în Bazele de Date Internaționale (BDI): EBSCO, Academic Search Complete, USA și Index Copernicus, Journals Master List, Polonia, DOAJ (Directory of Open Access Journals), Sweden

Anul primei apariții: 2000

Periodicitate: trimestrială

Cuprinsul, rezumatele și instrucțiunile pentru autori se găsesc pe pagina de Internet: <http://www.pm3.ro> Accesul la cuprins și articole în extenso (în format .pdf) este gratuit.