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1

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Editorial Office of the Journal

"Health, Sports & Rehabilitation Medicine"

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

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Contents

ORIGINAL STUDIES

Lifestyle and cardiovascular health: opinions and behaviors among adults having relatives with cardiovascular diseases <i>Lucia Maria Lotrean, Daniel Ursu, Mira Florea, Codruța Lencu</i>	4
Factors involved in the occurrence of body and head injuries among children of Cluj county practicing ball sports <i>Sorana Baci, Marius Manole, Alexandru Grecu, Anca Stefania Mesaroș</i>	9
Influence of <i>Lepidium meyenii</i> on stress induced by walking on a treadmill <i>Ramona Jurcău, Ioana Jurcău, Lucian-Daniel Rusu, Răzvan-Titus Pîrvan</i>	14
An opinion survey of doctors who attended a postgraduate course regarding spices and their use in sports <i>Ramona Jurcău, Ioana Jurcău, Cornelia Popovici</i>	21
Increased serum interleukin 6 in experimental periapical periodontitis associated with metabolic bone disease <i>Antonela Berar, Smaranda Buduru, Tudor Valentin Mîrza, Simona Iacob, Dragomir-Cosmin David, Luminita Matros, Mariana Constantiniuc</i>	28
Research regarding the development and evaluation of agility (balance, coordination and speed) in children aged 9-10 years <i>Dan Alexandru Szabo, Nicolae Neagu, Ioan Sabin Sopa</i>	33
The influence of attention in increasing sports performance in football at the age of 7-10 years <i>Gheorghe Dan Fetean, Gheorghe Monea, Marius Roșca</i>	41

REVIEWS

Biocrystallization test for early determination of oxidative stress <i>Cristina-Daniela Cîmpean, Mihai Berteanu</i>	45
Intermittent fasting in athletes: PROs and CONs <i>Valeria Laza</i>	52

RECENT PUBLICATIONS

Book reviews Rita Santos-Rocha (Editor). Exercise and sporting activity during pregnancy. Evidence-based guidelines <i>Gheorghe Dumitru</i>	59
---	----

EVENTS

In search of snow for the ski competitions in the mountain centers of Cluj county - 2020 <i>Laura Ionescu, Cristian Potoră</i>	61
--	----

PORTRAITS - Personalities of Romanian science and culture

Petru Derevenco - the man and his work <i>Călin Gabriel Șarlă, Daniela Ciobanu</i>	64
--	----

FOR THE ATTENTION OF CONTRIBUTORS

<i>The editors</i>	68
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ORIGINAL STUDIES

Lifestyle and cardiovascular health: opinions and behaviors among adults having relatives with cardiovascular diseases

Lucia Maria Lotrean¹, Daniel Ursu², Mira Florea³, Codruța Lencu⁴

¹Department of Hygiene, “Iuliu Hatieganu” University of Medicine and Pharmacy, Cluj-Napoca, Romania

²Graduating student, University of Medicine and Pharmacy, Cluj-Napoca, Romania

³Department of Family Medicine, “Iuliu Hatieganu” University of Medicine and Pharmacy, Cluj-Napoca, Romania

⁴Department of Endocrinology, “Iuliu Hatieganu” University of Medicine and Pharmacy, Cluj-Napoca, Romania

Abstract

Background. Assessment of opinions and behaviors related to cardio-vascular diseases (CVD) prevention is needed in order to develop appropriate interventions for CVD prophylaxis.

Aims. The study aims to assess the opinions and behaviors related to a healthy lifestyle and CVD prevention among Romanian adults who have relatives with cardiovascular diseases.

Methods. The study was performed in 2 hospital settings from Cluj-Napoca, Romania and involved 180 adults (90 men and 90 women) who had relatives with diagnoses of CVD. Data were collected through anonymous questionnaires, and height and weight were measured.

Results. The results show that a percentage of 58.3% of the adults had a body mass index higher than 24.9 and one quarter of the subjects declared that they do not perform at least 30 minutes of physical activity each day. With respect to alimentary habits, 78.3% of the study sample declared eating less than 3 portions of fruits and vegetables/day, while only 8.3% fulfilled the recommendations to eat at least 5 portions of fruits and vegetables per day. Nevertheless, 46.1% intend to eat more fruits and vegetables in the next month. 26.1% of the subjects were smokers (smoked in the last week), while 31.9% of the smokers declared that they would like to quit smoking in the next 6 months. The majority of the participants declared that they would like to receive more information and education regarding healthy lifestyle promotion and CVD prevention.

Conclusions. The results underline the need for appropriate screening, assessment, education and counseling of adults which have CVD patients in their family in order to detect and correct CVD risk factors.

Keywords: healthy lifestyle; cardiovascular disease prevention; adults having relatives with cardiovascular disease.

Introduction

According to Eurostat data, diseases of the circulatory system are one of the main causes of mortality in each of the European Union Member States (EU MS). In 2014, they caused 1.83 million deaths in EU MS; they accounted for 50-60% of all deaths in the Baltic Member States and Romania (1).

Diseases that affect the heart and vessels or cardiovascular diseases (CVD) have both non-modifiable risk factors (e.g. gender, age, genetic factors, ethnicity,) and modifiable risk factors (such as blood pressure, lipid and lipoprotein levels, body weight, nutritional habits, smoking behavior) (2); (Cannon, 2008; Zhang et al., 2018).

There is substantial evidence that health promotion

activities targeting the modifiable risk factors can prevent or reduce CVD (2); (Cannon, 2008; Zhang et al., 2018); (3). Hence, the World Health Organization (WHO) emphasizes the need of measures and activities at different levels in order to prevent and reduce active and passive smoking, to promote healthy nutrition, an active lifestyle and moderate consumption of alcohol, maintaining mental well-being for important benefits for CVD prevention and management, as well as for the prevention and reduction of other chronic diseases, such as different forms of cancer, diabetes, respiratory diseases (3).

Through exercise (30 minutes of moderate to vigorous-intensity activity on most days of the week), maintenance of appropriate body weight (a body mass index less than 25), proper diet (consumption of at least 400 g of fruits

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Address for correspondence: “Iuliu Hatieganu” University of Medicine and Pharmacy Cluj-Napoca 400012, Victor Babes Str. no. 8

E-mail: miraflorea@yahoo.com

Corresponding author: Mira Florea; miraflorea@yahoo.com

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and vegetables, consumption of fish minimum 2 times per week, reduced consumption of saturated fats and trans fatty acids, appropriate consumption of dietary fibers daily, reduction of dietary sodium intake) and a smoke-free lifestyle, an individual can decrease the risk for developing CVD (3); (Piepoli et al., 2016).

Hypothesis

This study focuses on Romanian adults who have relatives with CVD and aims to assess their opinions and behaviors related to healthy lifestyle and cardiovascular disease prevention, as a first step in order to develop appropriate interventions for CVD prophylaxis.

Material and methods

Research protocol

a) Period and place of the research

The study was performed in 2011, in 2 hospital settings from Cluj-Napoca, Romania. Approval for the study was obtained from the medical doctors in charge of the patients from the clinic units where the study was performed, an accepted procedure at the time when the study was performed. The study subjects were relatives of patients from hospitals with diagnoses of cardiovascular diseases and were contacted for participation in the study during their presence in the hospital for accompanying or visiting their relatives. Informed oral consent for participation was obtained from all participants.

b) Subjects and groups

The study involved 180 adults (90 men and 90 women) who had relatives with diagnoses of CVD and visited these relatives in the hospital during their stay there for checks or treatment. The participants received information from medical students regarding the study and the fact that participation was voluntary and implied completing an anonymous questionnaire and the measurements of height and weight. The persons who refused to participate were replaced with other relatives of the hospitalized patients. Persons who accepted to participate filled in the anonymous questionnaire. The final sample included 52.2% persons up to 45 years of age and 47.8% older, 36.7% from rural areas and 63.3% from urban areas, while the educational level was the following: 23.3% low, 41.1% medium, 35.5% high.

c) Tests applied

Anonymous questionnaires assessing several lifestyle behaviors were filled in by all the participants; their weight and height were also measured and the body mass index was calculated.

The current study presents information collected by means of anonymous questionnaires regarding the following issues:

- Demographic variables: age, gender, residence in urban or rural areas, educational level (1-low, meaning only junior high school or less, 1-medium, meaning only high school, 2-high, meaning university studies or more).
- Opinions regarding the importance of body weight, physical activity, several alimentary habits, active and passive smoking in influencing the risk of CVD.
- Involvement in intense and moderate physical activity, as well as walking; the participants were asked about the number of days on which they performed each

of these types of physical activity in the last week and the length of time dedicated to these activities with each occasion.

- Frequency of consumption of different food products (fruits and vegetables, different types of meat, different types of fats, beans, white and dark bread in the last week (less than 1/week, 1-2 times/week, 3-4 times/week, 5-6 times/week, daily), as well as of activities such as removing skin from the chicken meat before eating it (never, sometimes, frequently).

- Special attention was given to the consumption of fruits and vegetables, the participants being asked how many days they had consumed fruits and vegetables in the last week and how many portions they had consumed each of these days, being explained that a portion is defined as one medium fruit or one half cup of fruits or vegetables or one cup of raw leafy vegetables (e.g. lettuce), or three-fourths of a cup of vegetable or fruit juice.

At the same time, the participants were asked to indicate if they thought the amount of fruits and vegetables they consumed was enough and if they intended to eat more the next month.

- Exposure to passive smoking in public places and at home in the last week

- Behavior related to active smoking (smoking status, intention to quit in the future among smokers)

Persons who declared smoking in the last week were considered smokers.

- Availability to receive more information and education regarding healthy lifestyle promotion and CVD prevention

d) Statistical analysis

The medium time dedicated to physical activity per day by each participant was calculated using the following formula: $[2(EXH)+(FXI)+(GXJ)]/7$

Where E - number of days/week when intense physical activity was performed

H - number of minutes of intense physical activity performed on those days

F - number of days/week when moderate physical activity was performed

I - number of minutes of moderate physical activity performed on those days

G - number of days/week when walking was performed

J - number of minutes of walking performed on those days

Similarly to other studies, we considered that 30 minutes of vigorous physical activity were equivalent to 60 minutes of moderate physical activity (4).

The medium number of portions of fruits and vegetables was calculated by multiplying the number of days/week when they consumed fruits and vegetables by the number of portions/day and divided by 7.

The body mass index (BMI) was calculated using the following formula: $\text{weight}/(\text{height} \times \text{height})$; weight was measured in kg and height in m. The following cut-off values for the body mass index were considered: underweight (BMI <18.5), normal (BMI 18.5-24.9), overweight (BMI ≥25), obese (BMI ≥30) (5).

Pearson bivariate correlations were used to assess the associations between socio-demographic characteristics

(age, gender, residence and educational level) and lifestyle-related behaviors among the study sample. Data analysis was performed with the SPSS-20.0 statistics program. Significant results were reported at $p < 0.05$.

Results

Opinions regarding the role of lifestyle in CVD prevention

The results show that more than 91% of the study sample recognizes that a high body weight and active and passive smoking increase the risk of CVD, while performance of physical activity decreases the risk (Table I). The majority also know that consumption of fruits and vegetables contributes to prevention of CVD, but only 73% of the participants know that high consumption of animal fat increases the risk of CVD, while less than half know that consumption of food rich in dietary fibers (e.g. dark bread, beans) contributes to prevention of CVD.

BMI and lifestyle-related behaviors

A percentage of 58.3% of the adults had a BMI higher than 24.9. One quarter of the subjects declared that they did not perform at least 30 minutes of physical activity each day.

With respect to alimentary habits, 78.3% of the study sample declared eating less than 3 portions of fruits and vegetables/day, while only 8.3% fulfilled the recommendations to eat at least 5 portions of fruits and vegetables per day. Nevertheless, 52.8% of the participants believed that they should eat more fruits and vegetables, and 46.1% intended to do so the next month.

A percentage of 73.9% of the participants declared eating white bread at least 1-2/week and half of the participants even daily, while 63.9% consumed dark bread at least 1-2 times per week (one third of the participants consumed it daily). Weekly beans consumption was declared by 76.7% of the participants.

On the other hand, 60.6% of the participants declared having eaten fish at least 1-2 times in the last week. The consumption of pork and beef at least 1-2 times weekly was declared by 74.9% and 44.6% of the participants, respectively. A percentage of 90% of the study sample ate chicken at least 1-2 times per week, while 48.3% frequently removed the skin before eating it.

Regarding the consumption of fats, it can be seen that

the preferred type of fat was sunflower oil, with 93.3% declaring using it at least once per week and 48.7% even daily. Olive oil was consumed at least 1-2 times per week by 46.3% of the participants. A percentage of 61.1% of the participants consumed butter at least weekly, margarine was consumed at least 1-2 times per week by 47.4% of the adults, while 52% declared consuming the traditional fatty pork bacon at least 1-2 times/week and 26.3% used the pork fat for cooking/eating at least weekly.

The results show that 26.1% of the subjects were smokers (smoked in the last week), while 31.9% of the smokers declared that they would like to quit smoking in the next 6 months.

Exposure to passive smoking in public places in the last week was declared by 29.3% of non-smokers, while 12.5% of non-smoking subjects were exposed to passive smoking in their own houses in the last week.

A percentage of 85.8% of the participants declared that they would like to receive more information and education regarding healthy lifestyle promotion and cardiovascular disease prevention.

Factors which influence behaviors

The results of the bivariate correlation analyses show that there were several differences regarding behavior based on age, gender, residence and educational level (Table II).

Older people had a higher tendency to have a higher BMI, to cook with pork fat, not to avoid chicken skin, while they ate dark bread more frequently and were less involved in active smoking or exposed to passive smoking in public places or in their homes. On the other hand, they were more interested in getting more information about health promotion and cardiovascular disease prevention.

In comparison with men, women performed less physical activity. They declared a stronger intention to consume more fruits and vegetables, consumed olive oil more frequently, and fish and chicken as well as margarine and traditional bacon fat less frequently. They were less involved in active smoking.

In comparison with people from rural areas, people from urban areas declared eating more fruits and vegetables, consuming pork and beef meat less frequently, while using pork fat for cooking less frequently and eating dark bread more frequently. Active smoking was more frequent in urban areas.

Table I
Opinions regarding the role of lifestyle in CVD prevention

Opinions	I totally agree/ I partially agree %	Do not know %	I totally disagree/ I partially disagree %
A high body weight increases the risk of CVD	91.4	6.3	2.3
Consumption of fruits and vegetables contributes to prevention of CVD	88.3	7.8	3.9
Consumption of food rich in dietary fibers (e.g. dark bread, beans) contributes to prevention of CVD	43.9	43.3	12.8
High consumption of animal fat increases the risk of CVD	73	24.7	2.3
Performance of physical activity contributes to prevention of CVD	93.3	3.9	2.8
Active smoking increases the risk of CVD	95.6	4.4	0
Passive smoking increases the risk of CVD	93.9	5.6	0.5

Table II
Factors which influence behaviors - results of bivariate correlation analyses.

Indicators	Age ^a	Gender ^b	Rural-urban ^c	Education level ^d
BMI ^e	0.304	NS	NS	NS
Physical activity ^f	NS	-0.203	NS	NS
Portions of fruits and vegetables ^g	NS	NS	0.213	NS
Intention to consume fruits and vegetables ^h	NS	0.159	NS	0.168
Frequency of beans consumption ⁱ	NS	NS	NS	-0.247
Frequency of dark bread consumption ⁱ	0.273	NS	0.345	NS
Frequency of white bread consumption ⁱ	NS	NS	-0.309	NS
Frequency of fish consumption ⁱ	NS	-0.403	NS	NS
Frequency of pork consumption ⁱ	NS	-0.242	-0.149	NS
Frequency of beef consumption ⁱ	NS	NS	-0.237	NS
Frequency of chicken consumption ⁱ	-0.255	-0.174	NS	NS
Removing skin from chicken meat ^j	-0.263	NS	NS	0.186
Frequency of sunflower oil consumption ⁱ	NS	NS	NS	NS
Frequency of olive oil consumption ⁱ	NS	0.230	NS	NS
Frequency of butter consumption ⁱ	NS	NS	NS	0.214
Frequency of margarine consumption ⁱ	NS	-0.334	NS	NS
Frequency of pork fat use for cooking ⁱ	0.231	NS	-0.233	-0.347
Frequency of traditional fatty pork bacon consumption ⁱ	NS	-0.360	NS	-0.258
Active smoking ^k	-0.397	-0.162	0.440	NS
Passive smoking in public places ^l	-0.273	NS	NS	NS
Passive smoking at home ^l	-0.278	NS	NS	NS
Want more information ^m	0.217	NS	NS	0.195

From 22 to 80 years old; a- Coded as Men-1; Women -2; b- Coded as Rural-1, Urban-2; c- Coded as Low-1, Medium-2, High-3; d- Coded as 1-Underweight, 2-Normal, 3-Overweight, 4-Obese; e- Coded as less than 30 minutes/day-1, at least 30 minutes per day-2; f- Medium number of portions of fruits and vegetables consumed per day; g- Coded as No-1, Yes-2; h- Coded as less than 1/ week-1, 1-2 times/ week-2, 3-4 times/week-3, 5-6 times/week-4, daily-5; i- Coded as Never-1, Sometimes-2, Frequently-3; j- Coded as 1-No, 2-Yes; k- Number of days/week; l- Coded as No-1, Yes-2; NS- non-significant (P<0.05).

On the other hand, a higher educational level was associated with a stronger intention to eat more fruits and vegetables, eating butter more frequently and consuming traditional fatty bacon or pork fat for cooking less frequently, while removing skin from chicken meat more frequently. People with a higher educational level also expressed a higher interest in finding more information about prevention of CVD.

Discussions

More than 93% of the participants know that active and passive smoking have a risk for CVD. Other studies also underline the high level of knowledge of the Romanian population regarding the health effects of smoking (Trofor et al., 2018). One quarter of the participants declared smoking, this habit being more frequent among men and among those from urban areas. Almost one third of the smokers declared their intention to try to quit smoking in the next six months, emphasizing the need for medical counseling for this, in accordance with the results of other studies (Cehab et al., 2018; Vogiatzis et al., 2017). Among non-smokers, 29% declared exposure to passive smoking in public places in the last week and 12% in their own houses, exposure to passive smoking being more frequent among younger non-smokers. The study was performed before the ban of smoking in public places including bars and restaurants, which came into force in Romania in 2016. It might be possible that exposure to passive smoking in

public places has since diminished as a consequence of the legislation, as other studies indicated with regard to the effects of comprehensive banning of smoking in public places (Lotrean, 2008).

At the same time, more than 91% of the study sample know that physical activity and maintaining an appropriate body weight contribute to prevention of CVD. Half of the participants had a higher BMI, with older people having a higher tendency to be overweight. This underlines the need for education and counseling activities with regard to body weight management and chronic disease prevention, issues which were also underlined by other Romanian studies performed in different groups of Romanian adults (Lotrean et al., 2016; Lotrean et al., 2013). Three quarters of the participants declared performing at least 30 minutes of physical activity daily, which is a positive issue.

With regard to nutritional habits, the majority of the subjects recognize the importance of consuming fruits and vegetables. Nevertheless, the majority do not consume 5 portions of fruits and vegetables as recommended daily, but almost half declared their intention to eat more the next month. Other studies also emphasized the fact that low consumption of fruits and vegetables is an important issue which should be targeted by educational campaigns, programs and counseling (Lotrean et al., 2016; Lotrean et al., 2013; Slavin & Lloyd, 2012; Zhan et al., 2017).

The study shows the tendency of the majority of the study sample to frequently include in their diet chicken

meat (but only half of these remove the skin frequently) and pork, while fish meat is consumed at least once/week by less than two thirds of the participants and less than half eat beef weekly, with men eating fish and chicken more frequently than women, while people from rural areas eat pork and beef more frequently in comparison with those from urban areas.

The fat preferred for cooking is sunflower oil, while almost half consume or use for cooking at least once per week butter (consumption is more frequent among those with a higher educational level), margarine (men consume more than women), pork fat for cooking (more frequent among people from rural areas and among those with a lower educational level), fatty pork bacon (more frequent among men and people with a lower educational level). On the other hand, less than one out of two participants use olive oil at least once weekly, women tending to consume it more frequently. This situation is probably in relation to gastronomic and cultural influences, but also with the fact that more than one quarter do not know that animal fat increases the risk of CVD, as other studies also suggest (Lotrean et al., 2016). At the same time, consumption of white bread is preferred over consumption of dark bread, which is also in accordance with the gastronomic culture of the region, while less than half of the participants recognize the importance of eating food rich in fibers such as dark bread and beans for CVD prevention.

Conclusions and suggestions

1. The study evaluated the opinions and behaviors of Romanian adults having relatives with CVD with regard to lifestyle and cardiovascular health promotion.
2. The results underline the need for appropriate screening, assessment, education and counseling of adults which have CVD patients in their family in order to detect and correct inappropriate lifestyle and medical conditions.
3. The majority of the participants declared that they would like to receive more information and education regarding healthy lifestyle promotion and CVD prevention, which is an encouraging fact.
4. Efforts should be made to also get access to groups such as people with a lower educational level who seem to be less interested in these types of interventions.

References

- Cannon CP. Cardiovascular disease and modifiable cardiometabolic risk factors. *Clinic Cornerstone*. 2008;9(2):24-38. DOI:10.1016/s1098-3597(09)62037-8.
- Zhang XE, Cheng B, Wang Q, Wan JJ. Association of gender-specific risk factors in metabolic and cardiovascular diseases: an NHANES-based cross-sectional study. *J Invest Med*. 2018;66(1):22-31. doi: 10.1136/jim-2017-000434.
- Piepoli MF, Hoes AW, Agewall S, Albus C, Brotons C, Catapano AL, Cooney MT, Corrà U, Cosyns B, Deaton C, Graham I, Hall MS, Hobbs FDR, Løchen ML, Löllgen H, Marques-Vidal P, Perk J, Prescott E, Redon J, Richter DJ, Sattar N, Smulders Y, Tiberi M, van der Worp HB, van Dis I, Verschuren WMM, Binno S; ESC Scientific Document Group. European Guidelines on cardiovascular disease prevention in clinical practice: The Sixth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of 10 societies and by invited experts) Developed with the special contribution of the European Association for Cardiovascular Prevention & Rehabilitation (EACPR). *Eur Heart J*. 2016;37(29):2315-2381.
- Trofor AC, Papadakis S, Lotrean LM, Radu-Loghin C, Eremia M, Mihaltan F, Driezen P, Kyriakos CN, Mons U, Demjén T, Nogueira SO, Fernández E, Tountas Y, Przewoźniak K, McNeill A, Fong GT, Vardavas CI, EUREST-PLUS consortium. Knowledge of the health risks of smoking and impact of cigarette warning labels among tobacco users in six European countries: Findings from the EUREST-PLUS ITC Europe Surveys. *Tob Induc Dis*. 2018; 16:A10. (Supplement 2). doi: 10.18332/tid/99542.
- Chehab OM, Dakik HA. Interventions for smoking cessation in patients admitted with Acute Coronary Syndrome: a review. *Postgrad Med J*. 2018; 94(1108):116-120. doi: 10.1136/postgradmedj-2017-135040.
- Vogiatzis I, Pantartzidou A, Pittas S, Papavasiliou E. Smoking Cessation Advisory Intervention in Patients with Cardiovascular Disease. *Med Arch*. 2017;71(2):128-131. doi: 10.5455/medarh.2017.71.128-131.
- Lotrean LM. Effects of comprehensive smoke-free legislation in Europe. *Salud Publica Mex*. 2008;50 (Suppl 3):292-298.
- Lotrean ML, Karaki Y, Olivo del Valle M. Dietary patterns, involvement in physical activity and body mass index of Romanian adults having cardio-vascular diseases. *Balneo Res J*. 2016;7(1):51-54.
- Lotrean ML, Ailolaiei R, Torres G. Health Risk Behavior of Romanian Adults having Relatives with Cancer. *Asian Pac J Cancer Prev*. 2013;14(11):6465-6468. DOI:10.7314/apjcp.2013.14.11.6465
- Slavin JL, Lloyd B. Health benefits of fruits and vegetables. *Adv Nutr*. 2012;3(4):506-516. doi: 10.3945/an.112.002154.
- Zhan J, Liu YJ, Cai LB, Xu FR, Xie T, He QQ. Fruit and vegetable consumption and risk of cardiovascular disease: A meta-analysis of prospective cohort studies. *Crit Rev Food Sci Nutr*. 2017;57(8):1650-1663. oi: 10.1080/10408398.2015.1008980.
- ## Websites
- (1) Eurostat - Statistics Explained. Cardiovascular diseases statistics, 2014. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Cardiovascular_diseases_statistics#Deaths_from_cardiovascular_diseases. Accessed in June 2019.
 - (2) Institutul national de sănătate publică. Monitorizarea inegalităților în starea de sănătate a populației României în anul 2015. Available at: <http://insp.gov.ro/sites/cnepss/wp-content/uploads/2017/12/Inegalitati-in-starea-de-sanatate-2016-20-febr.pdf>. Accessed in June 2019.
 - (3) World Health Organization. Global Atlas on cardiovascular disease prevention and control, 2011. Available at: https://www.who.int/cardiovascular_diseases/publications/atlas_cvd/en/. Accessed June 2019.
 - (4) American Institute for Cancer Research. Food, Nutrition, Physical Activity and the Prevention of Cancer: a Global Perspective. Washington: AICR, 2009. Available at: www.researchgate.net. Accessed in June 2019.
 - (5) World Health Organization. Body mass index, 2019. Available at: <http://www.euro.who.int/en/health-topics/disease-prevention/nutrition/a-healthy-lifestyle/body-mass-index-bmi>. Accessed in June 2019.

Factors involved in the occurrence of body and head injuries among children of Cluj county practicing ball sports

Sorana Baci, Marius Manole, Alexandru Grecu, Anca Stefania Mesaros

Department of Aesthetics and Propedeutics, "Iuliu Hatieganu" University of Medicine and Pharmacy Cluj-Napoca

Abstract

Background. Sports dentistry has become very popular lately as the trend of a healthy life increases. Many families are raising their children from an early age in the spirit of a healthy life, and enroll them in team sports in order for them to practice physical activities on a regular basis. Injuries in different parts of the body are encountered in children practicing team sports and more often occur in ball games.

Aims. The objective of this study was to assess the frequency of occurrence of injuries in a group of children practicing ball games (sports group) in Cluj and to compare them with a control group.

Methods. The questionnaire and documents regarding informed consent were distributed to the 1273 families with children practicing basketball and to 1273 families with children that were not involved in regular sports activities.

Results. Our results were comparable with the results in the literature in regard to distribution related to gender, age, number of days of practice, years of experience, hours of rest, location of injuries in the body. Regarding practice days, a lower incidence (6.48%) was found in the sports group (Sg) for children with under 3 days of practice per week compared to children of the Sg with over 3 days of practice (8.4%). For the injured cases, the length of the period of resting time in training influenced the occurrence, not significantly, but nevertheless higher scores for injuries were encountered (49.11%) when no sufficient resting time was granted (50.89%). Another factor influencing the rate of injuries was the sleep duration, for which in children of the Sg, values ranged between 5.49% - 33.93% and 60.66% for 8-9 hours, 7-8 hours and 6-7 hours of sleep, respectively.

Conclusions. We can state that the results are similar to similar studies in the literature, in regard to gender distribution and injury distribution related to different body parts. We found out that the injury rate increased with age and experience in the basketball group, where lower limbs, followed by upper limbs and head were the most injured parts of the body. Insufficient knee and elbow protections were worn, but nevertheless in a higher proportion of cases than mouth guards.

Keywords: ball games, children, injuries, occurrence.

Introduction

People are motivated for a physically active life as different kinds of activities ensure, in addition to maintenance and improvement of fitness and health, socialization, pleasure, relaxation, competition. The disadvantage of practicing different types of sports is the assumed risk for injuries, which may, in some cases, lead to permanent disability (Newsome et al., 2001; Padilla & Balikov, 1993).

An injury has been defined as an incident occurring during a match or training in the club, causing the player to miss at least one match or one training session (Yde & Nielsen, 1989).

Dental trauma associated or not with injuries of the stomatognathic system in sports is the main connection

between sports and dentistry. Traumatic dental injuries have become a public dental health problem and sports accidents are included in this category, alongside injuries caused by violence and traffic accidents (Andreasen & Andreasen, 1994).

Sports dentistry has become very popular lately as the trend of a healthy life increases. A physically active lifestyle is important for all age groups (Bijur et al., 1995). Different types of indoor or outdoor activities involve various ages, from children and young adults to persons up to the 6-7 decades of life. Many families are raising their children from an early age in the spirit of a healthy life, and enroll them in team sports in order for them to practice physical activities on a regular basis (Kracher & Smith, 2017; Saini, 2011).

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Address for correspondence: Department of Dental Aesthetics and Propedeutics, "Iuliu Hatieganu" University of Medicine and Pharmacy Cluj-Napoca, Romania, Clinicilor str 32, Cluj-Napoca, PC 400006

E-mail: alexgreeck@yahoo.com

Corresponding author: Alexandru Grecu Gratian, e-mail: alexgreeck@yahoo.com

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Protective gears have improved over time and they have become more comfortable, user-friendly, and safe (Nielsen & Yde, 1989). Sports dentistry ensures different kinds of treatments for orofacial injuries, as well as prevention of those injuries through different methods (e.g. face shields, mouth guards).

Hypothesis

We started from the null hypothesis in our study, namely that there is no difference between the prevalence of dentofacial injuries in a group of children practicing sport (sports group - Sg) in Cluj county compared to a control group consisting of children that do not have organized sports activities (control group - Cg).

Material and methods

The present research was approved by the Ethics Committee of the University of Medicine and Pharmacy Cluj-Napoca. Parents provided a written informed consent.

Research protocol

a) Period and place of the research

The research took place in Cluj-Napoca during February and March 2020.

b) Subjects and groups

The participants were children aged 5-12 years practicing ball games (football, basketball, handball, volleyball) in Cluj county (ball group - Sg), and children with no regular sports activities (control group - Cg) of the same age (5-12).

c) Tests applied

Because the age of the children ranged between 5 and 12 years, the parent or guardian of the child filled in the questionnaire and provided an informed consent on behalf of the child. The questionnaire and documents about the informed consent were distributed to 1273 families with children practicing basketball and to 1273 families with children that were not involved in regular sports activities (control group). The respondents were 1219 basketball players and 1001 control subjects. Children practicing multiple sports ($n=59$) were excluded from this study. The questionnaires with missing data ($n=79$ for ball players and $n=118$ for the control group) were also excluded. The final population comprised in this study included 1081 children for the sports group and 883 for the control group.

Our self-designed questionnaire contained the following questions: Age? Gender? Have you suffered injuries (in Cg and Sg)? What is your school level? What is your team level (Sg)? What is your playing experience (in years)? How many days of practice do you have per week (Sg)? How many breaks do you have during a practice? How many sleeping hours do you have during the week? If injured, in which body part (Sg and Cg)? What kind of head injuries did you suffer (Cg, Sg)? Did you wear any protection gear (Sg)?

The questionnaire excluded some data in the case of the control group (for example: years of practice/experience, team level, number of practice days per week) and was more comprehensive for the sports group: questions related to: age, gender, years of

practice/experience (under 1, 1 to 5, over 5), weight, team level (local/ district competitions), number of practice days per week (under 3/ over 3), time for rest (breaks) during practice (sufficient/insufficient), number of sleep hours/24 h (over 5, between 5-8, 8.5-9, over 9), types of injuries in the upper limbs/lower limbs/dento-facial injuries, types of dento-facial injuries: fractures of the upper or lower jaw/ soft tissue/ tooth injuries.

d) Statistical processing

The collected data were systematized in Microsoft Excel tables and employed for descriptive univariate statistical procedures.

Results

A number of 814 boys and 267 girls took part in the study in the sports group (1081 boys and girls). Gender distribution in the control group was: 392 boys (44.3%) and 491 (55.60%) girls (Fig. 1, Fig. 2).



Fig. 1 – Gender distribution in the sports group.

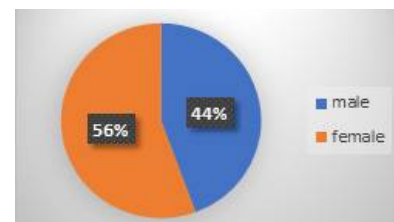


Fig. 2 – Gender distribution in the control group.

Age distribution for the sports group was as follows: 5-6 years, 396; 7-8 years, 311; 9-10 years, 255; 11-12 years, 119. Age distribution for the control group was the following: 211 (25%) children aged 5-6 years, 263 (31%) children aged 7-8 years, 196 (30%) children aged 9-10 years and finally, 113 children (14%) aged 11-12 years (Fig. 3, Fig. 4).

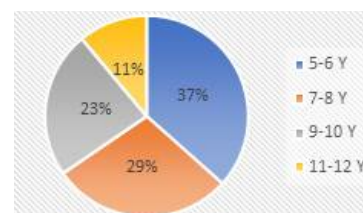


Fig. 3 – Age distribution in the sports group.

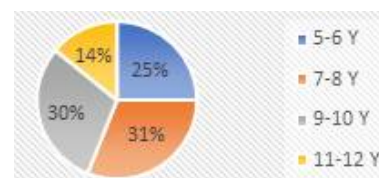


Fig. 4 – Age distribution in the control group.

In the sports group, out of 814 boys, 697 (85.62%) were uninjured and 117 (14.38%) had various injuries. In the control group, the rate of injuries was 9.62% (n=85 out of 883) (Fig. 5, Fig. 6).

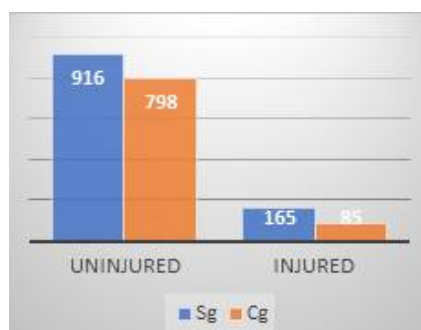


Fig. 5 – Injured - uninjured rate in the sports group and in the control group.

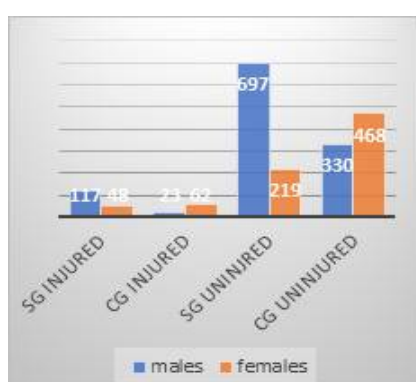


Fig. 6 – Injured - uninjured rate related to gender in the sports group and the control group.

In the sports group, out of 267 girls, 219 (82.02%) were uninjured and 48 (17.98%) had injuries.

The distribution of injuries related to gender in the control group was >23 girls (27.06%) and 62 boys (72.94%).

Out of 1081 children in the sports group, 937 (86.67%) were in elementary school and 144 (13.33%) were in secondary school. The distribution of the control group was 368 (41.67%) in secondary school and 515 in elementary school (58.32%) (Fig. 7).



Fig. 7 – School level distribution in Sg and Cg.

Regarding the team level, a 14.1% injury rate was encountered in children taking part in inter-regional competitions, while 83.9% of the injuries occurred in local trainings/competitions (Fig. 8).

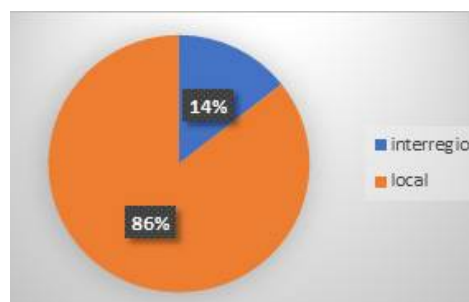


Fig. 8 – Distribution in the sports group related to the team level.

The experience of the players was also an important factor from our point of view. The children were divided into children with less than 1 year of practice, 1-5 years of practice and over 5 years of practice. Injuries occurred for the first category in 12.7% of the cases, and 87.3% of the children from this category were uninjured. In the 1-5 year experience category, 85.1% were uninjured, while 14.9% had injuries (Fig. 9).

Out of the children involved in sports for over 5 years, 84.7% were uninjured, while 15.3% had injuries (Fig. 9).



Fig. 9 – Distribution of injured / uninjured children related to the playing experience in Sg.

Another important factor was the number of practice days. Out of the 1081 children in the sports group, 165 had injuries. In 6.84% of the cases (74 children), injuries occurred in children with less than 3 days of practice per week and in 8.4% of the cases (91 children), in those with more than 3 days of practice per week (Fig. 10).

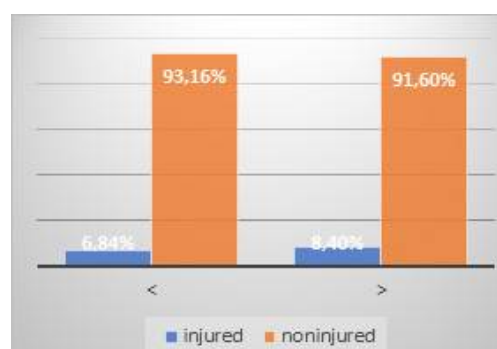


Fig. 10 – Distribution of injured/uninjured children related to the number of practice days of the players in Sg.

The time for breaks was also considered and was related to the occurrence of potential injuries. An assessment was made, and positive or negative answers (yes/no) were possible. The results showed a proportion of 50.89% (n=85) of cases with injuries that occurred when there was no sufficient resting time and a 49.11% (n=82) incidence when there was sufficient time for resting during the practice (Fig. 11).

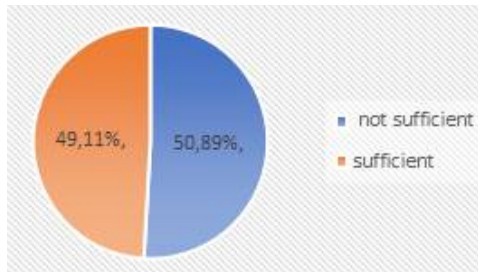


Fig. 11 – Assessment of break time during training in Sg.

The degree of rest is another factor that can determine injuries, so we assessed the sleep time per day in number of hours. We found out that for the sports group, injuries occurred in 60.60% (n=100) of the cases in children with less than 6-7 sleep hours, in 33.93% (n=56) of the cases in children sleeping between 7-8 hours, and in 5.45% (n=9) of the cases in children with 8-9 hours of sleep. For the control group, the prevalence was 55.4% (n=49) for children who usually slept less than 6-7 hours per day, 28.3% (n=25) for those who slept 7-8 hours, and 12.45 (n=11) for those who usually slept 8-9 hours per day (Fig. 12).

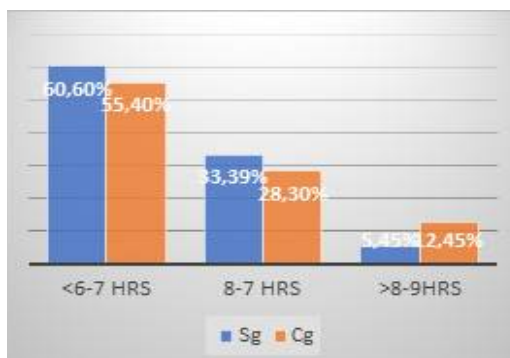


Fig. 12 – Distribution of injuries related to sleep hours in Sg.

In the sports group, where 165 children were injured, 58 had upper limb injuries, 77 had lower limb injuries, and 30 had head injuries. In the control group, 52 children had upper limb injuries, 22 had lower limb injuries and 11 had head injuries (Fig. 13).

We divided the head injuries for both groups into the following categories: lower/upper jaw fractures and skull injuries, tooth injuries and soft tissue injuries, and we found out that there were 2 cases of fractures and skull injuries, 7 cases of tooth injuries and 21 cases of soft tissue injuries. In the control group, most injuries were fractures of the lower limbs, 25.88% (22 children), 60% (52 children) had upper limb fractures, and the rest of 14.11% (11 children) had head injuries (Fig. 13). Head

injuries were divided as follows: 8 soft tissue injuries, 2 tooth injuries and 1 jaw and skull injury (Fig. 14).

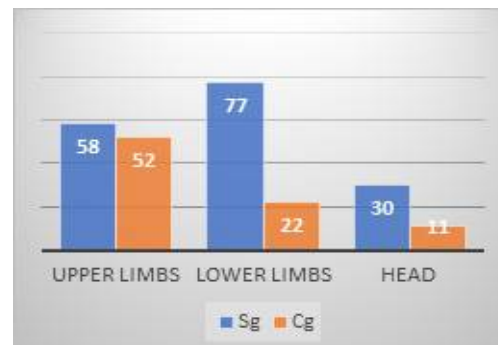


Fig. 13 – Distribution of injuries in the ball group vs the control group.

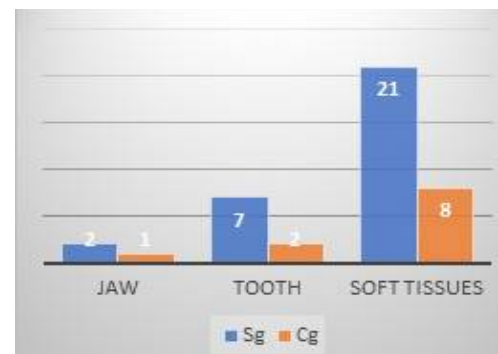


Fig. 14 – Distribution of head injuries in the ball group and the control group.

In the sports group, with respect to wearing the protection gear, knee- and arm-rests for the lower/upper limbs and mouth guards for the dento-facial area, it was found that out of the 58 children with hand injuries, 42 did not wear arm-rests. Out of the 77 leg injuries, children did not wear knee protections only in 12 cases (65 had knee protections) and out of the 30 cases with head injuries, only 2 wore mouth guards, as a protection for soft tissues and teeth (Fig. 15).



Fig. 15 – Distribution of injuries in Sg related to association or lack of association with protection gears (knee, elbow protection, mouth guards).

Discussions

The incidence of injuries (injuries per 1000 playing hours) in adolescents' ball games is encountered mainly during games, but injuries also occur during practice (Yde

& Nielsen, 1990). Yde and Nielsen found the following distribution of injuries in various sports (Table I):

Table I
Distribution of injuries in various sports

No of years		<10	< 14	<18
Injured players out of 1000	Football	65	43	44
	Handball	21	24	49
	Basketball	9	13	34
	Total	95	80	117

(Yde & Nielsen, 1990)

The mechanism of injuries is complex, through: falls, kicks from another player, kicks from the ball, collisions, and is encountered in different proportions depending on the type of ball game and the importance of the play (training or competitions) (Nielsen & Yde, 1989).

It has been found that if lower limb injuries are considered all together: ankle, knee and hip injuries, they give the highest percentage of injuries compared with other body parts (Azodo et al., 2011).

In ball players, the most common injuries are: shoulder/arm, hand/finger/ thigh/leg, knee, ankle and foot injuries.

Contact sport athletes have up to 10% more probability of suffering orofacial injuries when compared to non-practitioners (Stephens et al., 1985) and a 33-56% risk of suffering a facial injury during their career. Contact sports have maintained a relevant place in causation of orofacial trauma because the face is the most vulnerable and least protected area of the body (Bemelmans & Pfeiffer, 2000; Tulunoglu & Ozbek, 2006). Orofacial sports-related injuries are known to occur across a wide range of both organized and unorganized sports (Tesini & Soporowski, 2000). When screening 15 types of sports (Hootman et al., 2007), head-neck injuries reach a rate of 9.8-12.8% during practice and during games.

Studies also show that 13–39% (Sane, 1988) of all dental injuries are sports-related and of all sports accidents reported, 11-18% are maxillofacial injuries. Males are traumatized twice as often as females, with the maxillary central incisor being the most commonly injured tooth (Meadow et al., 1984). In children, sports activities were found to be responsible for 13% of overall oral trauma (Winters, 1996).

Conclusions

1. Within the limits of our study, we can state that the results are similar to those of similar literature studies regarding gender distribution and injury distribution related to the body parts.

2. We found out that the injury rate increased with age and experience in the basketball group, where the lower limbs, followed by the upper limbs and the head were the most injured parts of the body. Insufficient knee and elbow protections were worn, which were however found in a higher proportion of cases than mouth guards.

3. The authors suggest the need for further studies, in various population and age groups, in order to generate reference data for the general population.

Conflicts of interest

Nothing to declare.

Acknowledgement

All four authors have equal contributions to this study.

References

- Andreasen JO, Andreasen FM. Textbook of Color Atlas of Traumatic Injuries to the Teeth. 3rd ed. Copenhagen: Munksgaard, 1994.
- Azodo CC, Odai CD, Osazuwa-Peters N, Obuekwe ON. A survey of orofacial injuries among basketball players. *Int Dent J* 2011;61: 43-46. doi:10.1111/j.1875-595x.2011.00009.x.
- Bemelmans P, Pfeiffer P. Incidence of dental, mouth, and jaw injuries and the efficacy of mouthguards in top ranking athletes. *Sportverletz Sportschaden* 2000;14(4):139-143. DOI:10.1055/s-2000-8950.
- Bijur PE, Trumble A, Harel Y, Overpeck MD, Jones D, Scheidt PC. Sports and recreation injuries in US children and adolescents. *Arch Pediatr Adolesc Med.* 1995;149(9):1009-1016. DOI:10.1001/archpedi.1995.02170220075010.
- Hootman JM, Dick R, Agel J. Epidemiology of Collegiate Injuries for 15 Sports: Summary and Recommendations for Injury Prevention Initiatives. *J Athl Train.* 2007; 42(2): 311-319.
- Kracher CM, Smith WS. Sports-related dental injuries and sports dentistry, 2017. Available at: http://www.dentalcare.com/en-US/dental-education/continuing-education/ce127/ce127.aspx?moduleName_coursecontent&PartID=1&SectionID=1. Accessed 2019, Sept 20.
- Meadow D, Lindner G, Needleman H. Oral trauma in children. *Pediatr Dent.* 1984;6(4):248-251.
- Newsome PR, Tran DC, Cooke MS. The role of the mouthguard in the prevention of sports-related dental injuries: A review. *Int J Paediatr Dent.* 2001;11(6): 396-404. DOI:10.1046/j.0960-7439.2001.00304.x.
- Nielsen AB, Yde J. Epidemiology and traumatology of injuries in soccer *Am J Sports Med.* 1989;17(6):803-807. DOI:10.1177/036354658901700614.
- Padilla R, Balikov S. Sports dentistry: Coming of age in the '90s. *J Calif Dent Assoc.* 1993;21(4):27-34, 36-37.
- Saini R. Sports dentistry. *Natl J Maxillofac Surg. Br. J. Sp. Med.* 2011;2(2):129-131. doi: 10.4103/0975-5950.94465.
- Sane J. Maxillofacial and dental injuries in contact team sports. *Proc Finn Dent Soc.* 1988;84(Suppl 6-7):1-45.
- Stephens T, Jacobs DR Jr, White CC. A descriptive epidemiology of leisure-time physical activity. *Public Health Rep.* 1985;100(2):147-158.
- Tesini DA, Soporowski NJ. Epidemiology of orofacial sports-related injuries. *Dent Clin North Am* 2000;44(1):1-18.
- Tulunoglu I, Ozbek M. Oral trauma, mouthguard awareness, and use in two contact sports in Turkey. *Dent Traumatol* 2006;22(5):242-246. DOI:10.1111/j.1600-9657.2006.00386.x.
- Winters JE. Sports dentistry: The profession's role in athletics. *JADA.* 1996; 127:810-811.
- Yde J, Nielsen AB. Sports injuries in adolescents' ball games: soccer, handball and basketball. *Br. J. Sports. Med.* 1990;24(1):51-54. DOI:10.1136/bjism.24.1.51.

Influence of *Lepidium meyenii* on stress induced by walking on a treadmill

Ramona Jurcău¹, Ioana Jurcău², Lucian-Daniel Rusu³, Răzvan-Titus Pîrvan⁴

¹Department of Pathophysiology, Medicine Faculty, “Iuliu Hațieganu” University of Medicine and Pharmacy, Cluj-Napoca, Romania

²Emergency Clinical Hospital for Children, Cluj-Napoca, Romania

³Medical Department II, Medicine Faculty, “Iuliu Hațieganu” University of Medicine and Pharmacy, Cluj-Napoca, Romania

⁴Medicine Faculty, University of Oradea, Romania

Abstract

Background. High intensity physical exertion is a stress for the body; *Lepidium meyenii* (LM) is known for its antistress effects.

Aims. This study aimed to highlight phytotherapeutic modulation, under the action of a *Lepidium meyenii* product (LM; LMP), on anxiety (A), glycemia (G) and salivary pH (SpH), in physical stress caused by walking very fast on the treadmill, in sedentary subjects.

Methods. 24 healthy male volunteers were randomized to: a control group (C=8), without treatment; a group who received LMP 12 days (LM1=8); a group who received LMP 21 days (LM2=8). Stress model: walking very fast on the treadmill. Analyzed indicators: anxiety (A), glycemia (G) and salivary pH (SpH). Determinations: before LM treatment (T1), 15 minutes (T2) before, 30 minutes (T3) and 4 hours (T4) after the physical effort. The results obtained were analyzed using the SPSS statistical package.

Results. For C, compared to T1, the most significant were: increases for A (T2), G (T3); decrease for SpH (T3). In LM1 and LM2, values were significantly: low for A (T2), G (T3); high for SpH (T3). LM2 impact was greater than LM1. LM1/LM2 influence was more important on A.

Conclusions. 1) Dynamic developments of A, G, SpH were different for C, LM1/ LM2. 2) LM significantly reduced A/ G, increased SpH, with a more important influence on A. 3) LM2 effect was more intense than LM1. 4) We suggest LM may be useful in A, G, SpH modulation, in stress caused by walking very fast on the treadmill, in sedentary people, but further research is needed.

Keywords: stress, *Lepidium meyenii*, exercise, stress, anxiety, glycemia, salivary pH.

Introduction

Short-term physical exertion can be an important stress factor, as evidenced by increased cortisol (Cosio-Lima, 2012) and state anxiety, immediately pre- and post- exertion (Hermann et al., 2019; Jurcău & Jurcău, 2018), or involves other psychological factors (Monea et al., 2011; Ormenișan, 2008a; Ormenișan, 2008b). In addition, intense physical exertion can induce increased blood sugar (Jurcău et al., 2017; Keselman et al., 2017). On the other hand, modulation of the stress induced by physical exertion, especially by intense effort, has been a continuous concern for research in the field of sport, plant extracts and nutritional supplements. Thus, adaptogens (Panossian et al., 2018) and plants with an adaptogenic role represent an important resource for

modulating stress in general and physical exertion stress, in particular. In this sense, there are studies that have shown the modulation of physical stress with *Eleutherococcus senticosus* (Kimura & Sumiyoshi, 2004), *Rhodiola rosea* (Huang et al., 2009), *Schisandra chinensis* (Panossian, 2013; Jurcău et al., 2019) and *Ginseng* (Yang et al., 2018; Jurcău et al., 2018).

Lepidium meyenii (LM or Maca) is a plant recognized for its adaptogenic qualities. The interest in LM has increased in many parts of the world, and since 2005 this has been considered one of the seven representative Peruvian products (Gonzales et al., 2009). LM is a plant that grows at over 4000 meters altitude in the Central Andes of Peru and has different varieties depending on the color of the hypocotyl (Gonzales et al., 2014). It was found that

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Address for correspondence: “Iuliu Hațieganu” University of Medicine and Pharmacy Cluj-Napoca 400012, Victor Babes Str. no. 8

E-mail: ramona_mj@yahoo.com

Corresponding author: Ramona Jurcău; ramona_mj@yahoo.com

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differences between the biological properties of the three types of LM depend on differences in the cultivation soil (Zhao et al., 2012); on the other hand, all these varieties are present in the same soil (Tello et al., 1992). Thus, red maca has beneficial effects on mood, energy; black maca reduces blood sugar levels; both varieties produce similar responses on mood and health related quality of life score and improve quality of life parameters (Gonzales-Arimborgo et al., 2016). Maca contains many proteins, amino acids, fats and vitamins (Dini et al., 1994), secondary metabolites and other components (Cui et al., 2003).

LM is known to be an extremely effective remedy for the treatment of impotence (Qureshi et al., 2017) and a natural stimulant for improving sexual dysfunctions (Stone et al., 2009) in postmenopausal women, independent of estrogen and androgen activity (Brooks et al., 2008). It can also be used, as a dietary supplement, in the prevention and treatment of atherogenic lipoprotein, liver steatosis, antioxidative stress and impaired glucose tolerance (Vecera et al., 2007). Following treatment with black maca, in diabetic rats, thiobarbituric acid reactive substances and carbonylated proteins were reduced; therefore, lipid oxidation was also diminished and also increased the activity of superoxide dismutase and antioxidants of catalase (Qiu et al., 2016). In vitro, Maca increased cell viability and reduced cytotoxicity against oxidative stress, suggesting a neurobiological effect (Rodríguez-Huamán et al., 2017). In cells pre-treated with Maca extract, SOD activity increased, so that LM exhibited an antioxidant effect, by inhibiting the activity of free radicals, thus having a neuroprotective effect (Masoudi et al., 2014).

Administration of Maca 1% in the diet of hypertriglyceridemic animals led to an improvement in lipid profile and an increase in glucose tolerance (Vecera et al., 2007). In another rat study, in which diabetes was induced by administration of streptozotocin, administration of yellow maca resulted in decreased blood sugar and insulin levels (Rodrigo et al., 2011). In a male rat experiment in which diabetes was induced by administration of streptozotocin, administration of a black maca hydroalcoholic extract reduced blood glucose by 50% (Gonzales et al., 2013).

LM is also consumed as a sports supplement by endurance athletes (Stone et al., 2009). Thus, macamides, the main active components contained in Maca, determine the alleviation of physical fatigue by alleviating lesions of skeletal muscle and myocardium during exercise (Zheng et al., 2019). Following administration of a soluble lipid extract of yellow LM for three weeks, physical resistance increased by 41% compared to the control value, and the administration of a hydroalcoholic extract of black maca led to an increase in physical resistance of over 500% compared to the control (Choi et al., 2012). The administration of maca extract for 14 days to cyclists, participants in a 40 km race, significantly and quickly improved the performance time (Stone et al., 2009). In another study, the administration of a fresh maca concentrate, 500 mg daily for 60 days, to ten professional football players led to an increase in oxygen consumption and physical resistance (Ronceros et al., 2005).

After higher doses of Maca treatment, in stressed

mice, serum corticosterone levels were reduced (Ai et al., 2014). In addition, LM reduces psychological symptoms, including depression, anxiety (Brooks et al., 2008), and stress (Qureshi et al., 2017).

Objectives

This study aimed to highlight phytotherapeutic modulation, under the action of *Lepidium meyenii* (LM) product (LMP), on anxiety (A), glycemia (G) and salivary pH (SpH), in physical stress caused by walking very fast on the treadmill, in sedentary subjects.

Material and methods

Research protocol

a) Period and place of the research

An informed consent was obtained from each participant, according to the Declaration of Helsinki. The study was carried out in the 103 Family Medicine Cabinet in Cluj-Napoca, in December 2018.

b) Subjects and groups

A number of 24 volunteer healthy men were randomized to: the control group (C=8), without treatment; a group that received LMP for 12 days (LM1=8); a group receiving LMP for 21 days (LM2=8). The participants' average age was: 29.1±3 (C), 30.2±3 (LM1), 31.4±4 (LM2). The volunteer subjects came from several fitness centers near the family medicine office, and at the family medicine office the work place was set up, under medical supervision. The treadmill was borrowed from one of these fitness centers. All participants were asked not to smoke, not to consume coffee, alcohol, and not to use any medication or antioxidant the day before and during the physical effort. The study did not include persons with mental disorders, toxic addiction and cortisone therapies.

c) Tests applied

1) Study design

Before physical testing, all participants had a 4-min muscle heating session, on the treadmill (Technogym Myrun) adjusted to 30 watts, and after a 10 min break, they followed the testing exercise session, on the same treadmill: starting with a power of 30 watts, for four minutes, followed by a gradual increase of power and continuing until the appearance of the feeling of fatigue, perceived by each subject.

The chosen phytotherapeutic preparation contains *Lepidium meyenii* (Maca) root powder (500 mg) (1). *Lepidium meyenii* product (LMP) was given for 12 (LM1) and 21 (LM2) days, respectively, in a dose of 3 tablets per day, at 8.00-14.00-20.00, prior to physical stress.

2) *The indicator determination program* was the same for C, LM1, LM2, being carried out as follows:

- time 1 = T1 - before LM treatment
- time 2 = T2 - 15 min before exercise
- time 3 = T3 - 30 min after exercise
- time 4 = T4 - 4 h after exercise

3) Explorations

The examinations consisted of measuring:

- *anxiety (A)* - evaluated with Beck Anxiety Inventory (2): this scale is a self-report measure of anxiety, with 21 items. Scoring: 0 = not at all; 1 = mildly, but it didn't bother me much; 2 = moderately, it wasn't pleasant at times; 3 = severely, it bothered me a lot. The total score is the sum

of the 21 items: 0-21 = low anxiety; 22-35 = moderate anxiety; ≥ 36 = concerning anxiety.

- *glycemia (G)* - evaluated with a portable glucometer (mg/dl).

- *salivary pH (SpH)* - evaluated with the PHS-3G laboratory acidity meter, following a protocol according to an already developed model (Baliga et al., 2013): saliva was collected in the morning, after a 10-hour fast, during which subjects could only drink water; the subjects were asked to thoroughly rinse their mouth with bottled drinking water, and after 5 minutes to spit the entire saliva into the collector tube by flowing naturally to the front of the mouth, once a minute, for up to 10 minutes; during collection, the subjects were asked not to cough, talk, or lower their heads; the amount of collected saliva was 5 ml.

d) Statistical processing

The results obtained were analyzed using SPSS 19.0. statistical package.

For continuous data examination, Student's t test was used.

Results

We considered the parameter values for LM1 as a benchmark.

A. Anxiety (A) analysis (Table I)

For all groups, the dynamics of A was the same: the highest values were recorded immediately pre-stress (T2); the immediate post-stress values (T3) were close to immediate pre-stress values (T2); at 4 hours post-stress

(T4), A values remained elevated compared to T1.

At T2, T3 and T4: the A values for C, compared to LM1 and LM2, were the highest; the values for LM2 were the lowest. C-LM1 differences were significant at T2 ($p = 0.00001$), T3 ($p = 0.00001$) and T4 ($p = 0.00001$). LM1-LM2 differences were significant at T2 ($p = 0.00134$), T3 ($p = 0.000075$) and T4 ($p = 0.00197$). T2-T3 differences were: not significant for C ($p = 0.06545$) and significant for LM1 ($p = 0.0002$) and LM2 ($p = 0.000034$).

B. Glycemia (G) analysis (Table II)

For all groups, G dynamics was the same: pre-treatment (T1) values were close to immediate pre-stress values (T2); the highest values were registered - immediately post-stress (T3); at 4 hours post-stress (T4), G values remained elevated compared to T1 and close to those at T3.

At T3 and T4: G values for C - compared to LM1 and LM2 - were the highest; G values for LM2 were the lowest. C-LM1 differences were significant at T2 ($p = 0.00001$), T3 ($p = 0.00001$) and T4 ($p = 0.00001$). LM1-LM2 differences were significant at T3 ($p = 0.00888$) and T4 ($p = 0.39798$). T3-T4 differences were: not significant for C ($p = 0.05978$) and significant for LM1 ($p = 0.0193$) and LM2 ($p = 0.0004$).

C. Salivary pH (SpH) analysis (Table III)

For all groups, SpH dynamics was the same: pre-treatment values (T1) were close to immediate pre-stress values (T2); the highest values were recorded immediately post-stress (T3); at 4 hours post-stress (T4), SpH values remained elevated compared to T1 and close to those at T3.

Table I
Values for anxiety at moments T1-T4

Time	T1			T2			T3			T4		
Group	C	LM1	LM2	C	LM1	LM2	C	LM1	LM2	C	LM1	LM2
Mean	1.975	2.062	1.775	31.125	19.25	15.5	30.125	14.75	9.75	25.375	4.2375	3.1125
SD	0.2904	0.2175	0.3031	1.1659	1.7853	2.0615	1.1659	1.8540	1.7853	1.2183	0.5360	0.6772
Comparison with LM1 - p value	0.2669			0.0304 <.00001			0.0013 <.00001			0.00007 <.00001		
T2-T3 comparison - p value							0.06545 0.0002 0.00003					

Table II
Values for glycemia at moments T1-T4.

Time	T1			T2			T3			T4		
Group	C	LM1	LM2	C	LM1	LM2	C	LM1	LM2	C	LM1	LM2
Mean	71.25	71.625	70.875	71.25	72.625	73.5	148.75	131.25	123.875	146.125	123	114.5
SD	2.5860	7.4843	3.6550	2.1650	1.9960	2.7386	2.9047	6.3196	3.586	9.1093	7.1763	4.5552
Comparison with LM1 - p value	0.3979			0.3352 <.00001			0.0551 <.00001			0.00888 <.00001		
T3-T4 comparison - p value										0.0597 0.0193 0.0004		

Table III
Values for salivary pH at moments T1-T4

Time	T1			T2			T3			T4		
Group	C	LM1	LM2	C	LM1	LM2	C	LM1	LM2	C	LM1	LM2
Mean	7.34	7.325	7.2375	7.3375	7.3625	7.2	8.4	8	7.6625	8.2125	7.6125	7.0625
SD	0.1798	0.1713	0.1866	0.1653	0.1408	0.1	0.1	0.1732	0.2446	0.3620	0.1832	0.2287
Comparison with LM1 - p value	0.448			0.1882 0.3826			0.3233 0.00006			0.0049 0.0007		
T3-T4 comparison - p value										0.1039 0.0006 0.0006		

At T3 and T4: SpH values for C, compared to LM1 and LM2, were the highest; SpH values for LM2 were the lowest. C-LM1 differences were significant at T3 ($p=0.00006$) and T4 ($p=0.00079$). LM1-LM2 differences were significant at T3 ($p=0.00498$) and T4 ($p=0.00016$). T3-T4 differences were: not significant for C ($p=0.1039$) and significant for LM1 ($p=0.00059$) and LM2 ($p=0.00066$).

D. Intergroup analysis, related to T2/T1, T2/T3, T2/T4

a) *Anxiety* (Fig. 1). For all groups: the greatest differences between ratios were for T2/T1, and the smallest ones were for T2/T4. The T2/T1 ratio was the highest for C (15.7), and the lowest for LM2 (8.73). The T2/T4 and T2/T4 ratios were the lowest for C (1.03, and 1.23 respectively) and the highest for LM2 (1.59 and 4.9 respectively).

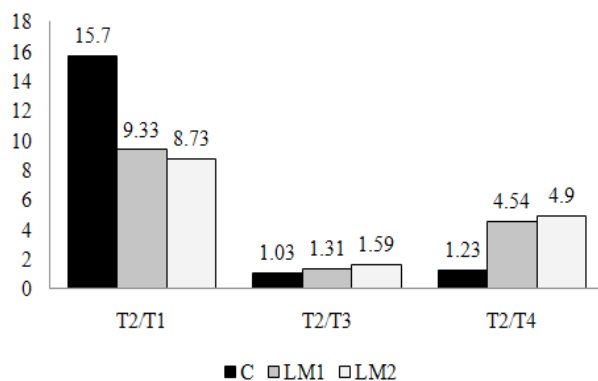


Fig. 1 – Intergroup analysis, related to anxiety, for: T2/T1, T2/T3, T2/T4.

b) *Glycemia* (Fig. 2). The greatest differences between the ratios were for T3/T1 (C=2.09, LM2=1.74) and T3/T2 (C=2.09, LM1=1.9), and the smallest ones were for T3/T4. The T3/T1 and T3/T2 ratios were highest for C (both 2.09) and the lowest for LM2 (1.74 and 1.69 respectively). The T3/T4 ratio was the lowest for C (1.02), and the highest for LM2 (1.09).

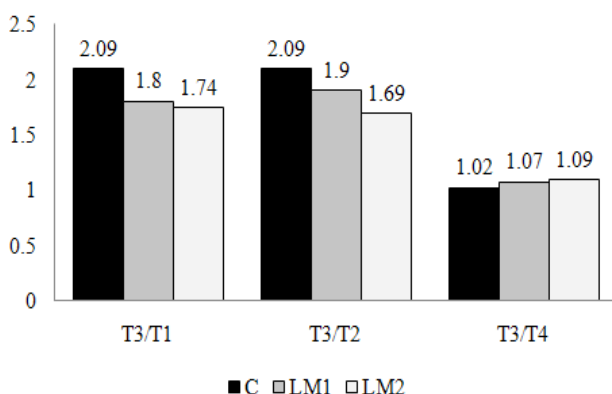


Fig. 2 – Intergroup analysis, related to glycemia, for: T3/T1, T3/T2, T3/T4.

c) *Salivary pH* (Fig. 3). The greatest differences between the ratios were for T3/T1, and the smallest ones were for T3/T4 (C=1.02; LM1=1.05). The T3/T1

and T3/T2 ratios were the highest for C (1.15 and 1.14 respectively) and the lowest for LM2 (1.07 for both). The T3/T4 ratio was the lowest for C (1.02), and the highest for LM2 (1.09).

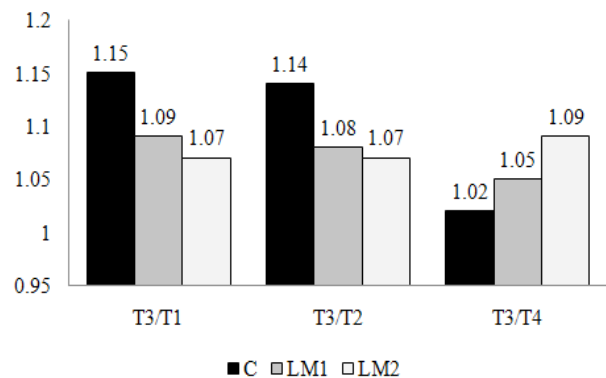


Fig. 3 – Intergroup analysis, related to salivary pH, for: T3/T1, T3/T2, T3/T4.

Discussion

1) Analysis of the results of the present study

The evolution of A, for all groups, had the highest increase in T2 values, which proves an anticipatory effect of stress, immediately prior to its production. The evolution of G and SpH, for all groups, had the highest increases in values at T3, which proves an important effect of stress immediately after its production.

The effect of physical stress on all parameters was the most intense for C. For A, the highest values being at T2 and T3, we compared the T2-T3 differences: it was found that the A values diminished immediately post-stress in LM2 ($p=0.000034$), compared to C ($p=0.0002$) and LM1 ($p=0.06545$). For G and SpH, the highest values being at T3 and T4, we compared the T3-T4 differences: G and SpH were found to be the lowest in LM2 at 4 hours post-stress (G, $p=0.000034$; SpH, $p=0.00066$), compared to C (G, $p=0.0002$; SpH, $p=0.00059$) and LM1 (G, $p=0.06545$; SpH, $p=0.1039$).

From the perspective of time ratios, it was found that the lowest effect of stress was on LM2. Parameter values increased the least, compared to T1: at T2, for A (T2/T1=8.73); at T3, for G (T3/T1=1.74) and SpH (T3/T1=1.07). Parameter values decreased the most, compared to T2: at T3, for A (T2/T3=1.59); at T4, for A (T2/T4=4.9), G (T3/T4=1.09) and SpH (T3/T4=31.09).

Therefore, PML provided a good anti-stress protection, the effect being much more important after 21 days (LM2) than after 12 days (LM1), the evidence being the significant LM1-LM2 differences at T2 (A, $p=0.00134$), at T3 (A, $p=0.000075$, G, $p=0.00888$, SpH, $p=0.00498$) and T4 (A, $p=0.00197$; G, $p=0.00959$; SpH, $p=0.00016$).

2) *Lepidium*. Pubmed chronological evidence

a) *Lepidium* - History and framing

Of the varied flora of the Andes (Flores et al., 2003) - also part of *Lepidium meyenii* (maca), - a cruciferous plant of different colors (Gonzales et al., 2009), of the genus *Lepidium* (Meissner et al., 2015), the only one in the world that grows natively at an altitude of 4,000-4,400 m (Tello et al., 1992).

b) *Lepidium* - Stress

Lepidium is known and used as an adaptogen (López-Fando et al., 2004) and as an antioxidant (Zha et al., 2014). *Lepidium* has a high content of polysaccharides (Zha et al., 2014). Animal studies have shown *Lepidium* efficiency by: protecting the alteration of spermatogenesis due to altitude stress (Gonzales et al., 2004); inhibition of lipid peroxidation (Gonzales-Castañeda et al., 2011); the antidepressant effect (Ai et al., 2014); protection against physical fatigue (Choi et al., 2012); reduction of oxidative stress, evidenced by decreased malondialdehyde (Yang et al., 2016); reduction of lactic acid under conditions of intense physical exertion (Tang et al., 2017).

c) *Lepidium* - Sport

Due to its valuable composition of polysaccharides, *Lepidium* is effective in sports: it improves the capacity of resistance to swimming (Choi et al., 2012); reduces post-exercise fatigue (Yang et al., 2016; Li et al., 2018); increases the duration of physical effort in swimming and its speed of achievement (Tang et al., 2017); extends the exhaustive swimming time (Zheng et al., 2019).

d) *Lepidium* - Anxiety

Lepidium has been shown to be effective in modulating stress: it reduces corticosterone (López-Fando et al., 2004); reduces anxiety and depression (Brooks et al., 2008); modulates diastolic blood pressure (Stojanovska et al., 2015); and increases libido (Gonzales et al., 2009).

e) *Lepidium* - Glycemia

Lepidium has beneficial effects in modulating blood sugar: it reduces blood sugar in diabetic rats (Eddouks et al., 2005; Gonzales et al., 2013); increases glucose tolerance (Vecera et al., 2007); normalizes blood glucose and glycosuria (Eddouks & Maghrani, 2008); reduces glycemia after exposure to low and high altitude (Gonzales-Arimborgo et al., 2016); after exposure to methanol, it normalizes blood sugar, improves lipid levels and reduces oxidative stress (Attia et al., 2019).

The results obtained in our study on anxiety and glycemia, by using a *Lepidium meyenii* product, are consistent with data from recent studies related to the changes of these parameters, under the action of stress, sport and *Lepidium* species. This study also confirms the modulating effect of *Lepidium meyenii* on anxiety and glycemia. The difference from the quoted studies is that our study has shown the effectiveness of *Lepidium meyenii* administration not only on anxiety and glycemia, but also on salivary pH, in physical stress caused by walking very fast on the treadmill, in sedentary subjects.

Conclusions

1. Dynamic developments of A, G, SpH were different for C, LM1/ LM2.
2. LM significantly reduced A/G, increased SpH, with a more important influence on A.
3. LM2 effect was more intense compared to LM1.
4. We suggest that LM may be useful in A, G, SpH modulation, in stress caused by walking very fast on the treadmill, in sedentary people, but further research is needed.

Conflicts of interest

Nothing to declare.

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References

- Ai Z, Cheng AF, Yu YT, Yu LJ, Jin W. Antidepressant-like behavioral, anatomical, and biochemical effects of petroleum ether extract from maca (*Lepidium meyenii*) in mice exposed to chronic unpredictable mild stress. *J Med Food*. 2014;17(5):535-542. doi: 10.1089/jmf.2013.2950.
- Attia ES, Amer AH, Hasanein MA. The hypoglycemic and antioxidant activities of garden cress (*Lepidium sativum* L.) seed on alloxan-induced diabetic male rats. *Nat Prod Res*. 2019;33(6):901-905. doi: 10.1080/14786419.2017.
- Baliga S, Muglikar S, Kale R. Salivary pH: A diagnostic biomarker. *J Indian Soc Periodontol*. 2013;17(4):461-465. DOI: 10.4103/0972-124X.118317
- Brooks NA, Wilcox G, Walker KZ, Ashton JF, Cox MB, Stojanovska L. Beneficial effects of *Lepidium meyenii* (Maca) on psychological symptoms and measures of sexual dysfunction in postmenopausal women are not related to estrogen or androgen content. *Menopause*. 2008;15(6):1157-1162. doi: 10.1097/gme.0b013e3181732953.
- Choi EH, Kang JI, Cho JY, Lee SH, Kim TS, Yeo IH, Chun HS. Supplementation of standardized lipid-soluble extract from maca (*Lepidium meyenii*) increases swimming endurance capacity in rats. *J Funct Foods* 2012;4(2):568-573.
- Cosio-Lima LM, Desai B, Stelzer JW, Schuler PB. Effects of 4:1 carbohydrate/protein solution versus a carbohydrate-alone solution on IL-6, TNF- α , and cortisol during prolonged cycling in hot environmental conditions. *Open Access J Sports Med*. 2012;15:3:21-6. doi: 10.2147/OAJSM.S28176.
- Cui B, Zheng BL, He K, Zheng QY. Imidazole alkaloids from *Lepidium meyenii*. *J Nat Prod*. 2003;66(8):1101-1103. DOI:10.1021/np030031i.
- Dini A, Migliuolo G, Rastrelli L, Saturnino P, Schettino O. Chemical composition of *Lepidium meyenii*. *Food Chem*. 1994;49(4):347-349.
- Eddouks M, Maghrani M, Zeggwagh NA, Michel JB. Study of the hypoglycaemic activity of *Lepidium sativum* L. aqueous extract in normal and diabetic rats. *J Ethnopharmacol*. 2005;97(2):391-395. DOI:10.1016/j.jep.2004.11.030.
- Eddouks M, Maghrani M. Effect of *Lepidium sativum* L. on renal glucose reabsorption and urinary TGF-beta 1 levels in diabetic rats. *Phytother Res*. 2008;22(1):1-5. DOI:10.1002/ptr.2101.
- Flores HE, Walker TS, Guimaraes RL, Bais HP, Vivanco JM. Andean root and tuber crops: Underground rainbows. *Hortscience*. 2003;38(2):161-167
- Gonzales GF, Gonzales-Castañeda C, Gasco M. A mixture of extracts from Peruvian plants (black maca and yacon) improves sperm count and reduced glycemia in mice with streptozotocin-induced diabetes. *Toxicol Mech Methods*. 2013; 23(7):509-518. doi: 10.3109/15376516.2013.785656.
- Gonzales GF, Gasco, M, Cordova, A, Chung, A, Rubio, J, & Villegas, L. Effect of *Lepidium meyenii* (Maca) on spermatogenesis in male rats acutely exposed to high altitude (4340 m). *Journal of Ethnopharmacology*. 2004;180(1):87-95. DOI:10.1677/joe.0.1800087.
- Gonzales GF, Gonzales C, Gonzales-Castañeda C. *Lepidium meyenii* (Maca): a Plant from the Highlands of Peru - from tradition to science. *Res Complement Med*. 2009;16(6):373-380.

- Gonzales GF, Villaorduña L, Gasco M, Rubio J, Gonzales C. [Maca (*Lepidium meyenii* Walp), a review of its biological properties] [Article in Spanish]. *Rev Peru Med Exp Salud Publica*. 2014;31(1):100-110.
- Gonzales-Arimborgo C, Yupanqui I, Montero E, Alarcón-Yaquette DE, Zevallos-Concha A, Caballero L, Gasco M, Zhao J, Khan IA, Gonzales GF. Acceptability, Safety and Efficacy of Oral Administration of Extracts of Black or Red Maca (*Lepidium meyenii*) in Adult Human Subjects: A Randomized, Double-Blind, Placebo-Controlled Study. *Pharmaceuticals (Basel)*. 2016;9(3). pii: E49. doi: 10.3390/ph9030049.
- Gonzales-Castañeda C, Rivera V, Chirinos AL, Evelson P, Gonzales GF. Photoprotection against the UVB-induced oxidative stress and epidermal damage in mice using leaves of three different varieties of *Lepidium meyenii* (maca). *Int J Dermatol*. 2011;50(8):928-938. doi: 10.1111/j.1365-4632.2010.04793.x.
- Hermann R, Lay D, Wahl P, Roth WT, Petrowski K. Effects of psychosocial and physical stress on lactate and anxiety levels. *Stress*. 2019;22(6):664-669. doi: 10.1080/10253890.2019.1610743
- Huang SC, Lee FT, Kuo TY, Yang JH, Chien CT. Attenuation of long-term *Rhodiola rosea* supplementation on exhaustive swimming-evoked oxidative stress in the rat. *Chin J Physiol*. 2009;52(5):316-324.
- Jurcău R, Jurcău I, Kwak DH, Grosu VT, Ormenisan S. Eleutherococcus, Schisandra, *Rhodiola* and Ginseng, for stress and fatigue - a review. *J Health, Sports Rehab Med*. 2019;20(1):12-17.
- Jurcău R, Jurcău I, Kwak DH. Brief analysis of the Sport-Ginseng relationship, from the perspective of PubMed publications. *Palestrica Third Mill Civiliz Sport*. 2018;20(4):212-216.
- Jurcău RN, Jurcău IM, Colceriu NA. Influence of *Rhodiola Rosea* product and physical training, on acute physical stress. *Acta Physiologica*. 2017;221:148.
- Jurcău RN, Jurcău IM. *Rhodiola rosea*'s relationship with stress, physical fatigue and endurance; a PubMed evaluation. *Palestrica Third Mill Civiliz Sport*. 2018;19(1):17-22.
- Keselman B, Vergara M, Nyberg S, Nystrom FH. A randomized cross-over study of the acute effects of running 5 km on glucose, insulin, metabolic rate, cortisol and Troponin T. *PLoS One*. 2017;12(6):e0179401. doi: 10.1371/journal.pone.0179401. eCollection 2017
- Kimura Y, Sumiyoshi M. Effects of various *Eleutherococcus swenticosus* cortex on swimming time, natural killer activity and corticosterone level in forced swimming stressed mice. *J Ethnopharmacol*. 2004;95(2-3):447-453. DOI:10.1016/j.jep.2004.08.027.
- Li Y, Xin Y, Xu F, Zheng M, Xi X, Cui X, Cao H, Guo H, Han C. Maca polysaccharides: Extraction optimization, structural features and anti-fatigue activities. *Int J Biol Macromol*. 2018;115:618-624. doi: 10.1016/j.ijbiomac.2018.04.063.
- López-Fando A, Gómez-Serranillos MP, Iglesias I, Lock O, Upamayta UP, Carretero ME. *Lepidium peruvianum* chacon restores homeostasis impaired by restraint stress. *Phytother Res*. 2004;18(6):471-474. DOI:10.1002/ptr.1455.
- Masoudi N, Ibanez-Cruceyra P, Offenburger SL, Holmes A, Gartner A. Tetraspanin (TSP-17) Protects dopaminergic neurons against 6-OHDA-induced neurodegeneration in *C. elegans*. *PLoS Genet*. 2014;10(12):1-15. doi: 10.1371/journal.pgen.1004767.
- Meissner HO, Mscisz A, Mrozikiewicz M, Baraniak M, Mielcarek S, Kedzia B, Piatkowska E, Jólkowska J, Pisulewski P. Peruvian Maca (*Lepidium peruvianum*): (I) Phytochemical and Genetic Differences in Three Maca Phenotypes. *Int J Biomed Sci*. 2015;11(3):131-145.
- Monea D, Ormenişan S, Bondoc-Ionescu D, Monea G. Methods for the inventory of stress produced by the resistance to the effort in junior football game. *Studia Universitatis Babeş-Bolyai, Educatio Artis Gymnasticae*. 2011;56(2):37-42.
- Ormenian S. The psycho-behavioral indices of the football players. *Studia Universitatis Babeş-Bolyai, Educatio Artis Gymnasticae*. 2008a;53(1):157-164.
- Ormenişan S. Tendencies in the training of professional players. *Studia Universitatis Babeş-Bolyai, Educatio Artis Gymnasticae*. 2008b;53(1):141-150.
- Panossian A, Seo EJ, Efferth T. Novel molecular mechanisms for the adaptogenic effects of herbal extracts on isolated brain cells using systems biology. *Phytomedicine*. 2018;50:257-284.
- Panossian AG. Adaptogens in mental and behavioral disorders. *Psychiatr Clin North Am*. 2013;(1):49-64. doi: 10.1016/j.psc.2012.12.005.
- Qiu C, Zhu T, Lan L, Zeng Q, Du Z. Analysis of maceane and macamide contents of petroleum ether extract of black, yellow, and purple *Lepidium meyenii* (Maca) and their antioxidant effect on diabetes mellitus rat model. *Brazilian Arch Biol Technol*. 2016;59:1-9.
- Qureshi M, Mehjabeen, Noorjahan, Muhammad S, Siddiqui FA, Baig I, Ahmad M. Phytochemical and biological assessments on *Lepidium meyenii* (maca) and *Epimedium sagittatum* (horny goat weed). *Pak J Pharm Sci*. 2017;30(1):29-36.
- Rodrigo ME, Valdivieso R, Suárez S, Oriondo-Gates R, Oré R. Disminución del daño oxidativo y efecto hipoglicemiante de la maca (*Lepidium meyenii* Walp) en ratas con diabetes inducida por streptozotocina. *An. Fac. Med*. 2011;72(1):7-11. DOI: 10.15381/anales.v72i1.1095.
- Rodríguez-Huamán Á, Casimiro-Gonzales S, Chávez-Pérez JA, Gonzales-Arimborgo C, Cisneros-Fernández R, Aguilar-Mendoza LA, Gonzales GF. Antioxidant and neuroprotector effect of *Lepidium meyenii* (maca) methanol leaf extract against 6-hydroxy dopamine (6-OHDA)-induced toxicity in PC12 cells. *Toxicol Mech Methods*. 2017;27(4):279-285. doi: 10.1080/15376516.2016.1275908.
- Roncero G, Ramos W, Garmendia F, Arroyo J, Gutiérrez J. Eficacia de la maca fresca (*Lepidium meyenii* WALP) en el incremento del rendimiento físico de deportistas en altura. *An Fac Med*. 2005;66(4):269-273.
- Stojanovska L, Law C, Lai B, Chung T, Nelson K, Day S, Apostolopoulos V, Haines C. Maca reduces blood pressure and depression, in a pilot study in postmenopausal women. *Climacteric*. 2015;18(1):69-78.
- Stone M, Ibarra A, Roller M, Zangara A, Stevenson E. A pilot investigation into the effect of maca supplementation on physical activity and sexual desire in sportsmen. *J Ethnopharmacol*. 2009;126(3):574-576. doi: 10.1016/j.jep.2009.09.012.
- Tang W, Jin L, Xie L, Huang J, Wang N, Chu B, Dai X, Liu Y, Wang R, Zhang Y. Structural Characterization and Antifatigue Effect In Vivo of Maca (*Lepidium meyenii* Walp) Polysaccharide. *J Food Sci*. 2017;82(3):757-764. doi: 10.1111/1750-3841.13619.
- Tello J, Hermann M, Calderón A. La maca (*Lepidium meyenii* Walp.) cultivo alimenticio potencial para las zonas altoandinas. *Bol Lima*. 1992;14:59-66.
- Vecera R, Orolin J, Skottová N, Kazdová L, Oliyarnik O, Ulrichová J, Simánek V. The influence of maca (*Lepidium meyenii*) on antioxidant status, lipid and glucose metabolism in rat. *Plant Foods Hum Nutr*. 2007 Jun;62(2):59-63. DOI:10.1007/s11130-007-0042-z.

- Yang Q, Jin W, Lv X, Dai P, Ao Y, Wu M, Deng W, Yu L. Effects of macamides on endurance capacity and anti-fatigue property in prolonged swimming mice. *Pharm Biol.* 2016;54(5):827-834. doi: 10.3109/13880209.2015.1087036.
- Yang QY, Lai XD, Ouyang J, Yang JD. Effects of Ginsenoside Rg3 on fatigue resistance and SIRT1 in aged rats. *Toxicology.* 2018;409:144-151. doi: 10.1016/j.tox.2018.08.010.
- Zha S, Zhao Q, Chen J, Wang L, Zhang G, Zhang H, Zhao B. Extraction, purification and antioxidant activities of the polysaccharides from maca (*Lepidium meyenii*). *Carbohydr. Polym.* 2014;111:584-587. doi: 10.1016/j.carbpol.2014.05.017.
- Zhao J, Avula B, Chan M, Clément C, Kreuzer M, Khan IA. Metabolomic differentiation of maca (*Lepidium meyenii*) accessions cultivated under different conditions using NMR and chemometric analysis. *Planta Med.* 2012;78(1):90-101. doi:10.1055/s-0031-1280117.
- Zheng Y, Zhang WC, Wu ZY, Fu CX, Hui AL, Gao H, Chen PP, Du B, Zhang HW. Two macamide extracts relieve physical fatigue by attenuating muscle damage in mice. *J Sci Food Agric.* 2019;99(3):1405-1412. doi: 10.1002/jsfa.9318.
- Websites**
- (1) <https://www.daciaplant.ro/macca-69-comprimare.html>. Accessed in December 2018.
- (2) <https://www.gphealth.org/media/1087/anxiety.pdf>. Accessed in December 2018.

An opinion survey of doctors who attended a postgraduate course regarding spices and their use in sports

Ramona Jurcău¹, Ioana Jurcău², Cornelia Popovici³

¹Department of Pathophysiology, Medicine Faculty, “Iuliu Hațieganu” University of Medicine and Pharmacy, Cluj-Napoca, Romania

²Emergency Clinical Hospital for Children, Cluj-Napoca, Romania

³Department of Physical Education and Sport, Medicine Faculty, “Iuliu Hațieganu” University of Medicine and Pharmacy, Cluj-Napoca, Romania

Abstract

Background. Spices (SPS) have proved to be useful also in sports. The objective was to evaluate medical doctors' (MD) opinion before/after a postgraduate medical course (PGC) about SPS and their use in sport (SPS-S).

Aim. It was to evaluate medical doctors' (MD) opinion before/after a postgraduate medical course (PGC) about spices (SPS) and SPS in sport (SPS-S).

Methods. A number comprising 94-MD answered a detailed questionnaire: 1) What are SPS? 2) How many SPS-PGC did you attend? 3) Which are the native SPS-countries? 4) How many SPS types do you know? 5) What are the main SPS effects/mechanisms? 6) What are the age groups to which SPS can be administered? 7) Which SPS modulate oxidative stress? 8) Which SPS influence endurance? 9) Which SPS are useful in physical fatigue? 10) Which SPS are useful in muscle soreness? 11) Which SPS are useful in exercise performance? 12) Which SPS are useful in sports? 13) On a scale of 1-10 how much did this course help you know more about SPS/ SPS-S? For data analysis we used the percentage of the total number of participants (% of N) who responded to each subitem.

Results. Most MD responses: 1) SPS are plants; 2) None; 3) Asian countries; 4) Four; 5) Increased immunity, antioxidant; 6) All less children; 7) Ginger, Cardamom, Curcumin; 8) I don't know; 9) Ginger; 10) I don't know; 11) Ginger; 12) Ginger. 13) 9.3.

Conclusions. 1) This PGC seems to be the first one regarding SPS. 2) Initially, most MDs had little SPS knowledge regarding SPS/SPS-S. 3) At the end of PGC, MDs demonstrated good accumulation of SPS information. 4) This PGC reached the goal of providing basic information about SPS/SPS-S, but additional SPS-related training is needed.

Keywords: spices, spices course, medical doctors, spices in sport.

Introduction

The concept of returning to the “roots” of medicine has been revived at present (Salehi et al., 2019). In human history and nutrition, spices have played an important role in the development of most cultures worldwide; they are part of substances added to foods, useful to enhance their aroma and taste (García-Casal et al., 2016). In cooking, different parts of plants, commonly referred to as herbs or spices, can be used: leaves, roots, bark, fruits, buds, seeds; spices have been used in gastronomic history to enhance the taste of food, being used, for example, for meat preparations, for sauces, vegetables and desserts (Opara & Chohan, 2014) or for drinks, to enhance their aroma and color (Yashin et al., 2017).

Over time, condiments have shown many benefits in preventing and treating a wide variety of ailments, such as aging, metabolic, neurological, cardiovascular and inflammatory diseases (Gottardiet al., 2016). These benefits are due to their multiple actions, such as antioxidant, anti-inflammatory, reducing glucose and cholesterol, improving cognition and mood (Jiang, 2019). Thus, in order to prevent and control many chronic diseases associated with malnutrition, in addition to caloric control and exercise, a spicy diet could also be considered (Nilius & Appendino, 2013). Underlying the actions of spices is the composition rich in different compounds, including polyphenols, which are increasingly studied, proving that they have a number

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Address for correspondence: “Iuliu Hațieganu” University of Medicine and Pharmacy Cluj-Napoca 400012, Victor Babes Str. no. 8

E-mail: ramona_mj@yahoo.com

Corresponding author: Ramona Jurcău; ramona_mj@yahoo.com

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of important properties (Opara & Chohan, 2014).

It has been proven that herbs and spices have an excellent antioxidant activity. They are rich sources of antioxidants, thus being useful for treating oxidative stress-induced diseases (Yashin et al., 2017). Thus, spices have an effect on lipid peroxidation, by eliminating reactive oxygen species or by chelating the metal ions required to initiate lipid peroxidation (Shobana & Naidu, 2000). It has been found that synergism exists between the different phytochemical components of spices, as spices as a whole are more potent antioxidants than their purified active extracts (Patra et al., 2016).

Oxidative stress is correlated with muscle fatigue (Li et al., 2017). Thus, physical exercise results in an increase in the production of radicals and other forms of reactive oxygen species (ROS), which are the basis of oxidative disorders; these redox disorders induced by exercise in skeletal muscles contribute to the production of muscle fatigue and muscle injury (Powers & Lennon, 1999). Sport is an area that interferes more and more with that of plant extracts and various plant products, given their multiple health benefits. Thus, the antioxidative actions of some plants and plant-derived compounds on physical exertion are already demonstrated (Avakian et al., 1984; Abidov et al., 2003; Huang et al., 2009; Jówko et al., 2011; Jurcău & Jurcău, 2017). Also, different plant extracts have been shown to have beneficial effects in increasing endurance (Murase et al., 2006; Lee et al., 2009; Panossian, 2013; Jurcău & Jurcău, 2018) and performance (Yang et al., 2018; Jurcău et al., 2019) and reduce physical fatigue (Kimura & Sumiyoshi, 2004; Khanum et al., 2005; Yang et al., 2018; Jurcău et al., 2019).

Objectives

The aim was to evaluate medical doctors' (MD) opinion before/after a postgraduate medical course (PGC) about spices (SPS) and SPS in sport (SPS-S).

Material and methods

Research protocol

a) Period and place of the research

The study and measurements were carried out in July 2018 at the "Iuliu Hațieganu" University of Medicine and Pharmacy. Participation of all subjects in the study was voluntary. The article capitalizes the results of a postgraduate course approved by the College of Physicians and held in 2018.

b) Subjects

The subjects were MDs of different specialties: 44 men and 50 women (N = 94). The average age of the participants was: 42.4 ± 9 for men; 49.9 ± 4 for women. All MD participants attended the same postgraduate course, on the topic of spices in sports.

c) Tests applied

- Study design

All MD subjects answered a detailed questionnaire, developed by Jurcău RN and Jurcău IM for the evaluation of this course, which contained 13 items, with their subitems (Table I).

- The determination program was as follows:

The participants answered the first 12 items 15 minutes before the course, and the last item, 13, 15 minutes after the end of the course.

d) Evaluation

For data analysis we used the percentage of the total number of participants (% of N) who responded to each subitem.

Table I
Items and subitems of the applied questionnaire.

Items	Subitems									
1) What are SPS?	I do not know		Flavors		Extracts			Plants		
2) How many SPS-PGC did you attend?	1		2		3			To none		
3) Which are the native SPS-countries?	I don't know		I know - enumeration:							
4) How many SPS types do you know?	<4		4				>4			
5) What are the main SPS effects/mechanisms?	I don't know		I know - enumeration:							
6) What are the age groups to which SPS can be administered?	I don't know		0-18	19-44	45-64	65-90	>90			
7) Which SPS modulate oxidative stress?	I don't know		I know - enumeration:							
8) Which SPS influence endurance?	I don't know		I know - enumeration:							
9) Which SPS are useful in physical fatigue?	I don't know		I know - enumeration:							
10) Which SPS are useful in muscle soreness?	I don't know		I know - enumeration:							
11) Which SPS are useful in exercise performance?	I don't know		I know - enumeration:							
12) Which SPS are useful in sports?	I don't know		I know - enumeration:							
13) On a scale of 1-10 how much did this course help you know more about SPS/ SPS-S?	1	2	3	4	5	6	7	8	9	10

Results

The presentation is in the order of the items in the questionnaire.

1) *What are SPS?* (Fig. 1) MD answers: 71.4% mentioned that SPS are plants; 3.1% answered that SPS are flavors; 20.6% mentioned that ADPs are extracts; 4.9% did not know.

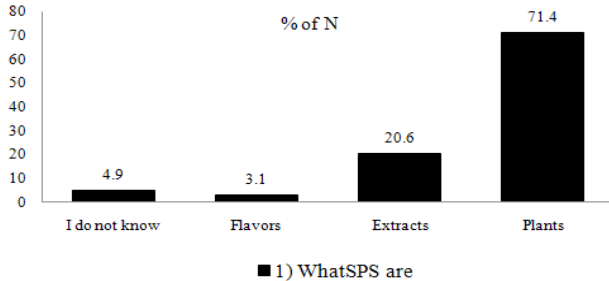


Fig. 1 – The percentage of respondents of N, for item 1.

2) *How many SPS courses did you attend?* (Fig. 2) All participants (100%) mentioned that they had not attended another SPS course.

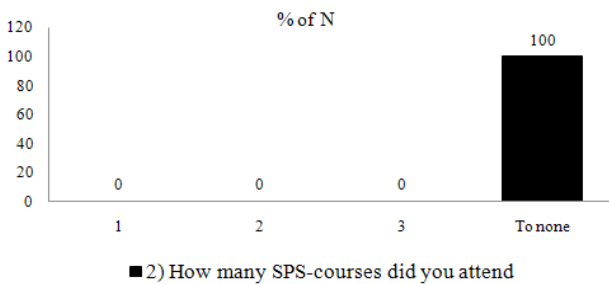


Fig. 2 – The percentage of respondents of N, for item 2.

3) *What are the native SPS countries?* (Fig. 3) The mentions for SPS countries were: 40% for India; 24% for countries of Arab origin; 19% for Mediterranean countries; 13% for yellow race countries (China, Japan, Korea); 4% for other countries; 0% did not know.

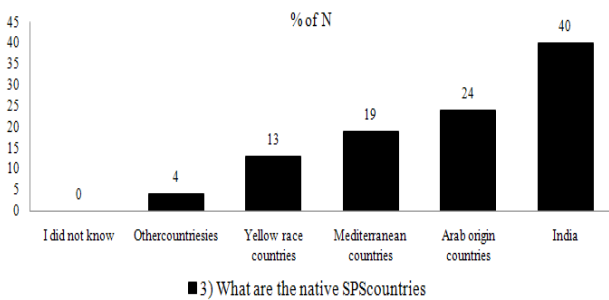


Fig. 3 – The percentage of respondents of N, for item 3.

4) *How many SPS types do you know?* (Fig. 4) The mentions for SPS types were: 49% for four types (pepper, cinnamon, cardamom, ginger); 30% more than four; 21% less than four.

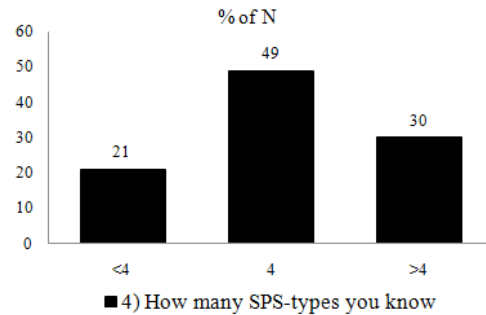


Fig. 4 – The percentage of respondents of N, for item 4.

5) *What are the main SPS effects/mechanisms?* (Fig. 5) The mentions for SPS types were: 42.2% for increase in immunity; 31.4% for antioxidant effects; 19.3% for other effects; 7.1% did not know.

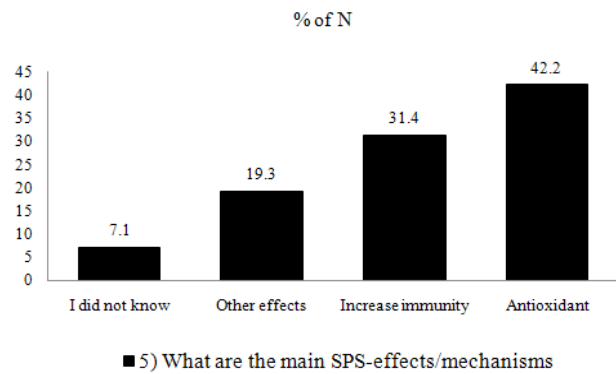


Fig. 5 – The percentage of respondents of N, for item 5.

6) *What are the age groups to which SPS can be administered?* (Fig. 6) The mentions for the age groups to which SPS can be administered were: 1.2% did not know; 3% for 0-18; 40.9% for 19-44; 31.9% for 45-64; 19% for 65-90; 4% for >90.

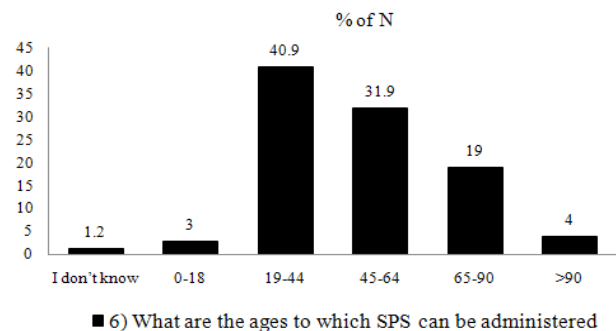


Fig. 6 – The percentage of respondents of N, for item 6.

7) Which SPS modulate oxidative stress? (Fig. 7) The mentions for SPS that modulate oxidative stress were: 43.1% for curcumin; 20.4% for ginger; 10% for cardamom; 9.4% for other SPS; 17.2% did not know.

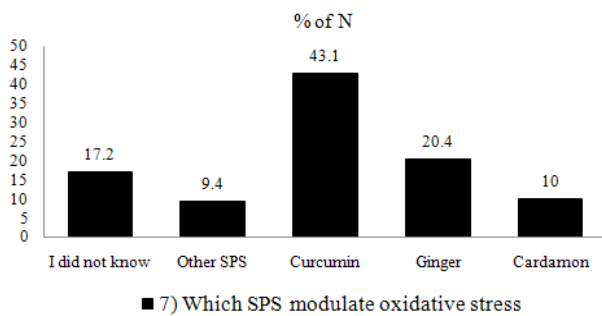


Fig. 7 – The percentage of respondents of N, for item 7.

8) Which SPS influence endurance? (Fig. 8) The mentions for SPS that influence endurance were: 72% did not know; 17% for other SPS; 4.9% for curcumin; 4.2% for ginger; 1.9% for cardamom.

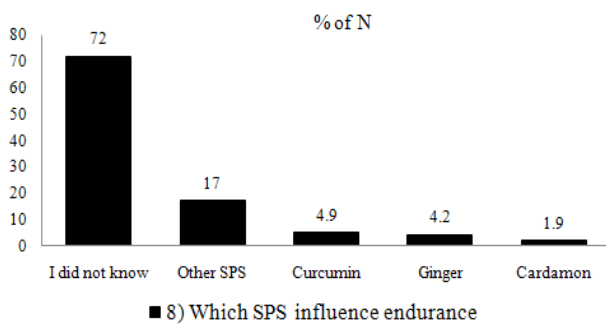


Fig. 8 – The percentage of respondents of N, for item 8.

9) Which SPS are useful in physical fatigue? (Fig. 9) The mentions for SPS useful in physical fatigue were: 49% for ginger; 34% did not know; 17% for different SPS.

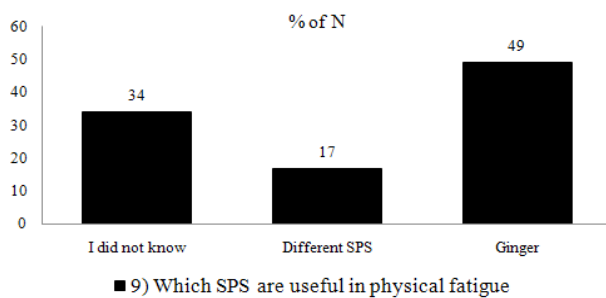


Fig. 9 – The percentage of respondents of N, for item 9.

10) Which SPS are useful in muscle soreness? (Fig. 10) The mentions for SPS useful in muscle soreness were: 90.1% did not know; 9.9% for different SPS.

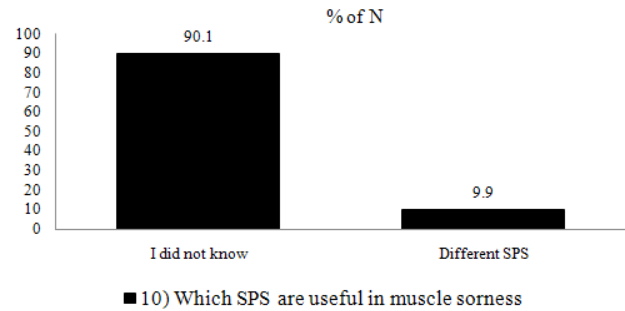


Fig. 10 – The percentage of respondents of N, for item 10.

11) Which SPS are useful in exercise performance? (Fig. 11) The mentions for SPS useful in exercise performance were: 43.4% for ginger; 37.3% did not know; 19.3% for different SPS.

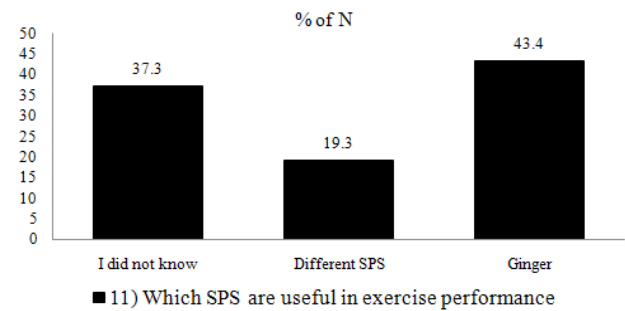


Fig. 11 – The percentage of respondents of N, for item 11

12) Which SPS are useful in sports? (Fig. 12) The mentions for SPS useful in sports were: 40.3% for ginger; 39.3% did not know; 20.4% for different SPS.

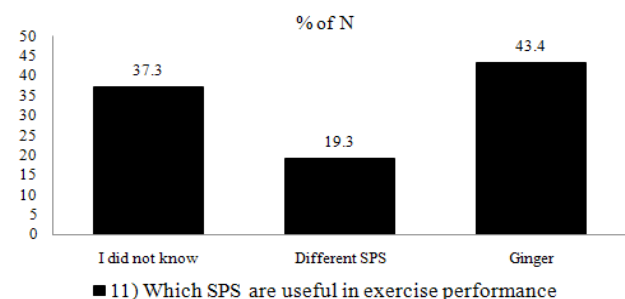


Fig. 12 – The percentage of respondents of N, for item 12

13) On a scale of 1-10 how much did this course help you know more about SPS? (Fig. 13) The mentions for how much this course helped know more about SPS were: 0% for 1-6; 1.7% for 7; 3.9% for 8; 4% for 9; 72.4% for 10.

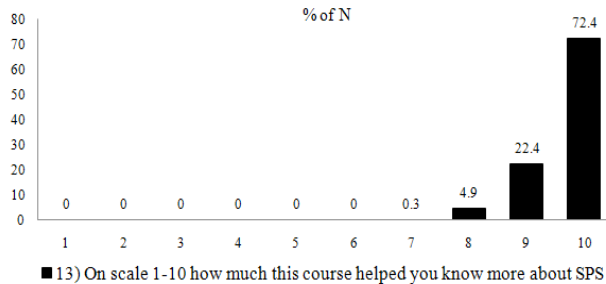


Fig. 13 – The percentage of respondents of N, for item 13.

Overall, most of the answers were in favor of using SPS. Differences between genders and ages were not important, for all items in the applied questionnaire. Most of the knowledge about SPS had female MDs and MDs aged 42-49 years.

Discussion

1) Analysis of the answers to the questionnaire

In this study, a large number of medical doctors (94) of different specialties and of both genders, in a relatively equal proportion, participated. For most of them, this was the first course about SPS in which they participated.

After applying the questionnaire, we found that most participants had, before the course, some generic information, but they did not know details, about: SPS native countries, effects and mechanisms for SPS, optimal age for SPS use, which SPS modulate oxidative stress.

MD participants had little or no information about SPS: what SPS are, SPS types, SPS effects/mechanisms. It was also found that doctors had very little information about SPS in sport: SPS for endurance, SPS in physical fatigue, SPS in muscle soreness, SPS in exercise performance. The comparable responses given by male MDs and female MDs, regardless of their age, do not allow us to make a particular comment about the differences in responses depending on the gender or the age of the participants.

What is encouraging with regard to the position of MD participants in the study towards SPS is the answer to the last item, which represented the end-of-course question. This answer shows that the information provided at the course helped most participants to understand SPS and SPS use in sport and thus, to create the possibility to better know, use and indicate SPS in the future.

2) Publications related to SPS. Pubmed evidence

Spices - Concept

Spices have been used since ancient times, mainly as flavoring and coloring agents, but also for food preservation (Gottardi et al., 2016). In addition, spicy food not only provides an important hedonic contribution, but also has beneficial effects on our health, such as modulation of gastrointestinal and cardiovascular activities, skeletal muscle performance, reduction of chronic inflammation and prevention of metabolic syndrome and diabetes (Nilius & Appendino, 2013). There is a wide variety of forms in which condiments can be used: fresh, dried whole, or dried before

grinding (Balasubramanian et al., 2016).

Spices - Effects / Mechanisms

It has been proven that spices have various beneficial effects on human health, including the following actions: anti-sclerotic, anti-inflammatory, anti-thrombotic, anti-rheumatic, anti-arrhythmic, gastroprotective, lipid lowering, lipoprotein oxidation inhibition with low density and protein glycerol, anti-allergic, anti-malarial, anti-viral (Yashin et al., 2017) and anti-microbial (Liu et al., 2017).

Spices - Oxidative stress. Some examples of spices are used in oxidative stress.

Among the spices proven to have antioxidant potential are the following, for which their active components are mentioned: turmeric/ curcumin, cloves/ eugenol, red pepper/ capsaicin, black pepper/ piperine, ginger/ gingerol, garlic, onion (Srinivasan, 2013). Types of spices with antioxidant effects: ginger - *Zingiber officinale* Rosc. (Zingiberaceae), by gingerol (Dugasani et al., 2010); rosemary, via carnosic acid, caffeic acid and its derivatives, such as rosmarinic acid (Moreno et al., 2014); other spices - cinnamon (Jayaprakasha et al., 2003), black pepper (Kapoor et al., 2009), curcumin (Abrahams et al., 2019).

Spices - sports, endurance, physical fatigue, muscular sensation, exercise performance.

A study in healthy male rats shows that regular training and supplementation with cinnamon bark extract increases overall antioxidant capacity and protects against oxidative damage induced by exhaustive exercises (Dehghan et al., 2014). Another experimental study in rats with diabetes, undergoing a resistance exercise, showed that the administration of rosemary extract can alleviate oxidative stress, by improving the activities of antioxidant enzymes and lowering the level of lipid peroxidation (Nazem et al., 2015). Curcumin can improve physical performance and prevent fatigue; thus, supplementation with curcumin results in increased endurance and physical performance and significantly reduces post-exercise lactate levels (Huang et al., 2015). Ginger can reduce pain through endurance and prolonged running; it can accelerate the recovery of maximal power after resistance exercise and reduce the inflammatory response to cardiorespiratory exercises (Wilson, 2015). Supplementation with capsaicin, a bioactive phytochemical substance in peppers, CAP, can lead to improved physical performance and alleviation of physical fatigue (Hsu et al., 2016). In the case of exercise-induced muscle injury, daily consumption of raw and heat-treated ginger leads to moderate to large reductions in muscle pain (Black et al., 2010). Coriander oil, used for massage as such or incorporated into creams or lotions, can help reduce mental tension and fatigue, as well as muscle spasms (Balasubramanian et al., 2016). Piperine, an active compound in black pepper, is a source for improving exercise capacity, as it balances carbohydrate and fat metabolism, as well as redox reactions during exercise (Kim et al., 2017).

Conclusions

1. This PGC seems to be the first one regarding SPS.
2. Initially, most medical doctors had little knowledge regarding spices/ spices in sport.
3. At the end of the postgraduate medical course,

medical doctors demonstrated a good accumulation of information about spices.

4. This postgraduate medical course reached the goal of providing basic information about spices/ spices in sport, but additional SPS-related training is needed.

Conflicts of interest

Nothing to declare.

Acknowledgement

The data regarding the course evaluated in this paper are the following: name “The modulatory role and the effects of spices in the mechanisms of stress”; code 112; period, 13.07.2018-17.07.2018. In order to have more participants, doctors enrolled in courses with the codes 113 and 114, courses which were conducted during the period 03.07.2018-07.07.2018 and 08.07.2018-2.07.2018, respectively, were also allowed to attend the course, to listen and to complete the questionnaire. All the three courses were organized within the Pathophysiology Department and were coordinated by Ramona-Niculina Jurcău and Carmen Sfrangeu. The courses can be found in the 2017-2018 brochure of the “Iuliu Hațieganu” University of Medicine and Pharmacy, Cluj-Napoca.

References

- Abidov M, Crendal F, Grachev S, Seifulla R, Ziegenfuss T. Effect of extracts from *Rhodiola rosea* and *Rhodiola crenulata* (Crassulaceae) roots on ATP content in mitochondria of skeletal muscles. *Bull Exp Biol Med*. 2003;136(6):585-587.
- Abrahams S, Haylett WL, Johnson G, Carr JA, Barden S. Antioxidant effects of curcumin in models of neurodegeneration, aging, oxidative and nitrosative stress: A review. *Neuroscience*. 2019;406:1-21. doi: 10.1016/j.neuroscience.2019.02.020.
- Avakian EV, Sugimoto RB, Taguchi S, Horvath SM. Effect of Panax ginseng extract on energy metabolism during exercise in rats. *Planta Med*. 1984;50(2):151-154. DOI:10.1055/s-2007-969657
- Balasubramanian S, Roselin P, Singh KK, Zachariah J, Saxena SN. Postharvest Processing and Benefits of Black Pepper, Coriander, Cinnamon, Fenugreek, and Turmeric Spices. *Crit Rev Food Sci Nutr*. 2016;56(10):1585-1607. doi: 10.1080/10408398.2012.759901.
- Black CD, Herring MP, Hurley DJ, O'Connor PJ. Ginger Zingiber officinale reduces muscle pain caused by eccentric exercise. *J Pain*. 2010;11(9):894-903. doi: 10.1016/j.jpain.2009.12.013.
- Dehghan G, Shaghghi M, Jafari A, Badalzadeh R. Effect of endurance training and cinnamon supplementation on post-exercise oxidative responses in rats. *Mol Biol Res Commun*. 2014;3(4):269-281.
- Dugasani S, Pichika MR, Nadarajah VD, Balijepalli MK, Tandra S, Korlakunta JN. Comparative antioxidant and anti-inflammatory effects of [6]-gingerol, [8]-gingerol, [10]-gingerol and [6]-shogaol. *J Ethnopharmacol*. 2010;127(2):515-520. doi: 10.1016/j.jep.2009.10.004.
- García-Casal MN, Peña-Rosas JP, Malavé HG. Sauces, spices, and condiments: definitions, potential benefits, consumption patterns, and global markets. *Ann N Y Acad Sci*. 2016;1379(1):3-16. doi: 10.1111/nyas.13045.
- Gottardi D, Bukvicki D, Prasad S, Tyagi AK. Beneficial Effects of Spices in Food Preservation and Safety. *Front Microbiol*. 2016;7:1394. doi: 10.3389/fmicb.2016.01394.
- Hsu YJ, Huang WC, Chiu CC, Liu YL, Chiu WC, Chiu YS, Huang CC. Capsaicin Supplementation Reduces Physical Fatigue and Improves Exercise Performance in Mice. *Nutrients*. 2016;8(10). pii: E648. doi:10.3390/nu8100648.
- Huang SC, Lee FT, Kuo TY, Yang JH, Chien CT. Attenuation of long-term *Rhodiola rosea* supplementation on exhaustive swimming-evoked oxidative stress in the rat. *Chin J Physiol*. 2009;52(5):316-324.
- Huang WC, Chiu WC, Chuang HL, Tang DW, Lee ZM, Wei L, Huang CC. Effect of curcumin supplementation on physiological fatigue and physical performance in mice. *Nutrients*. 2015;7(2):905-921. doi: 10.3390/nu7020905.
- Jayaprakasha GK, Jagan Mohan Rao L, Sakariah KK. Volatile constituents from *Cinnamomum zeylanicum* fruit stalks and their antioxidant activities. *J Agric Food Chem*. 2003;51(15):4344-4348. doi:10.1021/jf034169i.
- Jiang, TA. Health Benefits of Culinary Herbs and Spices. *JAOAC Int*. 2019;102(2):395-411. doi: 10.5740/jaoacint.18-0418.
- Jówko E, Sacharuk J, Balasińska B, Ostaszewski P, Charnas M, Charnas R. Green tea extract supplementation gives protection against exercise-induced oxidative damage in healthy men. *Nutr Res*. 2011;31(11):813-821.
- Jurcău R, Jurcău I, Kwak DH, Grosu VT, Ormenisan S. Eleutherococcus, Schisandra, Rhodiola and Ginseng, for stress and fatigue - a review. *J Health, Sports Rehab Med*. 2019;20(1):12-17.
- Jurcău R, Jurcău I, Kwak DH. Brief analysis of the Sport-Ginseng relationship, from the perspective of PubMed publications. *Palestrica Third Mill Civiliz Sport*. 2018;19 (4):212-216.
- Jurcău R, Jurcău I. Effect of Manuka honey administration on malondialdehyde, in intense exercise. *Palestrica Third Mill Civiliz Sport*. 2017;18(4):201-205.
- Jurcău R, Jurcău I. *Rhodiola rosea*'s relationship with stress, physical fatigue and endurance; a PubMed evaluation. *Palestrica Third Mill Civiliz Sport*. 2018;19(1):17-22.
- Kapoor IPS, Singh B, Singh G, De Heluani CS, De Lampasona, MP, Catalan, CAN. Chemistry and in vitro antioxidant activity of volatile oil and oleoresins of black pepper (*Piper nigrum*) *J. Agric. Food Chem*. 2009;57(12):5358-5364. doi: 10.1021/jf900642x.
- Khanum F, Bawa AS, Singh B. *Rhodiola rosea*: A Versatile Adaptogen. *Compr Rev Food Sci Food Saf*. 2005;4(3):55-62.
- Kim J, Lee KP, Lee DW, Lim K. Piperine enhances carbohydrate/fat metabolism in skeletal muscle during acute exercise in mice. *Nutr Metab (Lond)*. 2017;14:43. doi: 10.1186/s12986-017-0194-2.
- Kimura Y, Sumiyoshi M. Effects of various *Eleutherococcus swenticosus* cortex on swimming time, natural killer activity and corticosterone level in forced swimming stressed mice. *J Ethnopharmacol*. 2004;95(2-3):447-453. doi:10.1016/j.jep.2004.08.027.
- Lee FT, Kuo TY, Liou SY, Chien CT. Chronic *Rhodiola rosea* extract supplementation enforces exhaustive swimming tolerance. *Am J Chin Med*. 2009;37(3):557-572.
- Li Z, Wu F, Shao H, Zhang Y, Fan A, Li F. Does the Fragrance of Essential Oils Alleviate the Fatigue Induced by Exercise? A Biochemical Indicator Test in Rats. *Evid Based Complement Alternat Med*. 2017;2017:5027372. doi: 10.1155/2017/5027372.
- Liu Q, Meng X, Li Y, Zhao CN, Tang GY, Li HB. Antibacterial and Antifungal Activities of Spices. *Int J Mol Sci*. 2017;18(6), pii, E1283. doi: 10.3390/ijms18061283.
- Moreno S, Scheyer T, Romano CS, Vojnov AA. Antioxidant and antimicrobial activities of rosemary extracts linked to their polyphenol composition. *Free Radic Res*. 2006;40(2):223-231. doi:10.1080/10715760500473834.

- Murase T, Haramizu S, Shimotoyodome A, Tokimitsu I, Hase T. Green tea extract improves running endurance in mice by stimulating lipid utilization during exercise. *Am J Physiol Regul Integr Comp Physiol*. 2006;290(6):1550-1556.
- Nazem F, Farhangi N, Neshat-Gharamaleki M. Beneficial Effects of Endurance Exercise with *Rosmarinus officinalis* Labiatae Leaves Extract on Blood Antioxidant Enzyme Activities and Lipid Peroxidation in Streptozotocin-Induced Diabetic Rats. *Can J Diabetes*. 2015;39(3):229-234. doi: 10.1016/j.jcjd.2014.11.003.
- Nilius B, Appendino G. Spices, the savory and beneficial science of pungency. *Rev Physiol Biochem Pharmacol*. 2013;164:1-76. doi: 10.1007/112_2013_11
- Opara EI, Chohan M. Culinary herbs and spices, their bioactive properties, the contribution of polyphenols and the challenges in deducing their true health benefits. *Int J Mol Sci*. 2014;15(10):19183-19202. doi: 10.3390/ijms151019183.
- Panosian AG. Adaptogens in mental and behavioral disorders. *Psychiatr Clin North Am*. 2013;(1):49-64. doi: 10.1016/j.psc.2012.12.005.
- Patra K, Jana S, Mandal DP, Bhattacharjee S. Evaluation of the Antioxidant Activity of Extracts and Active Principles of Commonly Consumed Indian Spices. *J Environ Pathol Toxicol Oncol*. 2016;35(4):299-315. doi:10.1615/JEnvironPatholToxicolOncol.2016016387.
- Powers SK, Lennon SL. Analysis of cellular responses to free radicals, focus on exercise and skeletal muscle. *Proc Nutr Soc*. 1999;58(4):1025-1033. doi:10.1017/s0029665199001342.
- Salehi B, Zakaria ZA, Gyawali R, Ibrahim SA, Rajkovic J, Shinwari ZK, Khan T, Sharifi-Rad J, Ozleyen A, Turkdonmez E, Valussi M, Tumer TB, Monzote Fidalgo L, Martorell M, Setzer WN. Piper Species, A Comprehensive Review on Their Phytochemistry, Biological Activities and Applications. *Molecules*. 2019;24(7). pii:E1364. doi: 10.3390/molecules24071364.
- Shobana, S, Naidu, KA. Antioxidant activity of selected Indian spices. *Prostaglandins Leukot Essent Fatty Acids*. 2000;62(2):107-110. doi:10.1054/plef.1999.0128.
- Srinivasan, K. Dietary spices as beneficial modulators of lipid profile in condition of metabolic disorders and disease. *Food Funct*. 2013;4(4):503-521. doi: 10.1039/c2fo30249g.
- Wilson, PB. Ginger (*Zingiber officinale*) as an Analgesic and Ergogenic Aid in Sport, A Systemic Review. *J Strength Cond Res*. 2015;29(10):2980-2995. doi: 10.1519/JSC.0000000000001098.
- Yang QY, Lai XD, Ouyang J, Yang JD. Effects of Ginsenoside Rg3 on fatigue resistance and SIRT1 in aged rats. *Toxicology*. 2018;409:144-151. doi: 10.1016/j.tox.2018.08.010.
- Yashin A, Yashin Y, Xia X, Nemzer B. Antioxidant Activity of Spices and Their Impact on Human Health, A Review. *Antioxidants (Basel)*. 2017;6(3), pii:E70. doi: 10.3390/antiox6030070

Increased serum interleukin 6 in experimental periapical periodontitis associated with metabolic bone disease

Antonela Berar¹, Smaranda Buduru¹, Tudor Valentin Mîrza², Simona Iacob¹,
Dragomir-Cosmin David², Luminita Matros³, Mariana Constantiniuc¹

¹Department of Prosthodontics, Faculty of Dental Medicine, “Iuliu Hatieganu” University of Medicine and Pharmacy, Cluj-Napoca, Romania

²National Institute of Public Health - Regional Centre of Public Health, Cluj-Napoca, Romania

³Department of Microbiology, Faculty of Medicine, “Iuliu Hatieganu” University of Medicine and Pharmacy, Cluj-Napoca, Romania

Abstract

Background. Inflammatory cytokines such as interleukin 6 (IL-6) have implications in the pathogenesis of metabolic bone disorders and also in periapical disease. Both metabolic bone diseases and periapical periodontitis (PP) share a common feature represented by inflammation-mediated bone loss; however, the specific role of these cytokines is not always consistent.

Aims. The aim of the study was to assess the serum IL-6 levels and investigate the associations with histomorphometric changes in the alveolar bone around the molar roots in a rodent experimental model of PP.

Methods. The research was conducted on 3 groups of animals: group A – animals without any pathology, group B – animals with PP, and group C – animals with PP and simulated metabolic bone disease treated with alendronate (ALD). Peripheral blood was collected for biochemical analysis of IL-6 interleukin levels and the lower jaws were removed for histomorphometric analysis.

Results. Serum IL-6 levels were significantly increased in the experimental groups compared to the control group ($p < 0.05$). In group B, a moderate inflammatory infiltrate and a medium number of osteoclasts were present, while in group C, discrete inflammatory infiltrates accompanied by a low number of osteoclasts were confirmed by histomorphometric analysis.

Conclusions. The induction of PP determines elevated circulating levels of IL-6 with repercussions on the systemic state, maintaining a low degree of inflammatory response. The administration of ALD in female rodents contributes to the diminishing rate of extension in PP, limiting the destruction of the tissues.

Keywords: interleukin 6, periapical periodontitis, bone metabolism, estrogen deficiency.

Introduction

Periapical periodontitis (PP) is characterized by an inflammatory response of the periodontium at the root apex of teeth and concurrent progressive alveolar bone destruction as a consequence of pathogenic bacteria persistence in the endodontic biofilms (Nikolic et al., 2019; Romualdo et al., 2018). The supporting tissues of the teeth including alveolar bone, periodontal ligament and cementum are all affected during the development stages of the periapical disease.

Under physiological conditions, the complex remodeling process that appears in bone is controlled by the balance between bone formation by osteoblasts and degradation by osteoclasts. The main factor responsible for this activity is the receptor activator for NF- κ B ligand

(RANKL)/ osteoprotegerin (OPG) ratio, expressed by the bone cells (Blaschke et al., 2018; Al-Daghri et al., 2017). Osteoblasts are responsible for the construction of bone material by generating collagen, osteopontin and osteocalcin, and transforming them into an osteoid matrix. Then, the mineralization of the newly formed matrix is enhanced by calcium phosphate, hydroxyapatite and calcium carbonate. Osteoclasts manifest enzymatic activity contributing to the degradation of the bone matrix through resorption pits filled with acidic proteases (McDonald et al., 2017; Harmer et al., 2019).

Under pathological conditions, the bone cells release various inflammatory cytokines, such as interleukin 6 (IL-6) which plays a major role in the development of metabolic bone diseases (Hunter & Jones, 2015;

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Address for correspondence: Department of Prosthodontics, Faculty of Dental Medicine, “Iuliu Hatieganu” University of Medicine and Pharmacy Cluj-Napoca, 32 Clinicilor Street, 400006, Cluj-Napoca, Romania

E-mail: smarandabuduru@yahoo.com

Corresponding author: Smaranda Buduru; smarandabuduru@yahoo.com

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Schet et al., 2018; Eftekhari et al., 2018) and in the progression of periapical pathology (Balto et al., 2001; Azuma et al., 2014). IL-6 cytokine acts by reducing bone mineral density, affecting normal bone metabolism, and is assumed to have implications associated with osteoporosis (OP) (Yan et al., 2015; Kany et al., 2019; Saribal et al., 2019; Ding et al., 2008; Li et al., 2016) through different pathways: increasing osteoclast differentiation, activation, survival, enhancing RANKL expression and inhibiting osteoblast survival (Al-Daghri et al., 2017; Harmer et al., 2019). The uncoupling of the mechanism behind bone formation and resorption may induce metabolic bone diseases, including OP. The reduction of estrogen levels due to the loss of ovarian function in postmenopausal women determines bone loss and OP (Harmer et al., 2019; Eftekhari et al., 2018). Experimental studies investigating the relationships between hypoestrogenic conditions induced by ovariectomy and bone changes showed a decrease in mineral bone density of jaws in rodents (Romualdo et al., 2018) and also, structural modifications in trabecular alveolar bone (Tanaka et al., 2003; Duarte et al., 2004).

Pharmacological agents including alendronate (ALD), neridronate, ibandronate and other similar compounds are the primary drugs currently used in the treatment of metabolic diseases (Raj et al., 2016). These drugs exert effects on osteoclast activity, inhibiting bone resorption by lowering osteoclast numbers and influencing the RANKL/OPG ratio, as well as on osteoblasts.

Hypothesis

This study aimed to assess the serological modifications of IL-6 levels and also, to investigate the associations between serum IL-6 values and histomorphometric changes in the alveolar bone around the molar teeth roots in an experimental model of PP.

Material and methods

Research protocol

a) Period and place of the research

The present study received the approval of the Ethics Committee of the "Iuliu Hatieganu" University of Medicine and Pharmacy Cluj-Napoca. The experimental protocol was in agreement with the ethical research principles regarding the handling of laboratory animals, and took place between January and June 2016 in the Experimental Laboratory of the Physiology Department of the "Iuliu Hatieganu" University of Medicine and Pharmacy Cluj-Napoca.

b) Subjects and groups

A total of thirty female rodents (*Rattus norvegicus*) with a mean age of 3 months and a weight ranging between 250 g and 280 g were obtained from the Centre of Experimental Medicine of our University.

The study groups (10 animals / group) comprised:

- group A - rodents without any pathology;
- group B and group C, in which occlusal cavities in the lower molar teeth with dental pulp chamber opening were created, using a round steel bur, carefully avoiding furcal perforations. Group C was also subjected to the surgical procedure of ovariectomy, according to the technique described by Khajuria et al., 2012, following which bone metabolism deficiencies were induced as a result of the reduction of estrogen levels. After 10 days postoperatively, alendronate sodium treatment was administered in group C by subcutaneous injection, in two weekly doses of 1 mg/kg body weight until the end of the experiment.

c) Tests applied

For evaluation at different moments of the experiment, peripheral venous blood was collected at 2, 4 and 8 weeks in test tubes, centrifuged at 4°C for 15 min and preserved at -20°C until biochemical analysis. The quantitative detection of IL-6 in serum samples was performed using Rat IL-6 ELISA kit (Boster Biological Technology Co., Ltd.), according to the manufacturer's instructions.

At the moments mentioned above, the animals were sacrificed and their lower jaws were excised in order to perform histomorphometric investigations. The specimens were fixed by immersion in 10% buffered formalin for 24 h and preserved in 4% EDTA solution until complete decalcification. After paraffin embedding, the blocks containing the molar teeth were longitudinally sliced along their axis, resulting in 5 µm thick serial sections. They were stained with hematoxylin and eosin (HE) and subjected to light microscopy for evidencing the apical and periapical regions of the molar teeth. The inflammatory cellular infiltrate and the degree of bone loss were investigated histomorphometrically by quantification of the inflammatory cells and osteoclasts present in the perimeter of the analyzed regions.

d) Statistical processing

The data of this study were statistically analyzed using Starts Direct v 2.7.2 software and Excel (Microsoft Office 2010).

Results

The analysis of serum IL-6 levels considering the three groups of rodents at different experimental moments and their statistical significance were presented in Table I.

Table I
Comparative analysis of the studied groups and their statistical significance.

Moments	Group	Mean ± SD	Statistical significance (p)			
2w	A	2.82 ± 0.18	A-B	0.0020	2w-4w	0.0038
	B	2.50 ± 0.23	A-C	8.14x10 ⁻⁵	2w-8w	2.17x10 ⁻⁶
	C	5.70 ± 1.33	B-C	1.98x10 ⁻⁵	4w-8w	8.97x10 ⁻⁵
4w	A	2.82 ± 0.18	A-B	0.5639	2w-4w	0.002
	B	2.95 ± 0.40	A-C	5.52 x 10 ⁻¹²	2w-8w	0.1641
	C	6.84 ± 0.44	B-C	6.29x10 ⁻¹⁴	4w-8w	0.3482
8w	A	2.82 ± 0.17	A-B	3.21x10 ⁻⁴	2w-4w	0.0309
	B	4.02 ± 0.43	A-C	0.0020	2w-8w	0.8526
	C	5.85 ± 2.22	B-C	0.0284	4w-8w	0.2364

The statistical analysis of IL-6 values evidenced the following for unpaired samples:

- at 2 weeks - highly statistically significant differences between groups A and C ($p < 0.001$) and also between groups B and C ($p < 0.001$);
- at 4 weeks - similar results to those obtained at 2 weeks;
- at 8 weeks - very statistically significant differences between groups A and C ($p < 0.01$) and also between groups B and C ($p < 0.05$).

The statistical analysis of IL-6 values showed the following for paired samples:

- in group B - highly statistically significant differences between weeks 2-8, weeks 4-8 ($p < 0.001$) and very statistically significant differences between weeks 2-4 ($p < 0.01$);
- in group C - statistically significant differences between weeks 2-4 ($p < 0.05$).

Regarding the descriptive histological analysis of tooth sections, in group A, tooth sections showed no inflammation or bone resorption (Figs. 1A, C). Group B, at 2 weeks, showed PP in acute stages with a higher intensity, necrosis of periodontal ligament, resorption of mineralized tissues (bone and radicular cement) (Fig. 1B). At 4 weeks, there was a predominantly moderate inflammatory infiltration of mononuclear cells (macrophages, lymphocytes) and greater bone loss, and at 8 weeks, the intensity of PP decreased, chronic inflammatory cell infiltrate was present and bone destruction was stabilized. In group C, PP appeared at 2 weeks, with inflammatory infiltrate mainly consisting of neutrophils and macrophages. Also, reduced alveolar bone resorption was observed. Frequently encountered, dental pulp lesions were represented by septic pulp necrosis. In parallel, a conjunctive reaction was observed with the multiplication of fibrous tissue (Fig. 1D). At 4 weeks, the same lesions were present, specifically bone loss, pulp necrosis, desmodontal space widening and

fibrous tissue multiplication, and at 8 weeks, PP changes were identical to those previously mentioned, but their intensity was more reduced.

The statistical analysis of inflammatory infiltrate evidenced the following for unpaired samples:

- at 2 weeks – very statistically significant differences between groups B and C ($p < 0.01$);
- at 4 weeks – no statistically significant differences between the groups of rodents;
- at 8 weeks – highly statistically significant differences between groups B and C ($p < 0.001$).

The statistical analysis of inflammatory infiltrate evidenced the following for paired samples:

- in group B – no statistically significant differences between the time moments ($p > 0.05$);
- in group C – statistically significant differences between weeks 2-4 and weeks 4-8 ($p < 0.01$).

The statistical analysis of alveolar bone resorption evidenced the following for unpaired samples:

- at 2 weeks – very statistically significant differences between groups B and C ($p < 0.01$);
- at 4 weeks – highly statistically significant differences between groups B and C ($p < 0.001$);
- at 8 weeks – statistically significant differences between groups B and C ($p < 0.01$).

The statistical analysis of alveolar bone resorption evidenced the following for paired samples:

- in group B – no statistically significant differences between the time points ($p > 0.05$); in group C - statistically significant differences between weeks 4-8 ($p < 0.01$) and weeks 2-4 ($p < 0.05$).

In group B, IL-6 levels were positively correlated with the number of osteoclasts, having the correlation coefficient $r = 0.5522$, and with the inflammatory infiltrate, $r = 0.5618$, at 2 weeks, and negatively correlated with the inflammatory infiltrate at 8 weeks, $r = -0.8528$. In group C, IL-6 was negatively correlated with the number of osteoclasts, $r = -0.8381$.

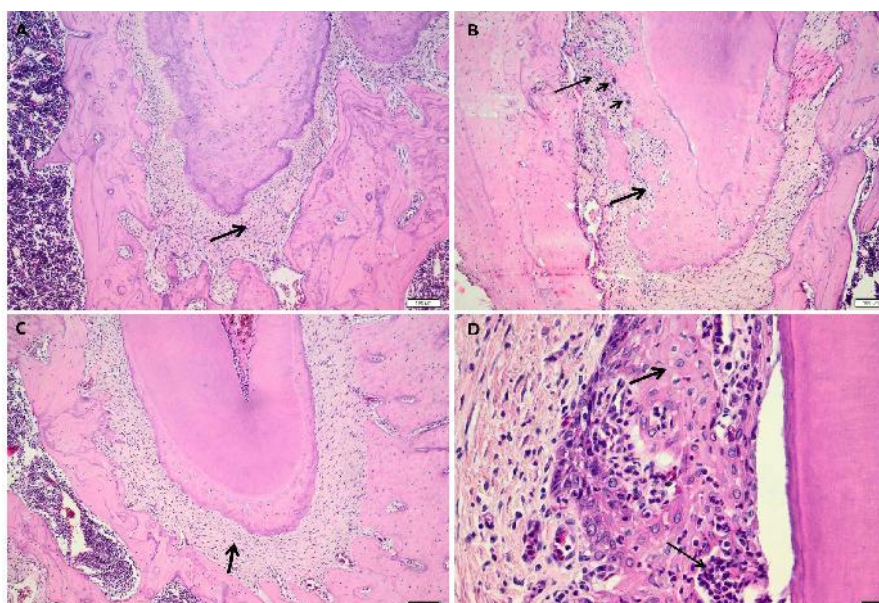


Fig. 1 – A, C. Periodontal space and apical regions with normal aspect (arrows), H&E x 100; B. Cementum and bone resorption (thick arrow), osteoclasts (short arrows), H&E x 100; D. Periodontal inflammatory infiltrate (thin arrows), epithelialization (thick arrows), H&E x 400.

Discussions

Both PP and OP are pathological conditions affecting bone, with an imbalance in the turnover process. PP is a localized process reflected in alveolar bone (Azuma et al., 2013), whilst OP manifests as a metabolic dysregulation in the entire skeleton with the excessive activity of osteoclasts. In the case of PP, the locally accumulated inflammatory cells in the affected area generate the cytokine and inflammatory mediators, acting as causative factors in alveolar bone destruction, concomitantly with the hindering of the repair or formation of new bone. In the case of OP, a longer time period is needed for the emergence of structural modifications in cancellous bone and the involved mechanisms have a greater complexity (Mundy et al., 1993).

The available literature emphasizes the role of bone cells in maintaining bone homeostasis (Jeong & Kim, 2016; Schett, 2018; Metzger & Narayanan, 2019). The activity of these cells influences the equilibrium between bone formation and resorption. The major implication of osteoclasts in bone loss is well known: their activation following various pathological conditions determines an increased production of inflammatory cytokines, such as IL-6 (Kany et al., 2019; Eftekhari et al., 2018). A recent study observed a high risk of bone resorption in postmenopausal women with OP as a consequence of estrogen deficiency and release of IL-6 cytokine activating osteoclasts through RANKL (Al-Daghri et al., 2017).

The current study revealed that serum IL-6 levels of ovariectomized rodents treated with ALD were increased in all stages when compared with control and PP groups. These results are in agreement with other studies reporting elevated concentrations of inflammatory cytokines in peripheral blood associated with PP (Zhang et al., 2015; Georgiou et al., 2019).

PP and OP are characterized by bone loss coinciding with increased IL-6 secretion. In an endodontic context, IL-6 acts as an important mediator in modulating the response to bacterial infection (Nibali et al., 2012), being synthesized locally by bone cells (Balto et al., 2001), and reflected later in systemic peripheral blood (Georgiou et al., 2019). It is also known as a regulatory factor in the differentiation activity of osteoblasts and osteoclasts (Xie et al., 2018; Yan et al., 2015; Harmer et al., 2019). IL-6 overexpression may be linked to the extent of chronic inflammatory lesions, resulting in alveolar bone resorption and damage to the periodontal ligament (Nibali et al., 2012).

The pathological role of IL-6 as a mediator in bone resorption has been subjected to controversy over the last decades. Clinical and experimental studies investigating IL-6 expression report the release of this cytokine from osteoblasts (Xie et al., 2018; Yan et al., 2015), with a pivotal role in the formation of osteoclast precursors (Balto et al., 2001; Romaldo et al., 2018), leading to an increased number of osteoclasts and activating the bone resorption pathways (Ji et al., 2019; Harmer et al., 2019). Other studies addressing the impact of IL-6 in the pathogenesis of PP found high IL-6 levels correlated with the extent of tissue damage (Abdolsamadi et al., 2008). Cintra et al., 2016 found elevated serum levels of IL-6 in a rat model of apical periodontitis. Bresil et al., 2017 suggested that prolonged estrogen deficiency influences the progression of apical periodontitis, causing greater lesions in ovariectomized

rats, due to the persistence of the inflammatory process in the bone. Inflammation-induced osteolysis proved to be present in both postmenopausal OP and periapical diseases, as a possible systemic damaging factor (Lopez et al., 2015; Romualdo et al., 2018). A recent study conducted on ovariectomized rodents with induced PP showed more elevated levels of proinflammatory cytokines, hypothesizing the role of estrogen activity in post-menarche women with apical disease (Romualdo et al., 2018). The property of bisphosphonates to bind the crystals of hydroxyapatite makes them useful in the treatment of certain pathologies associated with increased bone resorption, such as OP (Xiong et al., 2010).

According to the literature, little evidence concerning the impact of PP is available. Xiong et al., 2010 focused on the effects of bisphosphonate administration on alveolar bone resorption, using one of the most efficient agents, alendronate, in experimentally induced PP. Their study suggests the possible implication of alendronate in the inhibition of osteoclast activity. The reduction of bone damage in PP was observed in ovariectomized rats as a consequence of this therapy, suggesting the possible protective role of these agents (Wayama et al., 2015) in the inhibition of osteoclastogenesis. Our study subscribes to these previous findings regarding the effects of bisphosphonates on the development of PP.

Concerning the histological analysis of the periapical area in the present study, moderate inflammatory changes in animals with induced PP were detected when compared to reduced inflammatory changes in ovariectomized animals treated with alendronate. A moderate number of osteoclasts in direct contact with the alveolar bone surrounding the affected area in PP animals was observed when compared to the low number of osteoclasts in treated ovariectomized animals. Future studies are needed in order to elucidate the complex mechanisms involved in the pathogenesis of PP, with focus on the implications of cytokines in inflammatory alveolar bone alterations.

Conclusions

1. Elevated circulating IL-6 levels were identified in association with alveolar bone resorption in the experimental model of PP.
2. A negative correlation was observed between bone loss and IL-6 values in PP and simulated metabolic bone disease, probably due to the action of ALD in diminishing the rate of alveolar destruction.

Conflicts of interest

Nothing to declare.

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References

- Abdolsamadi HR, Vahedi M, Esmacili F, Nazari S, Abdollahzadeh S. Serum Interleukin-6 as a Serologic Marker of Chronic Periapical Lesions: A Case-control Study. *J Dent Res Dent Clin Dent Prospects*. 2008;2(2):43-47. doi: 10.5681/

- joddd.2008.009.
- Al-Daghri NM, Aziz I, Yakout S, Aljohani NJ, Al-Saleh Y, Amer OE, Sheshah E, Younis GZ, Al-Badr FB. Inflammation as a contributing factor among postmenopausal Saudi women with osteoporosis. *Medicine (Baltimore)*. 2017;96(4): e5780. doi: 10.1097/MD.00000000000005780.
- Azuma MM, Samuel RO, Gomes-Filho JE, Dezan-Junior E, Cintra LTA. The role of IL-6 on apical periodontitis: A systematic review. *Int Endod J*. 2014;47(7):615-621. doi: 10.1111/iej.12196.
- Balto K, Sasaki H, Stashenko P. Interleukin-6 deficiency increases inflammatory bone destruction. *Infect Immun*. 2001;69(2):744-750. DOI:10.1128/IAI.69.2.744-750.2001.
- Blaschke M, Koepf R, Cortis J, Komrakova M, Schieker M, Hempel U, Siggelkow H. IL-6, IL-1 β , and TNF- α only in combination influence the osteoporotic phenotype in Crohn's patients via bone formation and bone resorption. *Adv Clin Exp Med*. 2018;27(1):45-56. doi: 10.17219/acem/67561.
- Brasil SC, Santos RMM, Fernandes A, Alves FRF, Pires FR, Siqueira JF, Armada L. Influence of oestrogen deficiency on the development of apical periodontitis. *Int Endod J*. 2017;50(2):161-166. doi: 10.1111/iej.12612.
- Cintra LTA, Samuel RO, Azuma MM, De Queiróz AOS, Ervolino E, Sumida DH, et al. Multiple Apical Periodontitis Influences Serum Levels of Cytokines and Nitric Oxide. *J Endod*. 2016;42(5):747-751. doi: 10.1016/j.joen.2016.01.022.
- Ding C, Parameswaran V, Udayan R, Burgess J, Jones G. Circulating levels of inflammatory markers predict change in bone mineral density and resorption in older adults: A longitudinal study. *J Clin Endocrinol Metab*. 2008;93(5):1952-1958. 10.1210/jc.2007-2325.
- Duarte PM, Gonçalves PF, Sallum AW, Sallum EA, Casati MZ, Nociti FH. Effect of an estrogen-deficient state and its therapy on bone loss resulting from an experimental periodontitis in rats. *J Periodontal Res*. 2004;39(2):107-110. DOI: 10.1111/j.1600-0765.2004.00714.x.
- Eftekhari H, Hosseini SR, Pourreza Baboli H, Mafi Golchin M, Heidari L, Abedian Z, Pourbagher R, Amjadi-Moheb F, Mousavi Kani SN, Nooreddini H, Akhavan-Niaki H. Association of interleukin-6 (rs1800796) but not transforming growth factor beta 1 (rs1800469) with serum calcium levels in osteoporotic patients. *Gene*. 2018;671(March):21-27. doi: 10.1016/j.gene.2018.05.118.
- Georgiou AC, Crielaard W, Armenis I, de Vries R, van der Waal S V. Apical Periodontitis Is Associated with Elevated Concentrations of Inflammatory Mediators in Peripheral Blood: A Systematic Review and Meta-analysis. *J Endod [Internet]*. 2019;45(11):1279-1295.e3. doi: 10.1016/j.joen.2019.07.017.
- Harner D, Falank C, Reagan MR. Interleukin-6 interweaves the bone marrow microenvironment, bone loss, and multiple myeloma. *Front Endocrinol (Lausanne)*. 2019;9:788. doi: 10.3389/fendo.2018.00788.
- Hunter CA, Jones SA. IL-6 as a keystone cytokine in health and disease. *Nat Immunol*. 2015;16(5):448-457. doi: 10.1038/ni.3153.
- Jeong WJ, Kim HJ. Osteoclasts: Crucial in Rheumatoid Arthritis. *J Rheum Dis*. 2016;23(3):141-147. https://doi.org/10.4078/jrd.2016.23.3.141.
- Ji YF, Jiang X, Li W, Ge X. Impact of interleukin-6 gene polymorphisms and its interaction with obesity on osteoporosis risk in Chinese postmenopausal women. *Environ Health Prev Med*. 2019;24(1):48. doi: 10.1186/s12199-019-0803-y.
- Kany S, Vollrath JT, Relja B. Cytokines in inflammatory disease. *Int J Mol Sci*. 2019;20(23): pii: E6008. doi: 10.3390/ijms20236008.
- Khajuria DK, Razdan R, Mahapatra DR. Description of a new method of ovariectomy in female rats. *Rev Bras Reumatol*. 2012;52(3):462-470.
- Li X, Zhou ZY, Zhang YY, Yang HL. IL-6 contributes to the defective osteogenesis of bone marrow stromal cells from the vertebral body of the glucocorticoid-induced osteoporotic mouse. *PLoS One*. 2016;11(4): e0154677. doi: 10.1371/journal.pone.0154677.
- López-López J, Castellanos-Cosano L, Estrugo-Devesa A, Gómez-Vaquero C, Velasco-Ortega E, Segura-Egea JJ. Radiolucent periapical lesions and bone mineral density in post-menopausal women. *Gerodontology*. 2015;32(3):195-201. doi: 10.1111/ger.12076.
- McDonald MM, Fairfield H, Falank C, Reagan MR. Adipose, Bone, and Myeloma: Contributions from the Microenvironment. *Calcif Tissue Int*. 2017;100(5):433-448. doi: 10.1007/s00223-016-0162-2.
- Metzger CE, Narayanan SA. The role of osteocytes in inflammatory bone loss. *Front Endocrinol (Lausanne)*. 2019;10:285. doi: 10.3389/fendo.2019.00285.
- Mundy GR. Cytokines and growth factors in the regulation of bone remodeling. *J Bone Miner Res*. 1993;8(Suppl 2):S505-S510. DOI:10.1002/jbmr.5650081315.
- Nibali L, Fedele S, D'Aiuto F, Donos N. Interleukin-6 in oral diseases: A review. *Oral Dis*. 2012;18(3):236-243. doi: 10.1111/j.1601-0825.2011.01867.x.
- Nikolic N, Jakovljevic A, Carkic J, Beljic-Ivanovic K, Miletic M, Soldatovic I, Andric M, Ivanovic V, Milasin J. Notch Signaling Pathway in Apical Periodontitis: Correlation with Bone Resorption Regulators and Proinflammatory Cytokines. *J Endod*. 2019;45(2):123-128. doi: 10.1016/j.joen.2018.10.015.
- Raj DV, Abuzar M, Borromeo GL. Bisphosphonates, healthcare professionals and oral health. *Gerodontology*. 2016;33(1):135-143.
- Romualdo PC, Lucisano MP, Paula-Silva FWG, Leoni GB, Sousa-Neto MD, Silva RAB, Silva LAB, Nelson-Filho P. Ovariectomy Exacerbates Apical Periodontitis in Rats with an Increase in Expression of Proinflammatory Cytokines and Matrix Metalloproteinases. *J Endod*. 2018;44(5):780-785. doi: 10.1016/j.joen.2018.01.010.
- Saribal D, Hocaoglu-Emre FS, Erdogan S, Bahtiyar N, Caglar Okur S, Mert M. Inflammatory cytokines IL-6 and TNF- α in patients with hip fracture. *Osteoporos Int*. 2019;30(5):1025-1031. doi: 10.1007/s00198-019-04874-2.
- Schett G. Physiological effects of modulating the interleukin-6 axis. *Rheumatol (United Kingdom)*. 2018;57 (suppl_2):ii43-ii50. doi: 10.1093/rheumatology/kex513.
- Tanaka M, Ejiri S, Toyooka E, Kohno S, Ozawa H. Effects of ovariectomy on trabecular structures of rat alveolar bone. *J Periodontal Res*. 2002;37(2):161-165. DOI:10.1034/j.1600-0765.2002.01601.x.
- Wayama MT, Yoshimura H, Ohba S, Yoshida H, Matsuda S, Kobayashi J, Gomes Filho JE, Sano K. Diminished Progression of Periapical Lesions with Zoledronic Acid in Ovariectomized Rats. *J Endod*. 2015;41(12):2002-2007. doi: 10.1016/j.joen.2015.08.029.
- Xie Z, Tang S, Ye G, Wang P, Li J, Liu W, Li M, Wang S, Wu X, Cen S, Zheng G, Ma M, Wu Y, Shen H. Interleukin-6/interleukin-6 receptor complex promotes osteogenic differentiation of bone marrow-derived mesenchymal stem cells. *Stem Cell Res Ther*. 2018;9(1):13. doi: 10.1186/s13287-017-0766-0.
- Xiong H, Wei L, Hu Y, Zhang C, Peng B. Effect of alendronate on alveolar bone resorption and angiogenesis in rats with experimental periapical lesions. *Int Endod J*. 2010;43(6):485-491. doi: 10.1111/j.1365-2591.2010.01703.x.
- Yan L, Hu R, Tu S, Cheng WJ, Zheng Q, Wang JW, Kan WS, Ren YJ. Meta-analysis of association between IL-6 -634C/G polymorphism and osteoporosis. *Genet Mol Res*. 2015;14(4):19225-19232. DOI: 10.4238/2015.december.29.32.
- Zhang J, Huang X, Lu B, Zhang C, Cai Z. Can apical periodontitis affect serum levels of CRP, IL-2, and IL-6 as well as induce pathological changes in remote organs? *Clin Oral Investig*. 2016;20(7):1617-1624. doi: 10.1007/s00784-015-1646-6.

Research regarding the development and evaluation of agility (balance, coordination and speed) in children aged 9-10 years

Dan Alexandru Szabo¹, Nicolae Neagu¹, Ioan Sabin Sopa²

¹George Emil Palade University of Medicine, Pharmacy, Science, and Technology, Târgu Mureș, Romania

²Lucian Blaga University, Faculty of Science, Department of Environment Sciences, Physics, Physical Education and Sport, Sibiu, Romania

Abstract

Background. Physical education in school is a crucial activity in establishing a well-balanced and harmonious body from young children to teenagers, developing motor skills, personality traits and building strong and durable relationships. One of the most important motor skills developed in physical education, in school, is the combination of speed, coordination and balance named nowadays agility. More authors described agility as being the capacity to quickly change direction, having high levels of speed and coordination, being well-balanced and creative.

Aims. The present study followed the idea of finding and evaluating the level of agility development in primary school children aged between 9 and 10 years old. The research group was composed of children from two Romanian schools: School “Mihai Eminescu” and School “George Popa” from Medias — Sibiu, with a sample of 105 children (49 males and 56 females) aged between nine and ten years old. The program of improvement was implemented 15 minutes in every physical education class for a 3-month period in 2019.

Methods. The research method used was an experimental method using two agility tests (the Agility T test and the Agility L test) whose purpose was to evaluate the initial and final level of agility. For statistical interpretation, the t-Student test, Mann-Whitney test and Welch correlation were used.

Results. The results in both agility tests showed improved results from the initial test to the final test after the 3-month training period. A statistically significant difference was found comparing the initial and final results of the male subjects in both schools in agility T test and also in agility L test. In addition, a statistically significant difference was demonstrated between the initial and final evaluation in female subjects by agility L test and by comparing the initial and final results of females between schools using the agility T test.

Conclusions. The conclusions of our experiment showed that the hypothesis was confirmed that following implementation of a specific program of development of combined motor qualities, speed and coordination (agility) can be improved and significantly better results in the two applied tests, between the initial and the final testing, can be obtained. Developing agility at young ages can contribute to a future athlete's sport career by building a strong foundation of motor skills.

Keywords: agility, speed, coordination, dynamic balance, body movement.

Introduction

Depending on the area to which we refer, the term movement may have different meanings. In the field of physical exercise practice, movement represents “the ability of an individual to travel from point to point, with the purpose of changing the position of the body or the different body segments, to move, to interact with other individuals and to act in the environment (physical or social)”. Depending on its nature, movements can be voluntary, non-voluntary, cyclic, acyclic, automatic, passive, active, uniform, accelerated, etc. All these represent types or genres of movement (Hantiu, 2013a).

Motor qualities or skills are defined by some authors as those characteristics of the body that materialize in the body's ability to perform movements with certain speed, strength, coordination or resistance indices. They are present in all the motor acts of individuals, each of them requiring a certain degree of manifestation of the others (Hantiu, 2013b).

Neagu (2012) asserted that although aptitudes largely belong to the genetic portfolio of an individual, they have in their composition a series of phenotypic elements (under the influence of the educational environment, for example), participating in their translation (through

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

E-mail: dan-alexandru.szabo@umfst.ro

Corresponding author: Dan Alexandru Szabo, e-mail: dan-alexandru.szabo@umfst.ro

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developing processes) from predisposing primary forms to increasingly refined, superior forms, defined in the form of talent, skill, etc.

In another form, motor skills can be defined as those predominantly endogenous individual characteristics—hereditary predispositions—with a share of exogenous influences—of an instructive-educational nature, which determine external motor manifestations, the actual movements, respectively (Neagu, 2012).

Motor qualities are considered important for the physical, mental and social evolution of children (Gallahue & Ozmun, 2002) and may even be the foundation of an active and healthy lifestyle, as many studies have shown a positive association between good motor skills and higher levels of physical activity. For example, it has been shown that a good index of the level of motor qualities has positive effects on health, effectively influencing the improvement of the cardiorespiratory capacity, the maintenance of an optimal body weight, the improvement of the level of practice and daily activities, the development of the executive function of the body, etc. (Lubans et al., 2010; Fisher et al., 2005; Williams et al., 2008; Krombholz, 2013).

The musculoskeletal and postural aesthetic deficiencies of human beings are in full ascension due to the new modern lifestyle and lack of concern for the prevention of their appearance, thus resulting in pronounced somatic disabilities (Vos et al., 2010). Research conducted in the last decade shows that biomechanical disorders start at an early age, and that problems emerging during this period can be present throughout life. Thus, a child who has physical pain during this period of development may experience pain even in adulthood (Hestbaek et al., 2006). It is very important to point out that these musculoskeletal disorders can have serious consequences on the physical and mental development of the child. A child with physical deficiencies will have a more withdrawn behavior, will be tempted to give up social activities that may have benefits on different levels and will present a major risk of behavioral underdevelopment. Last but not least, that child will be tempted to give up physical and sports activities, which play a very important role in maintaining health, thus being prone to other physiological problems, such as cardiovascular problems, diabetes, etc. (Andersen et al., 2016).

Several scientific sports studies concluded that one of the most important elements of the agility skill is speed or the rapid movement of the body. Older definitions of the agility skill are considered by many too basic and simplistic; the basic or the basic elements of the agility skill are more likely to be: balance of the body, coordination of parts of the body or the entire body, also the ability or the possibility of athletes to adapt and have rapid reactions to a change of the environment or different situations (Plisk, 2008). More and more specialists consider nowadays that the agility technique is a more complex motor skill and consider agility among the mixed physical motor skills composed of a combination of basic motor skills (Mekota, 2000). Although speed is a fundamental component of the agility skill, scientists affirm that it must not be confused or misinterpreted, and one must not put an equal sign between

speed and agility; agility has more components and can be superior to speed or quickness; this combined ability also has coordination and balance abilities.

The newer investigation in sports research concluded that speed ability and agility motor quality represent independent and different physical motor abilities and in the process of their development they require a high level of muscular specificity development (Sheppard & Young, 2006). Particular attention should be given to the development of the agility skill, to the anticipation and decision-making abilities (Young et al., 2002). Also, the speed and agility techniques involve moving the whole body very quickly, but unlike the speed skill, the attribute of changing direction is added to the agility skill.

A general definition of agility that is accepted by many sports scientists presents the agility skill as “a rapid whole-body movement with modification of running direction in response to a stimulus” (Van Gelder & Bartz, 2011). The agility skill implies the movement of the entire body or only of the upper or lower body segments to rapidly change the running direction without losing precision or balance (Allum et al., 2002).

The fundamental components of the agility skill are coordination and movement control, but they must be taken into account apart from the other components that affect the level of agility development, such as dynamic balance, mobility of joints, power of the body, and flexibility or elasticity, levels of energy resources, strength, speed and biomechanical structure of movement (Sporis et al., 2010).

Objectives

This research was aimed at examining several important phenomena, which must be studied in the field of physical education and sport. Some of the most important tasks of the research are the importance of educating and developing motor qualities in children, the motor skills examined in this study being speed and coordination, tested and interpreted in a combined and unitary way, through a series of motor activities corresponding to their studies.

Hypothesis

In the present research, we started from the hypothesis that tracking the application of our specific program of development of the combined motor qualities, speed and coordination (agility), we will obtain significantly better results in the two applied tests, between the initial and the final testing. This program was implemented with the help of specialized teachers in the educational instructional process of physical education and sports lessons, taking place for a period of about 3 months, followed at the end of the testing by data collection and interpretation, to observe the changes resulting in the motor skills of the studied subjects.

Materials and methods

Research protocol

This investigation was overseen in accordance with the Declaration of Helsinki (2013) and approved by the Ethics Committee before the beginning of the study. It also met the ethical standards for Sport and Exercise Science Research. Due to the fact that the general data protection

regulation entered in force on 25 May 2018 (Regulation (EU) 2016/679), which imposes a single set of rules on personal data protection, the tutors of the investigated subjects were provided with an agreement for recording and using personal data. This agreement was signed in two copies by all tutors and provides for the use of records of some motor parameters, then using them while respecting confidentiality, without using the child's identity.

a) Period and place of the research

The experimenting time frame was extended over a period of 3 months, the initial testing being applied at the beginning of February 2019, over a week. Between the two tests, initial and final, we designed a specific program for the development of the two combined motor qualities, which was used for 15 minutes in each physical education lesson.

The current research and data collection were carried out by means of motor tests, conducted in two state secondary schools in the city of Mediaș - School "George Popa" and School "Mihai Eminescu".

b) Subjects and groups

In order to carry out this study, we decided to choose a sample of 105 children aged between 9 and 10 years (49 boys and 56 girls), students of two secondary schools in the city of Mediaș.

Both schools were asked for an agreement to enable them to participate in physical education classes, with the purpose of conducting tests and collecting the data needed for the experiment.

The research was prospective in nature, one of the methods used being the quantitative method, which involves collecting and analyzing the data by performing some tests.

The study was conducted during the hours of physical education and sports and was assisted by the teachers responsible for the class.

c) Tests applied

Data collection was carried out following the application of two agility tests: the "T" test and the "L" test.

- The "T" test

This test includes in its process execution, specific types of actions (running forward, running back, running with added steps and changes in direction), which emphasize the development of combined motor qualities, speed and coordination. Being a test in which the speed level is predominantly targeted, the results will be interpreted in seconds.

Test description:

The test consists of a route, using different forms of running, also including certain changes of direction.

Method of performing the test

The teacher places 3 cones at a distance of 5 meters on a straight line (D, B, C), and a fourth cone (A) is located 10 meters from the middle cone (B) so that the four cones form a "T". Cone "A" will represent the starting point and also the end point of the test.

The subject starts with the "start" command from cone "A"; runs at maximum speed up to cone "B", touches the cone; runs with added steps up to cone "C", touches it; keeps moving at speed with added steps to cone "D", touches it; performs the movement with added steps up to

cone "B", touches it; then runs at speed with the back to the arrival point represented by cone "A".

The teacher will note the time of each subject separately.

- The "L" test

The "L" test is efficient for monitoring the speed of movement, multidirectional speed and the coordination of the psychomotor system of the body, responsible for adapting the movements, with the purpose of performing it in the most efficient possible way.

Description of the test

The teacher places 3 cones (A, B, C) at a distance of 5 meters from one other, imitating the shape of the letter "L".

The test will start from the right of step (A), with the face to step (B).

At the "start" signal, the subject runs at speed to step (B), touches it; turns and runs back towards milestone (A), touches it; then runs towards milestone (C), bypassing milestone (B) from the outside, touches it; runs back to the starting point, again bypassing milestone (B) from the outside, finishing the test after passing it.

The test results were recorded in a table, and then they were centralized and grouped into categories. As analysis methods, statistical analysis and qualitative analysis were used.

d) Statistical processing

Statistical analysis included descriptive statistics (frequency, percentage, mean, median, standard deviation) and inferential statistics. The D'Agostino & Pearson test was applied to determine the distribution of the analyzed data series. For median comparison, the Mann Whitney test and the non-parametric test for unpaired data were applied. The significance threshold chosen for p value was 0.05. Statistical analysis was performed using the GraphPad Prism.

Results

Table I

Results of the "T" and "L" tests in male subjects (initial + final).

Male gender	T Test Initial	T Test Final	L Test Initial	L Test Final
Mean	15.59	15.47	11.83	11.67
Std. deviation	1.591	1.576	0.9465	0.8719
P value	0.0029		P<0.0001	

By analyzing the results presented in Table I, it can be seen that in the male gender the average time obtained in the agility T test, at the initial evaluation, was 15.59 ± 1.591 seconds compared to the final measurement, where we obtained 15.47 ± 1.576 seconds. A 0.12 seconds improvement can be detected, which is considered, using Student t test with a value of $p < 0.05$, to be statistically significant (Table I and Fig. 1).

Also, Table I shows the data for the male gender in the agility L test; at the initial analysis, a result of 11.83 seconds can be seen compared to 11.67 at the final evaluation. The result at the final examination was improved by an average of 0.16 seconds which is considered, using Student t test with a value of $p < 0.05$, to be statistically significant (Table I and Fig. 1).

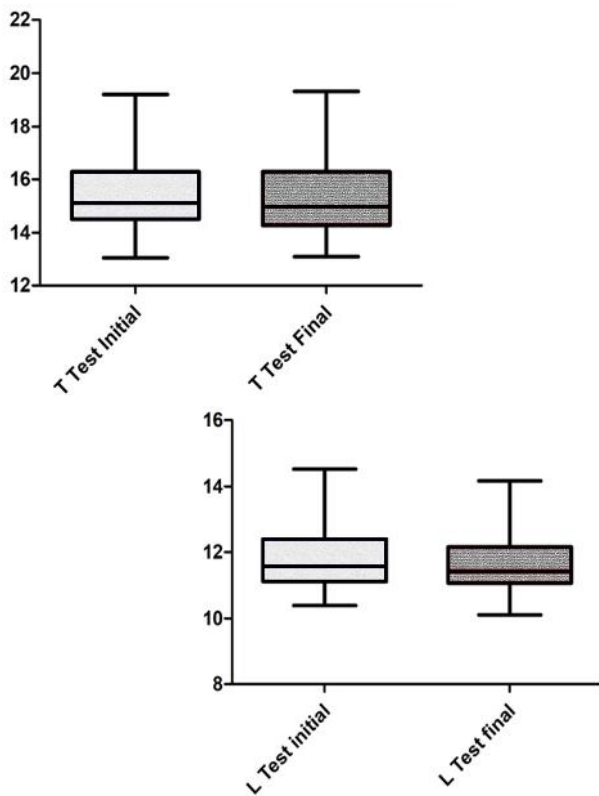


Fig. 1 – The "T" and "L" test results, in male subjects (initial + final in seconds).

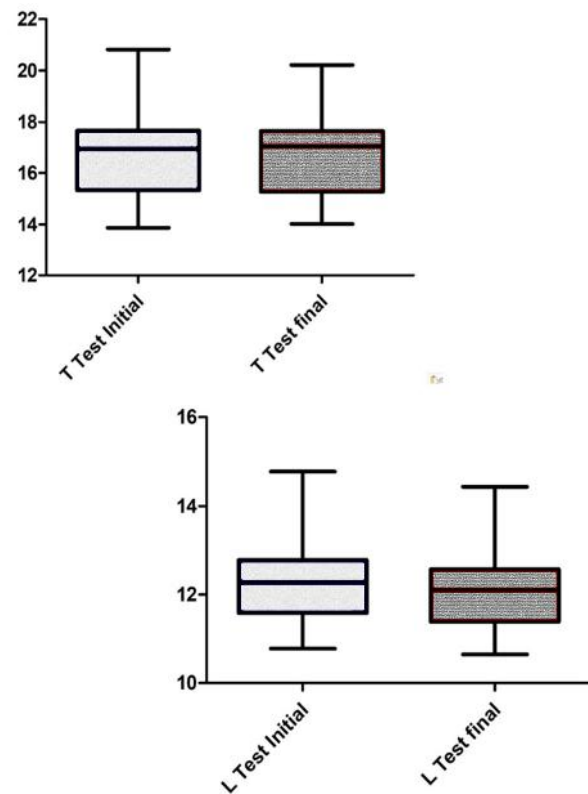


Fig. 2 – The "T" and "L" test results, in female subjects (initial + final in seconds).

Table II

Results of the "T" and "L" tests, in female subjects (initial + final).

Female gender	T Test Initial	T Test Final	L Test Initial	L Test Final
Mean	16.75	16.68	12.27	12.11
Std. deviation	1.537	1.509	0.9253	0.9075
P value	0.1437		P<0.0001	

By analyzing the results presented in Table II, it can be observed that in the female gender, at the agility T test initial evaluation, the average result was 16.75 seconds compared to the final result that was 16.68 seconds, with an improvement of 0.07 seconds from the initial to the final test. The result, using Student t test with a value of $p < 0.05$, is considered not statistically significant in the T test for the female gender (Table II and Fig. 2).

At the agility L test initial evaluation, we registered 12.27 seconds correlated with the final test, where the average was 12.11 seconds, with a 0.16 second improvement. Comparing the results of both calculations, using Student t test with a value of $p < 0.05$, we found a statistically significant difference between the average of the initial and final results in the L-test for the female gender (Table II and Fig. 2).

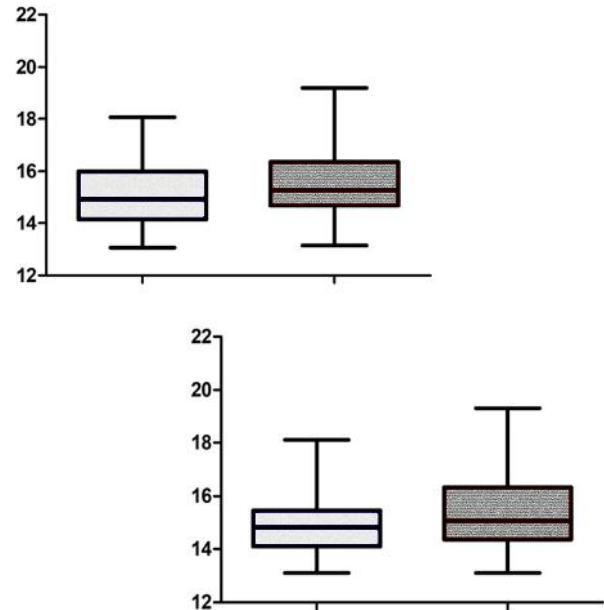


Fig. 3 – Initial and final results in the "T" test, in male subjects, between the two schools, in seconds.

Table III

Initial and final results in the "T" test, in male subjects, between the two schools.

T Test Initial	Male gender		T Test Final	Male gender	
	George Popa school	Mihai Eminescu school		George Popa school	Mihai Eminescu school
Mean	15.18	15.75	Mean	15.06	15.63
Std. deviation	1.476	1.626	Std. deviation	1.416	1.626
P value	0.2612		P value	0.2566	

Table IV

Initial and final results in the "L" test, in male subjects, between the two schools.

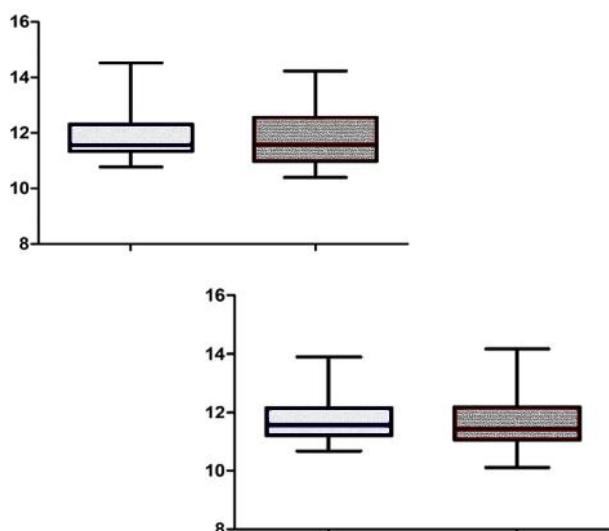
L Test Initial	Male gender		L Test Final	Male gender	
	George Popa school	Mihai Eminescu school		George Popa school	Mihai Eminescu school
Mean	11.93	11.79	Mean	11.75	11.64
Std. deviation	0.9378	0.9606	Std. deviation	0.8050	0.9067
P value	0.4386		P value	0.5067	

Table V

Initial and final results in the "T" test, in female subjects, between the two schools.

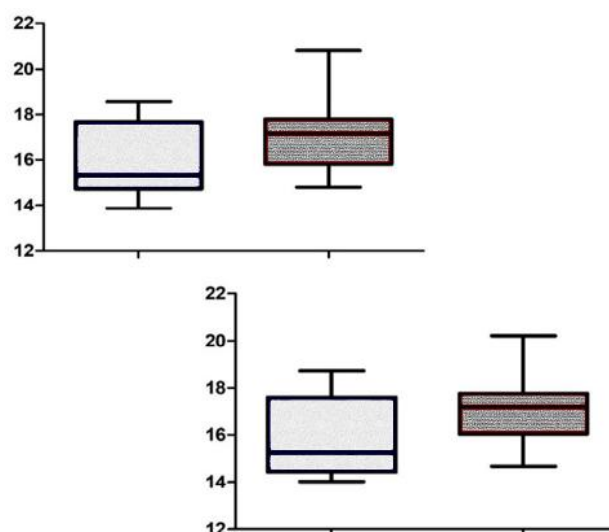
T Test Initial	Female gender		T Test Final	Female gender	
	George Popa school	Mihai Eminescu school		George Popa school	Mihai Eminescu school
Mean	16.05	17.10	Mean	15.93	17.06
Std. deviation	1.567	1.414	Std. deviation	1.608	1.319
P value	0.0143		P value	0.0069	

By correlating the results obtained by both schools (Table III and Fig. 3), it can be seen that "George Popa" school had an improvement of 0.12 seconds between the initial and final results in the agility T test in the male gender, with an initial result of 15.18 seconds compared to 15.06 seconds. "Mihai Eminescu" school also had an improvement of 0.12 seconds between the initial and final results in the agility T test in the male gender, with an initial result of 15.75 compared to 15.63 seconds in the final test. A comparison of the final results between the two schools, using Student t test with a value of $p < 0.05$, showed no statistically significant difference between the final results of the agility T test in the male gender.

**Fig. 4** – Initial and final results in the "L" test, in male subjects, between the two schools, in seconds.

Analyzing the results obtained by both schools (Table IV and Fig. 4) shows that School "George Popa" had an improvement of 0.18 seconds between the initial and final results in the agility L test in the male gender, with an initial result of 11.93 seconds compared to 11.75. School "Mihai Eminescu" registered an improvement of 0.15 seconds between the initial and final results in the agility L test in

the male gender, with an initial result of 11.79 correlated with 11.64 seconds in the final test. Comparing the final results between the two schools, using the Mann-Whitney test with a value of $p > 0.05$, no statistically significant difference was found between the final results of the agility T test in the male gender.

**Fig. 5** – Initial and final "T" test results in female subjects, between the two schools, in seconds.

The next step was to analyze the findings obtained by both schools in the agility T test - female gender (Table V and Fig. 5). It can be observed that School "George Popa" had an improvement of 0.12 seconds between the initial and final results in the agility T test in the female gender, with an initial result of 16.05 seconds compared to 15.93 at the final evaluation. School "Mihai Eminescu" showed an improvement of 0.04 seconds between the initial and final measurements of the agility T test in the female gender, with an initial outcome of 17.10 compared to 17.06 seconds in the final test. Comparing the final results between the two schools, using Student t test with a value of $p > 0.05$, evidenced a statistically significant difference between the final results of the agility T test in the female gender (Fig. 7).

Table VI

The results of the "L" test, initial and final, in female subjects, between the two schools.

L Test Initial	Female gender		L Test Final	Female gender	
	George Popa school	Mihai Eminescu school		George Popa school	Mihai Eminescu school
Mean	12.44	12.19	Mean	12.24	12.04
Std. deviation	1.135	0.8010	Std. deviation	1.138	0.7724
P value	0.3352		P value	0.4943	

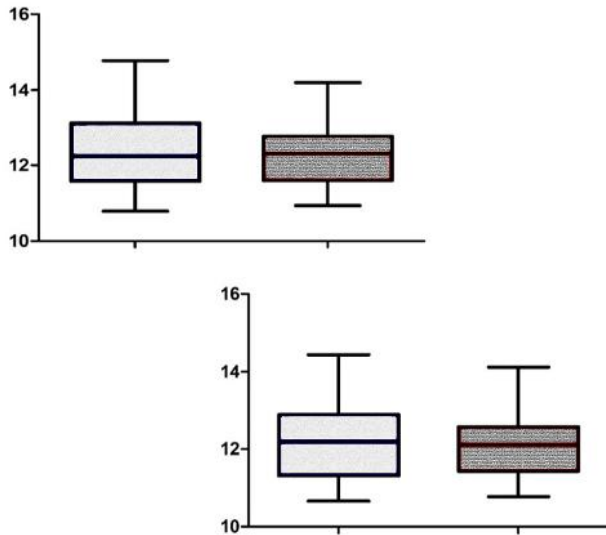


Fig. 6 – The "L" test, initial and final, in female subjects, between the two schools, in seconds.

At the final evaluation, we correlated the findings obtained by both schools in the agility L test - the female gender (Table VI and Fig. 6): School "George Popa" had an improvement of 0.20 seconds between the initial and final measurements in the agility L test for the female gender, with an initial result of 12.44 seconds compared to 12.24 at the final evaluation. School "Mihai Eminescu" had an improvement of 0.15 seconds between the initial and final results in the agility L test for the female gender, with an initial result of 12.19 compared to 12.04 seconds in the final test. Comparing the final results between the two schools, using the Welch correction with a value of $p > 0.05$, no statistically significant difference was found between the final data of the agility L test in the female gender (Fig. 8).

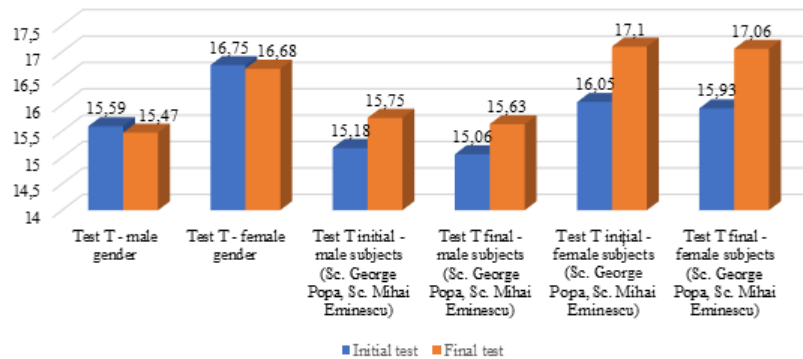


Fig. 7 – Comparison of initial and final T test values.

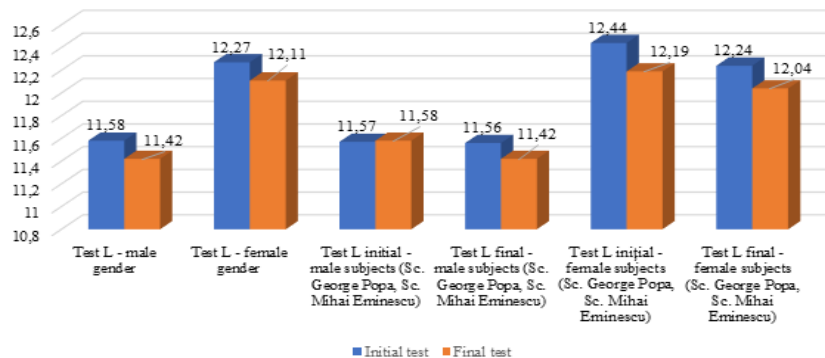


Fig. 8 – Comparison of the values of the L-test—initial and final.

Discussions

The importance of building motor qualities is an increasingly common topic in research studies, demonstrating each time the positive effects that result from their education.

The motor capacity of an individual adds up to a series of motor manifestations (skills), which, depending on their level of growth, influence the level of efficiency in performing a series of motor acts or actions. This idea was also studied by B. Sebastian in his paper entitled "Study on developing speed and skill through movement games in the basketball game."

In the literature, the importance of developing the nervous system during childhood is discussed very often, stressing that this is the crucial age at which the structures of neurons and the connections between them develop most efficiently, resulting in an improvement of motor qualities based on the speed of nerve impulses.

Developing speed and coordination at an early age, by teachers specialized in physical education and sports, prepares children for possible careers in the sports field, facilitating the work of coaches and thus avoiding stagnation of motor skills.

There is an increasing body of data that support the efficacy of training interventions to develop both the change of direction abilities (Brughelli et al., 2008) and the perceptual and decision-making aspects of agility (Serpell et al., 2011).

The results of the present research indicated significant improvements between the initial and the final examination in both agility tests, agility T test and agility L test. We compared the initial and final results in male subjects and female subjects and then we compared the results in males and females between the schools to see if any statistically significant difference could be found. The results showed a statistically significant difference in comparing the median time obtained by the male gender at the agility T test initial and final evaluation, which was considered, using Student t test with a value of $p < 0.05$, to be statistically significant; also, other statistically significant differences were found in the male gender in the agility L test, using Student t test with a value of $p < 0.05$, statistically significant. Other statistically significant differences were found by comparing the initial and final results in the female gender at the agility T test initial examination. The average result was 16.75 seconds compared to the final result which was 16.68 seconds, with an improvement of 0.07 seconds from the initial to the final test.

Other recent studies found no statistically significant differences in the level of agility between subjects practicing different sports games such as basketball, volleyball or soccer (Horicka et al., 2014). Some scientific papers discovered that agility manifests specifically in many sports; in judo, the agility to start, stop and change direction of movement requires one or maybe two small steps, taken quickly and dynamically to attack the opponent and reach the throwing position; conversely, a tennis player needs 4–5 steps to reach the coming ball (Inglis & Bird, 2016) and a soccer player needs many steps (Taylor et al., 2017). Straight line sprinting does not translate to

enhanced agility performance and instead supports the position in that linear running speed and jumping ability (Popowczak, 2019).

Conclusions

1. In conclusion, based on the studies carried out, it can be said that the development of speed and coordination in children in the primary cycle is essential for their good growth and evolution, thus managing to ensure a high motor capacity.

2. Motor skills can also be developed through testing systems similar to those performed in this research; they have very high attractiveness among students. The spirit of competition was extremely pronounced throughout the physical education hours, students wishing to achieve performances that would place them in front of the class.

3. Another conclusion is that the results of these tests can bring valuable information to teachers. For example, students who have had a good time in both tests have very high speed and coordination indices, being recommended to be guided by the specialist teacher to a certain branch of sport, such as basketball, handball, football, etc.

4. Such exercises help students develop their spirit of self-awareness, appreciating the individual value they have from a motor point of view, in some cases even inspiring them the desire to progress, with the purpose of overcoming their colleagues.

5. The conclusions of our experiment showed that the hypothesis was confirmed that the implementation of specific programs for the improvement of the combined motor qualities, speed and coordination (agility), can improve those skills and allow obtaining significantly better results in the two applied tests, between the initial and the final testing. Developing agility at young ages can contribute to a future athlete's sport career by building a strong foundation of motor skills.

References

- Allum J, Carpenter M, Honegger F, Adkin A, Bloem B. Age-dependent variations in the directional sensitivity of balance corrections and compensatory arm movements in man. *J Physiol.* 2002; 542(Pt 2):643-663. doi: 10.1113/jphysiol.2001.015644.
- Andersen LB, Bugge A, Dencker M, Eiberg S, El-Naaman B. The association between physical activity, physical fitness and development of metabolic disorders. *Int J Pediatr Obes.* 2011;6 (Suppl 1):29-34. doi: 10.3109/17477166.2011.606816.
- Brughelli M, Cronin J, Levin G, Chaouachi A. Understanding change of direction ability in sport: A review of resistance training studies. *Sports Med.* 2008;38(12):1045-1063. doi: 10.2165/00007256-200838120-00007.
- Fisher A, Reilly JJ, Kelly LA, Montgomery C, Williamson A, Paton JY. Fundamental movement skills and habitual physical activity in young children. *Med Sci Sports Exerc.* 2005;37(4):684-688. doi:10.1249/01.mss.0000159138.48107.7d.
- Gallahue DL, Ozmun JC. *Motor Development: A theoretical model. Understanding motor development: infants, children, adolescents, adults.* 5th ed. New York: McGraw-Hill, 2002.
- Hantiu I. *Kinesiologie-Știința mișcării* Ed. Univ Press, Oradea, 2013a.
- Hanțiu I. *Educație fizică și sport - Teorie și metodică.* Ed Univ

- Press, Oradea, 2013b.
- Hestbaek L, Leboeuf-Yde C, Kyvik KO, Manniche C. The course of low back pain from adolescence to adulthood: eight-year follow-up of 9600 twins. *PubMed Spine*. 2006;31(4):468-472. doi: 10.1097/01.brs.0000199958.04073.d9.
- Horicka P, Simonek J, Hianik J. The relationship between speed factors and agility in sport games. *J Hum Sport Exerc*. 2014;9(1):49-58. DOI: 10.4100/jhse.2014.91.06.
- Inglis P, Bird SP. Reactive agility tests-Review and practical applications. *J Aust. Strength Cond.*, 2016;24(5):62-69.
- Krombholz H. Motor and cognitive performance of overweight preschool children. *Percept Mot Skills*. 2013;116(1):40-57. doi: 10.2466/22.25.PMS.116.1.40-57.
- Lubans DR, Morgan PJ, Cliff DP, Barnett LM, Okely AD. Fundamental movement skills in children and adolescents: review of associated health benefits. *Sports Med*. 2010;40(12):1019-1035. doi: 10.2165/11536850-000000000-00000.
- Měkota K. Definition and structure of motor abilities. *Czech kinanthropology*. 2000;4(1):59-69.
- Neagu N. *Motricitatea umană: Fundamente psihopedagogice*, Ed Univ Press, Târgu Mureș, 2012.
- Plisk SS. Speed, agility and speed endurance development. In T.R. Beachle and R.W. Earle (Eds.), *Essential of Strength Training and Conditioning*. Champaign, IL: Human Kinetics, 2000.
- Popowczak M, Rokita A, Świerczko K, Szczepan S, Michalski R, Maćkała K. Are Linear Speed and Jumping Ability Determinants of Change of Direction Movements in Young Male Soccer Players? *J. Sports Sci. Med*. 2019;18(1):109-117.
- Serpell BG, Young WB, Ford M. Are the perceptual and decision-making aspects of agility trainable? A preliminary investigation, *J Strength Cond Res*. 2011;25(5):1240-1248. doi: 10.1519/JSC.0b013e3181d682e6.
- Sheppard JM, Young WB. Agility Literature Review: Classifications, Training, and Testing. *J Sports Sci*, 2006; 24(9):919-932. DOI:10.1080/02640410500457109.
- Sporis G, Milanovic L, Jukic I, Omrcen D, Molinuevo J. The effect of agility training on athletic power performance; *Kinesiology*, 2010;42(1):65-72.
- Taylor JB, Wright AA, Dischiavi SL, Townsend MA, Marmon AR. Activity Demands During Multi-Directional Team Sports: A Systematic Review. *Sports Med*. 2017;47(12):2533-2551. doi: 10.1007/s40279-017-0772-5.
- Van Gelder LH, Bartz SD. The effect of acute stretching on agility performance. *J Strength Cond Res*. 2011;25(11):3014-3021. doi: 10.1519/JSC.0b013e318212e42b.
- Vos T, Flaxman AD, Naghavi M, Lozano R, Michaud C, Ezzati M. Years lived with disability (YLDs) for 1160 sequelae of 289 diseases and injuries 1990-2010: a systematic analysis for the Global Burden of Disease Study. *Lancet*. 2010;380(9859):2163-2196. doi: 10.1016/S0140-6736(12)61729-2.
- Williams HG, Pfeiffer KA, O'Neill JR, Dowda M, McIver KL, Brown WH. Motor skill performance and physical activity in preschool children. *Obesity*. 2008;16(6):1421-1426. doi: 10.1038/oby.2008.214.
- Young WB, James R, Montgomery I. Is Muscle Power Related to Running Speed with Changes of Direction? *J Sports Med Phys Fitness*. 2002;42(3):282-288.

The influence of attention in increasing sports performance in football at the age of 7-10 years

Gheorghe Dan Fetean, Gheorghe Monea, Marius Roșca

Faculty of Physical Education and Sport, “Babeș-Bolyai” University Cluj-Napoca, Romania

Abstract

Background. The concept of uniform training of children and juniors in football is a requirement that has been increasingly expressed by many technicians. The improvement of distributive attention and focused attention plays an important role in increasing sports performance.

Aims. The study aims to examine the relationship between attention and sports performance.

Methods. Attention was assessed using two testers: the EM – 05.48 C focused attention tester and the combined EM – 05.54, EM 05.55 distributive attention tester.

Results. Following the tests applied, it was found that football players' performance increased after the training program. Distributive attention registered the following results: the number of correct reactions at the final testing increased by an average of 1.26. The means were 130.27 at the initial testing and 131.53 at the final testing, with a percent increase of 1.0%. The number of erroneous reactions at the final testing decreased by an average of 1.66, the mean values being 5.13 at the initial testing and 3.47 at the final testing. The mean performance at the final testing increased by 0.34, the percent increase of the mean performance being 1.3%. During the experiment, the intervention on the five teams was performed three times a week for 20-25 minutes.

Conclusions. Distributive attention significantly improved following the intervention. Correct reactions increased by 1.26, erroneous reactions decreased by 32.5%, and there was a 1.3 increase in the mean performance at the final testing; the mean increase was not statistically significant, $p=0.300>0.05$, for $Z=-1.036$.

Focused attention improved following the intervention, correct responses increased by 16.6%, erroneous responses decreased by 67.8% at the final testing, and performance dispersion registered a decrease of only 3.1%, which means that it was not statistically significant, $p=0.887>0.05$, for $Z=-0.142$.

Keywords: football, sports performance, distributive attention, focused attention, sport.

Introduction

The study of attention is one of the most important fields in cognitive psychology and cognitive neuroscience, because it addresses fundamental questions such as “voluntary control and subjective experience which appear and regulate our behavior” (Posner, 2007).

Attention consists of orienting and focusing cognitive mental activity on an object or a phenomenon (Cosmovici, 1999).

Epuran et al. (2008) define attention as the basic requirement for the conscientization of the entire psychobehavioral life, supporting the idea that without attention, no external or internal information is received or processed.

According to the authors, attention is the function of selectively orienting and focusing mental activity

on objects and phenomena, with the aim of perceiving and understanding them for an effective organization of behavior (Epuran, 2008).

Attention is a distinct process having its own content and being an attribute of mental processes. Oscillation of attention occurs as an effect of protection inhibition; fixation of attention is easy in the case of action with moving objects (Iosif, 1996). Attention allows optimizing knowledge of an object by its separation from what surrounds it. The manifestation of attention causes effects that are extremely important for mental life. Of these, we mention the following:

- Focusing attention even on a weak intensity stimulus induces a perception of the stimulus as much stronger than it actually is.
- The increase in the clarity of an object or a phenomenon is also the result of focusing attention.

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Address for correspondence: Faculty of Physical Education and Sport, “Babeș-Bolyai” University, Cluj-Napoca, No. 7 Pandurilor Str.

E-mail: feteangheorghe@yahoo.com

Corresponding author: Gheorghe Dan Fetean, feteangheorghe@yahoo.com

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- The rapid perception of a fact, an object or an event is another effect caused by the manifestation of attention.

In order to reach optimum sports performance, it is imperative for athletes to remain focused throughout the duration of a competition. If they manage to focus on essential information and avoid disturbing factors, they have a good chance to perform at the highest level (Crăciun, 2012).

Attention does not have a specific content. It rather designates a condition of mental life due to the fact that the environment in which we live is extremely complex, and we are quite limited in processing information. Depending on the presence or absence of the intention to be attentive, *voluntary attention* has been differentiated from *involuntary attention*.

Involuntary attention is defined by the fact that orientation and focus are spontaneous, involuntary and effortless. Voluntary attention does not occur naturally; it is intentional and consciously self-regulated. The selective direction of cognitive and psychomotor activity is based on the regulatory function of language. Attention is focused by self-command or command: "I should be attentive", based on an adequate motivational stimulus. Voluntary attention supports activity at all times, which is why many researchers consider that voluntary attention is decisive for the development of activity. During competition, attention is focused on the opponent, ready to communicate "key" actions or movements, important for the continuation of the competition. Waiting, anticipating and following the movements are orientations of both perceptual attention and action-based attention, as a preparatory motor attitude, as an anticipation of action (Epuran, 2001).

Researchers have studied the orientation of attention in sport and have found a number of results of which we mention the following:

- All studies show that subjects who participate in open skill sports, such as boxing (Nougier, 1989), hockey (Enns, 1997), pentathlon (Nougier, 1989), football (Lum, 2002), or volleyball (Castiello, 1992), had a higher attention level than novices for orienting their attention in the visual space. Athletes might prefer to pay proportionally less attention to highly probable events and more attention to less probable events. This is unlikely to be the case of athletes who practice closed skill sports (Nougier, 1996).

- Other studies demonstrate that professional athletes can modulate their attention according to the task-specific requirements (Castiello, 1992). More precisely, experienced volleyball players (Pesce, 1998) and professional skiers (Turatto, 1999) showed a better adaptation of attentional focus efficacy, which means that depending on the task, professional athletes are better than novices at modulating the attentional focus dimension.

- Physical exercise or submaximal load leads to a reduction of the reaction time among professional athletes, and especially, for non-valid indices, the attention reaction time decreased (Pesce, 2004).

- Attentional orientation may also have an influence on the control of a motor skill during its execution (Lépine, 1989) or the performance of a decision-making task specific to each sport.

Regardless of its form of manifestation (involuntary,

voluntary or post-voluntary), attention evidences a set of highly objectifiable and relatively rigorously quantifiable dimensions, based on which it can be analyzed, compared and evaluated. Among the most important dimensions we mention: volume, focus, stability, mobility and distribution.

"The volume of attention expresses the number of distinct "elements" or "entities" (letters, numbers, syllables, words, geometric shapes, images, objects) that a subject can embrace simultaneously with high and relatively equal clarity (on a perceptive or on a mental plane – representation, imagination)" (Golu, 2005).

Objectives

We aimed to study the relationship between attention and sports performance, more precisely, to show the fact that attention is an important predictor of sports performance in football starting with the age of 7-10 years.

Hypothesis

Following the psychological training program proposed for implementation, we assumed that football players might have a significantly higher post-test level of attention and sports performance compared to pre-test values.

Material and methods

Before initiating the study, the approval of the Ethics Committee of the Faculty of Physical Education and Sport of the "Babeş Bolyai" University in Cluj-Napoca was obtained, as well as the informed consent of the subjects and their parents' written consent.

Research protocol

a) Period and place of the research

The research was initiated on 1 August 2015, and the intervention program was applied until 20 July 2016. The research was carried out at the training facilities of the sports clubs. Initial testing was conducted in the period 1-10 August 2015. During the experiment, the intervention on the five teams was performed three times a week for 20-25 minutes. The final testing was conducted in the period 10-20 June 2016. During this period, the children had two holidays: from 23.12.2015 to 04.01.2016 and from 29.04.2016 to 16.05.2016.

b) Subjects and groups

The study was performed in 90 subjects, male athletes aged 9 years, members of the football clubs ACS Best Junior Cluj-Napoca, Star Mediaş, Viitorul Luduş, Armenopolis Gherla and ACS Satu Mare.

c) Tests applied

- *Focused attention* was measured using the *EM – 05.48 C focused attention tester*. The device controlled by microprocessors is designed based on modern electronic solutions. It is used to examine the stability and oscillation of attention, and it can provide information about the rapidity of observation and understanding, as well as about risk-taking willingness. This machine provides indications about dysfunctions in understanding the work tasks and about the observation capacity performance. The focused attention test can be used in all fields where sustained and continuous attention plays an important role in activity.

Examination using the focused attention tester can be included in the methodology of various studies because measurements also provide information about memory qualities, the focused attention capacity, as well as about the degree of resistance to monotony.

- *Distributive attention* was measured using the combined EM – 05.54, EM 05.55 distributive attention tester. This device for the combined testing of distributive attention, of the focused attention capacity and eye-hand coordination can be successfully used in skill testing, in activities involving a high level of attention. The machine as a testing instrument can also be used for educational counseling. There is a junction between attention and vigilance, which is why the results obtained are an important landmark in the evaluation of a subject's capacity. The tester can be used in the field of mental skill testing, as well as in scientific research.

Methods for the development of focused attention

The subjects were arranged in a line, each with the ball at their foot. Each player executed 3 shots from 8-10 m, at a fixed point: on the goal net, a red card was placed that each subject had to hit. Each subject was given time to focus without being disturbed by the other players. The exercise was performed simultaneously at the two goals, the subjects being divided into two equal groups.

Methods for the development of distributive attention

The subjects were placed in two lines facing the goal; each player executed 3 shots from 8-10 m, at a fixed point. Two subjects shot at the goal at the same time, trying to hit the card on the goal net. The exercise was carried out at one goal, while attempting to distract the attention of the two players as much as possible.

Exercises useful for distracting attention and developing distributive attention:

- at the moment of shooting, the coach whistles;
- at the moment of shooting, the coach shouts the name of a subject.

d) Statistical processing

The results were statistically processed using the SPSS software (variant V23) and Microsoft Office 2010, Word and Excel. Data were statistically processed using the Student t test.

Effect size

The tests for the verification of the statistical hypotheses, through the *p* threshold value, indicate whether there are statistically significant differences between the means of the two tests, but not the size of the difference. The effect size, assessed as small, medium, large, small to medium, etc., quantifies the size of the difference. The size of the difference between the mean results of the two dependent tests (same sample) was evaluated using Cohen's effect size index.

Results

Table I
Distributive attention – correct reactions, erroneous reactions and performance (progress).

Statistical indicators	T I	T F	Z	p
Correct reactions - Mean	130.27	131.53	0.974	1.26
Erroneous reactions	5.13	3.47	-2.728	0.006
Progress (mean performance)	26.05	26.39	-1.036%	0.300

Table II
Focused attention – correct responses, erroneous responses and performance (progress).

Statistical indicators	T I	T F	Z	p
Correct responses - Mean	21.73	25.33	-2.560	0.010
Erroneous responses	3.93	1.27	-3.191	0.001
Progress (mean performance)	19.53	18.92	-0.142%	0.887

Discussions

In conclusion, from a psychological point of view, attention is a form of mental life, which applies to various contents and consists of a focusing of consciousness on a limited area. Attention is a synthesis function, gathering all available data and resources around an object or a phenomenon. It is a state of relative monoideism facilitated by the intervention of motivation and emotions. A role is also played by previously acquired knowledge and skills. The solution of voluntary attention problems depends on the progress made in the study of volition.

The attention focusing capacity varies significantly from one individual to another. It is an expression of the entire personality, mainly expressing its aspirations (Cosmovici, 1996).

In Table I, it can be seen that the number of correct reactions increased at the final testing by an average of 1.26. The means were 130.27 at the initial testing and 131.53 at the final testing. The percent increase was 1.0%. The dispersion of the results of both tests was homogeneous. The difference between the means was small to medium. The increase in the number of correct reactions was not statistically significant, $p=0.330>0.05$, for $Z=-0.974$. The null hypothesis was accepted.

The number of erroneous reactions decreased at the final testing by an average of 1.66, the mean values being 5.13 at the initial testing and 3.47 at the final testing. The percent decrease in erroneous reactions was 32.5%. The dispersion of the data of both tests was inhomogeneous. The difference of the means was medium to large. The number of erroneous reactions decreased significantly, $p=0.006<0.05$, for $Z=-2.728$. The null hypothesis was rejected (Table I).

The mean performance increased at the final testing by 0.34, the mean values being 26.05 at the initial testing and 26.39 at the final testing. The percent increase in the mean performance was 1.3%. The results were homogeneously dispersed in the case of both tests. The difference between the means was small to medium. The mean increase was not statistically significant, $p=0.300>0.05$, for $Z=-1.036$. The null hypothesis was accepted (Table I).

The correct responses for focused attention increased at the final testing by an average of 3.60. The mean values were 21.73 at the initial testing and 25.33 at the final testing. The mean percent increase was 16.6%. The dispersion of responses was inhomogeneous at the initial testing and relatively homogeneous at the final testing. The difference between the means was medium to large. The mean increase of correct responses for focused attention was statistically significant, $p=0.010<0.05$, for $Z=-2.560$. The null hypothesis was rejected (Table II).

The mean number of erroneous responses for focused

attention decreased at the final testing by 2.66, the mean values being 3.93 at the initial testing and 1.27 at the final testing. The percent decrease of erroneous responses was 67.8%. The dispersion of the results of both tests was inhomogeneous. The difference between the means was large to very large. The decrease in the mean number of erroneous responses was statistically significant, $p=0.001<0.05$, for $Z=-3.191$. The null hypothesis was rejected (Table II).

The results recorded for the dispersion of focused attention decreased at the final testing by an average of 0.61, the mean values being 19.53 at the initial testing and 18.92 at the final testing. The percent decrease of dispersion was 3.1%. The results obtained were inhomogeneously dispersed in the case of both tests. The difference between the means was very small. The decrease in the dispersion of focused attention was not statistically significant, $p=0.887>0.05$, for $Z=-0.142$. The null hypothesis was accepted (Table II).

Conclusions

The results obtained following the two tests, initial and final, demonstrate that the introduced variable caused progress, focused attention as well as distributive attention being significantly improved at the final testing.

Distributive attention was considerably improved following the intervention. Correct reactions increased by 1.26, the number of erroneous reactions decreased by 32.5%, and there was a 1.3% increase in the mean performance at the final testing; the mean increase was not statistically significant, $p=0.300>0.05$, for $Z=-1.036$.

Focused attention improved following the intervention, correct responses increased by 16.6%, erroneous responses decreased by 67.8% at the final testing, and there was a decrease of only 3.1% in the dispersion of performance, which means that it was not statistically significant, $p=0.887>0.05$, for $Z=-0.142$.

Conflicts of interests

Nothing to declare.

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References

- Castiello U, Umiltà C. Orienting of attention in volley-ball players. *International Journal of Sport Psychology*, 1992; 23, 301-310.
- Crăciun M. Psihologia sportului pentru antrenori. Editura Risoprint, Cluj-Napoca, 2012; 103; 122; 147; 149-159.
- Cosmovici A. Psihologie generală, Editura Polirom, Iaşi, 1996, 66-74.
- Cosmovici A, Iacob L (coord). Psihologie şcolară. Ed. Polirom Iaşi, 1999, 131.
- Epuran. M. Haldovici, I, Toniţa, F., (2001). Psihologia Sportului de performanţă: teorie şi practică, FEST, Bucureşti, 69-70.
- Epuran M., Psihologia sportului de performanţă, Teorie şi practică, Editra FEFS, Bucureşti, 2008, 4-73, 159, 161, 164, 170.
- Enns J, Richards J. Visual attentional orienting in developing hockey players. *Journal of Experimental Child Psychology*, 1997; 64, 255-275.
- Golu M. Bazele psihologiei generale, Editura Universitară, Bucureşti, 2005, 231-232; 530-531.
- Iosif Gh, Moldovan M. Psihologia muncii. Ed Didactică şi Pedagogică, Bucuresti, 1996, 27-29.
- Lépine D, Glencross D, Requin J. Some experimental evidence for and against a parametric conception of movement programming. *Journal of Experimental Psychology. Human Perception and Performance*, 1989; 15, 347-362.
- Nougier V, Ripoll H, Stein JF. Orienting of attention with highly skilled athletes. *International Journal of Sport Psychology*, 1989; 20, 205-223.
- Nougier V, Rossi B, Alain C, Taddei F. Evidence of strategic effects in the modulation of orienting of attention. *Ergonomics*, 1996 ;39(9), 1119-1133.
- Pesce-Anzeneder C, Bo'sel R. Modulation of the spatial extent of the attentional focus in high-level volleyball players. *European Journal of Cognitive Psychology*, 1998; 10, 247-267.
- Pesce C, Casella R, Capranica L. Modulation of visuospatial attention at rest and during physical exercise: Gender differences. *International Journal of Sport Psychology*, 2004; 35, 328-34.
- Posner, M., Rothbart, M. K. Research on attention networks as a model for the integration of a psychological science. *Annual Review of Psychology*, 2007; 58, 1-23.
- Turatto M, Benso F, Umiltà C. Focusing of attention in profesional women skiers. *International Journal of Sport Psychology*, 1999; 30, 339-349.

REVIEWS

Biocrystallization test for early determination of oxidative stress

Cristina-Daniela Cîmpean¹, Mihai Berteanu^{1,2}

¹PhD Student, “Carol Davila” University of Medicine and Pharmacy, Bucharest, Romania

²Department of Rehabilitation Medicine, Elias University Hospital, Bucharest

Abstract

Oxidative stress is an imbalance of oxidants/antioxidants in favor of oxidants as stated by Sies in 1985, and may arise due to excessive sports, physical and mental stress, high altitude exposure, diets, temperature variations, extreme cold or heat weather, smoking, hypoxia, immobilization stress and so on. It is also the main cause of the most common illnesses of the current age: cardiovascular disease, diabetes, infection, chronic fatigue syndrome, depression, malignancy, and neurodegenerative disorders. The early determination of oxidative stress, although important for health, is not always simple and often requires laborious and expensive analysis. Biocrystallization, also called sensitive crystallization, is a simple and inexpensive qualitative method used for almost 100 years in the study of herbs, foods and also in human health for orientation of diagnosis. The method also allows a rapid assessment of the therapeutic effectiveness of remedies or recommended procedures for patients with a certain pathology. In this paper we are looking to answer the following question: is it possible to use this method in order to assess the level of oxidative stress induced by varying environmental or internal factors and to observe the efficiency of the treatment?

Keywords: biocrystallization, oxidative stress, carbonyl stress.

Introduction

Oxidative stress is an imbalance between all oxidants and antioxidants, in favor of oxidants (Sies, 1985). High levels of oxidants can be the result of exogenous exposure or endogenous production of various reactive oxygen species (ROS), reactive nitrogen species such as nitric oxide and peroxynitrite (Sies, 1997), reactive carbonyl species (RCS), reactive sulphur species (RSS) and reactive selenium species (RSeS), which exceeds the level of internal antioxidant defense mechanisms or the ability to repair the damage caused by ROS to cell proteins, lipids and DNA.

It may arise due to sport activities (Dejica, 2000), physical and mental stress, diets, high altitude exposure, temperature variations, extreme cold or heat weather, hypoxia, immobilization stress, smoking (Bidian & Tache, 2007), aging, diabetes, ischemia, infection, uremia, hypertension, malignancy (Manolescu, 2011), as well as muscle injury and inflammatory disease processes, including hyperthyroid myopathy, sepsis (Ploșteanu, 2018).

Physiological implications

Free radicals and other oxidant non-radicals have important physiological roles through redox sensing and redox signaling as long as they remain within certain limits, which is termed oxidative eustress or physiological oxidative stress, positive oxidative stress (Yan, 2014; Pizzino et al., 2017).

Pathological implications

Toxic and excessive oxidative burden is named distress (Sies et al., 2017). The level of oxidative stress is very important in human health because it can be involved or can be a basis for cancer (Halliwell, 2007), neurological degenerative diseases such as Parkinson's disease (Hwang, 2013), Alzheimer's disease (Valko et al., 2007), for the main cardiovascular diseases including atherosclerosis (Bonomini et al., 2008), myocardial infarction (Ramond et al., 2013; Dean et al., 2011), heart failure (Singh et al., 1995), genetic diseases such as Lafora disease (Roma-Mateo et al., 2015), fragile X syndrome (de Diego-Otero et al., 2009) and sickle-cell anemia (Amer et al., 2006),

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Address for correspondence: Department of Rehabilitation Medicine, Elias University Hospital, Mărăști Av, No. 17, 1st District, Postal Code 011416, Bucharest, Romania

E-mail: cimpean_cristina@yahoo.com

Corresponding author: Cristina-Daniela Cîmpean, cimpean_cristina@yahoo.com

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mental and developmental diseases such as ADHD (Joseph et al. 2015), Asperger syndrome (Parellada et al., 2012), autism (James et al., 2004) and depression (Jiménez-Fernández et al., 2015), dermatological diseases such as lichen planus (Aly and Shahin, 2010) and vitiligo (Arican & Kurutas, 2008).

Oxidative damage

There are multiple proposed mechanisms through which oxidative stress might reduce important health status processes such as cardiac and neurological function, and the first is by damaging cellular proteins, lipids and membranes, DNA, RNA and microRNA oxidation, thus inducing cellular dysfunction or death through apoptosis and necrosis. Recently, in diabetes mellitus, “carbonyl stress” was described, which is characterized by accumulation of reactive carbonyl compounds having deleterious effects upon the target biomolecules (Oprea et al., 2013). Because of these very important consequences, early determination of oxidative distress and even its surveying can be needed.

Methods and indicators for oxidative stress

Exploring the oxidative status of the body can be performed in the following 6 ways (Nemes-Nagy et al., 2012):

1. Free radical measurement by absorption spectroscopy.
2. Measurement of chemical uptake (chemical trapping) by quantitative determination of the elimination of specific derivatives of salicylic acid, hydroxylated or nitrosylated compounds.
3. Measuring the antioxidant capacity of each antioxidant or total plasma antioxidant capacity.
4. Determination of antioxidant enzyme activities (SOD, CAT, GPX) and non-enzymatic antioxidants (Dejica, 2000, 2001).
5. Measurement of biological compounds resulting from oxidative processes.
6. Measurement of antioxidant/oxidizing substance ratio.

Non-invasive methods

In the last years, a range of non-invasive assay systems for oxidative status using spectrophotometric analysis of the redox state of mitochondrial and extramitochondrial cytochromes, redox-sensitive two-photon microscopy, electron spin resonance (ESR), electron paramagnetic resonance (EPR), genetically encoded fluorescent protein indicators and other fluorescent probes was presented (Sies et al, 2017).

Invasive methods

For evaluation of the oxidative stress level, we currently use a panel of standardized or unstandardized serum markers such as gamma-glutamyl transpeptidase, advanced oxidation protein products, thiobarbituric acid reactive substances, serum albumin, serum uric acid level (Manolescu et al., 2011), lipoperoxides and aldehydes (Muresan et al. 2006), oxidized low density lipoprotein (LDL) particles, total antioxidant capacity of serum (Re et al., 1999), total thiols and non-protein thiols (Himmelfarb et al., 2000), concentration of protein carbonyls (Hawkins

et al., 2009), hypoxanthin (Tache, 2001) ceruloplasmin (Sunderman & Nomoto, 1970; Tache, 2000). In the last years, concentrations of 8-Oxo-2'-deoxyguanosine and 8-hydroxyguanosine within a cell have been a measurement of oxidative stress (Valavanidis et al., 2013). Such determinations are not widely available, so the use of simple methods for monitoring oxidative stress such as biocrystallization can be welcome.

Biocrystallization

The first biocrystallization experiments were conducted in 1922-1923 (Pfeiffer, 1930; Pfeiffer, 1968). Ehrenfried Pfeiffer and his team tested many inorganic salts and in 1925 they completed the sensitive crystallisation method based on dehydrated copper chloride ($\text{CuCl}_2 \cdot x\text{H}_2\text{O}$), the most sensitive salt with respect to the added substrate.

The principle of biocrystallization

Pure dehydrated copper chloride solution crystallizes in an orthorhombic system, forming fine needles, conglomerated in deposits. When a small amount of biological substance is added to the copper chloride solution, typical crystalline formation is completely inhibited, crystals increase several thousand times in volume and appear as unspecific dendritic or curved forms (Shibata et al., 1994). This phenomenon can be used as a morphological test.

An important experiment for understanding this type of sensitive crystallization was made by Shibata et al. in 1998 using X-ray photo-electric spectroscopy of the copper chloride network derived from a solution containing human blood. This test showed that the atoms in the added biological substrate (nitrogen, carbon or oxygen atoms) are absorbed at the surface of the copper chloride crystals, where there is a phenomenon of exchange of copper chlorine peripheral electrons, but they cannot be detected anywhere within the copper chloride crystals. In this experiment, the conclusion was that these elements (nitrogen, carbon and oxygen) influence only the morphology of copper chloride crystallization. Another study conducted in France by Charpentier showed that electric and magnetic fields have no influence on biocrystallization (Charpentier et al., 1998).

The most important influence of any additive is on the growth process (Reiter & Barth, 2010). Crystallization has two important elements: a growth process and a nucleation (Leray, 1968). Both parts of the phenomenon are influenced and controlled by concentration or temperature, and can only occur at concentrations higher than saturation concentration and at temperatures below the melting point.

Biocrystallization test in human and veterinary health

The blood biocrystallization test is a minimally invasive analysis using a solution of hemolyzed capillary blood as an additive in the process of copper chloride crystallization. Fresh or dry blood samples can be used. The freshly taken samples of blood provide more accurate images than those taken on filter paper which become dry and are used after more than six days. The time of taking the blood samples is also important. The most appropriate time interval is between 8-9 a.m. on an empty stomach, and for women

it is best to avoid giving samples two days before and two days after the menstrual cycle (Bessenich, 1953).

This method has been used over time in health as a guiding diagnosis of any type of disorder, both in humans and animals, to specify general health, vitality, aging and even for early diagnosis of cancer.

The first studies were performed by Pfeiffer (1927-1961). The method was soon put into practice by other doctors, who confirmed Pfeiffer's results. Gruner in 1940 considered the blood crystallization test useful for early detection of cancer because positive results were shown in the case of susceptible strains of animals.

For diagnosis of various diseases, we mention the studies of Begouin (1938), Pfeiffer and Miley (1939), Trumpp and Rascher (1939), Seigle (1939), Isabel (1940), Selawry (1949, 1957, 1952, 1957, 1959, 1969, 1984); Rohlofs (1944); Krebs (1947); Kubin (1954); Bourgeois (1954); Beckmann (1959); Bessenich (1960); Spielberger (1983); Barth (1984, 1985); Hoffmann (1985); Gulati (1994); Kuczkowski (1995); Cocude (1998); Piva (1998); Knijipenga (1996); Shibata (1996, 1998), Shaikh (2012), Sarode (2013), Mehrotra (2015), Vara (2015), Bali (2017), Rawat (2018), Tarigoppula (2018).

The test also indicates the general terrain of vitality, e.g. oxidative, anemic, fibrotic, sclerotic, inflammatory, congestive, and can evaluate aging (Cocude et al., 1992; Selawry & Selawry, 1957; Selawry 2008; Shibata 1996).

Indicators of biocrystallization test

The evaluation of crystalline patterns use the notions of well or weak centered and coordination (Selawry & Selawry, 1957), and the notions of structure and texture (Barth, 1997). The crystalline structure refers to the main branches which depart from the center to the periphery. The texture is formed by fine crystals which depart from the main branches and form a more or less dense structure that covers up the surface of the plate.

For blood testing, the Pfeiffer or Selawry evaluation is used according to the individual case. Unlike the crystallization image of pure copper chloride which does not have a main center but a set of small crystalline

clusters independent of each other, the image of sensitive crystallization of the blood of a healthy person is an organized, centered ensemble that reflects the unity.

The weakening of coordination, reflected in the appearance of secondary crystallization centers individualized to the general radiant structure, occurs in the case of various diseases, but especially in cancerous patients. Alternatively, the reduction in coordination is expressed by crystal density differences between regions of the same crystallization plate.

Strips are more vaguely drawn, fewer and more terrible in the case of a strong diminution of vitality, as it happens especially shortly before the moment of death, when the image of crystallization is closer to the specific image of crystallization of pure chlorine (Selawry, 2008)

Indicators of oxidative stress

Oxidative stress can be diagnosed using the biocrystallization test from the early stages in which clinical or paraclinical signs are reduced. The main indicators are primarily texture and "anarchic structures", along with specific forms for inflammation, fibrosis and sclerosis. The first oxidative stress indicators are changes in the texture appearance of the crystallization image, namely a tendency towards a mineral type that can be localized in the case of fibrosis or cirrhosis or generalized in some cases where the patient has been subjected to prolonged physical or psychological effort. In the more advanced stages, this specific type of texture can overlap the fibrosis-specific forms ("brush shapes"). Under prolonged oxidative stress, a fine and dull texture specific to sclerosis, with very fine vacuoles at the periphery can be seen as a very clear cut, as if done with scissors. The texture of large spaces between rays occurs in situations with excessive oxidative metabolism (thyrotoxicosis), when gaps have a somewhat rough appearance. If the general appearance is lacunar-pale, weak in forms, with a lack of oxygen, it indicates anaemia. Clearly outlined gaps indicate a tendency to sclerosis (Selawry, 2008).

Within the texture, superimposed elements can indicate local or general oxidative stress as shown in Table I.

Table I
Specific signs for local and general oxidative stress

Specific sign	Encountered	Characteristics	References
elements of fibrosis	fibrosis, conjunctive tissue reactions (i.e. postoperative scars)	a brush shape, with an angle of less than 30° in the case of chronic inductions and a fan shape, with an angle of more than 30° in the case of cirrhosis or subacute inflammation	Selawry, 2008 Piva et al., 1994
elements of inflammation	acutely localized inflammations, allergies	star formation, or smaller forms of rudimentary stars ("sparks")	Selawry, 2008 Piva et al., 1994
elements of necrosis	tubercular caverns, pulmonary abscesses, necrotic tumours	Maltese cross (with more or less symmetrical arms, with 3 or 4 arms)	Selawry, 2008 Piva et al., 1994 Donadio, 1950
'transverse form' ('anarchic structure') stage I and II	atypical oblique elements in stage I, and more perpendicular, more clearly delimited and denser atypical oblique elements in stage II	local functional changes induced by oxidative stress, arteriosclerosis, sclerosis, fibrosis, liver cirrhosis, arthrosis, degenerative bone processes and in the case of benign tumors, leukoplakia of the oral mucosa	Selawry, 1980 Rawat et al., 2018 Piva et al., 1994 Sarode, 2013
'transverse form' ('anarchic structure') stage III and IV	atypical oblique and perpendicular elements, more numerous and often containing short stripes that partially disrupt (phase III) or completely disrupt (stage IV) the general radial distribution	malignancy, cancer	Selawry, 1980 Piva et al., 1994 Pfeiffer, 1930 Barth, 1990 Sarode, 2013

If persistent oxidative stress is predominantly located in organs and tissues, a disordered appearance of the crystallization network, named by Barth “anarchic forms or structures”, may appear over time in the area on the crystallization image that is appropriate to that organ, or sometimes even with wide distribution on the plate. Pfeiffer and Selawry named these specific structures “transverse elements”.

These elements go through four stages, described by Selawry (1957, 2008), which can precede by 3-4 years the physical appearance of organic changes and is the expression of local functional changes induced by oxidative stress. If therapeutic intervention occurs in Stage I or II, where there are only functional disorders due to local oxidative stress, the progression to structural changes can be reversible and can also be followed by sensitive blood crystallization, finding the gradual disappearance of “anarchic forms” on the crystallisation image.

Stages I and II are found on crystallization images made of aged animal or plant tissue extracts, and in the case of various diseases caused by oxidative stress: arteriosclerosis, sclerosis, fibrosis, liver cirrhosis, arthrosis, degenerative bone processes, and in the case of benign tumors (Selawry, 1980) as well as in premalignant lesions such as leukoplakia of the oral mucosa (Rawat et al. 2018).

In Stage I, atypical oblique elements are present, which become more perpendicular, more clearly delimited and denser in Stage II. At the time of the malignant tumor appearance, these elements are more numerous and often contain short stripes that partially disrupt (stage III) or completely disrupt (stage IV) the general radial distribution. They are called anarchic structures because they are an element of “anarchy” for the general order of the crystallization image (Selawry, 1980).

Comparison of biocrystallization with the current methods of O/AO balance analysis

The assessment of oxidative status is complex and involves the measurement of various parameters of the O/AO balance and their correlation. In contrast to the current methods for evaluating oxidative status, the superiority of biocrystallization resides in providing an overview of the health status and thus allowing discrimination between oxidative eustress that is associated with the health status and the development of oxidative distress as well as its progression. For this, however, comparative clinical studies are needed in the future.

Discussions

The results obtained by different workers under different laboratory conditions show a similar pattern of biocrystallization tests in normal healthy individuals. This specific pattern is completely changed when copper chloride crystallizes from solutions containing impurities, especially proteins such as proteins from human blood (Gruner, 1940; Bercy, 1995). These proteins or various protein degradation products (amines) are considered responsible for the specific biocrystallization pattern in oxidative stress, cancer, inflammation, allergies or other specific pathologies. It is known that oxidative stress is associated with a significant decrease of glutathione, which

is a tripeptide (Schafer & Buettner, 2001).

The most important long-term effect of oxidative stress and ionizing radiation is DNA damage, also involved in aging and oncogenesis (Evans & Cooke, 2004). The biological effects are the increase of 8-oxoguanine and thymine glycol. 8-Oxo-2'-deoxyguanosine (8-oxo-dG) is an oxidized derivative of deoxyguanosine and one of the major products of DNA oxidation (de Souza-Pinto et al., 2001). Concentrations of 8-oxo-dG and 8-hydroxyguanosine in white blood cells or urine are a measurement of oxidative stress. Valavanidis et al. (2013) considered that increased 8-oxo-dG levels in tissues can serve as a biomarker of oxidative stress and also observed increased 8-oxo-dG levels during carcinogenesis. Also, tissue 8-oxo-dG levels increase with age (Nie et al., 2013; Hamilton et al., 2001). Oxidative stress also rises in conditions of fatigue, lack of sleep, prolonged working hours, workload, psychological trauma, the impossible prospect of alleviating stress being evidenced by significantly increased formation of 8-hydroxydeoxyguanosine (8-OH-dG) (Srivastava & Kumar, 2015; Masahiro et al., 2001).

This DNA damage phenomenon may be accompanied by specific protein synthesis and it is known that the biocrystallization test is especially sensitive to blood protein levels.

Proteins are one of the main targets of ROS, leading to the formation of carbonyls and other oxidized moieties (Kehre & Smith, 1994). The highly reactive ROS can lead to protein denaturation among others.

Human and animal studies report that high altitude induces a rise in proteins, DNA and lipid oxidative damage (Bakony & Radak, 2004). The study of Radak et al. published in 1997 demonstrates that training at 4000 m altitude increased carbonylation of certain muscular proteins, probably actins. Hypoxia can be involved in oxidative protein damage. Anaerobic exercise increases the accumulation of reactive carbonyl derivatives in the lung of rats (Radak et al., 1997; Radak et al., 1998).

It is considered that the “anarchic structures” which are the main indicators of oxidative stress appear due to changes in the protein content of the analyzed serum. Many enzymes are implicated in endogenous or exogenous oxidative stress, some of them being involved in the generation of oxygen or nitrogen free radicals (NADPH oxidases, xanthine oxidase, mitochondrial respiratory enzymes, cytochrome P450, cyclooxygenases, lipoxygenases, peroxisomal enzymes, nitrogen synthases). Others are involved in antioxidant processes (SOD, catalase, peroxidases, hemoxygenases). Enzymes, however, are macromolecules of protein origin. A series of protein compounds that do not have enzymatic activity such as serum albumin, thioredoxins and proteins involved in transition metal ion binding such as ferritin, transferrin, haptoglobin, hemopexin, ceruloplasmins, metallothioneins have an antioxidant role. Glutathione is a tripeptide. In conclusion, we find that numerous protein molecules are involved in the oxidative balance. It is possible that “anarchic structure” may arise as a result of changing the serum ratio of these protein molecules under conditions of endogenous or exogenous oxidative stress.

The blood biocrystallization test has been used in

the last ten years in human health for early detection of oxidative stress related diseases such as diabetes mellitus and oncological diseases.

In cases with diabetes mellitus, the test is positive in the early stages of prediabetic conditions, before clinically evident manifestations. It can differentiate between controlled and uncontrolled diabetes by observing the number of centers of nidus in the crystallization pattern (Vara et al., 2015).

It can be useful for detecting cancer cases and for early detection of precancerous cases even in individuals with no clinical signs. The crystallization test was found to be a sensitive, reliable, economical and less invasive procedure for screening of potentially malignant oral disease and oral cancer. The method can be useful especially when the localization of malignancy or precancerous lesions is inaccessible to biopsy and is correlated well with the histopathological grade I and II. The number of "transverse elements" increased as the tumor grade advanced from Grade I to Grade II and Grade III. It is suitable for mass screening programs. The test can also be helpful for assessing the predisposition to cancer in individuals with high risk or genetic predisposition (Gulati et al., 1994; Kuczkowsky et al., 1995; Bali & Fulzele 2017; Bali & Marathe, 2017; Mehrotra et al., 2017; Shaikh et al., 2012; Sarode et al., 2013; Rawat et al., 2018; Tarigoppula et al., 2018).

For the future, we recommend that research focus on crystallization patterns in metabolic disorders where alterations in polyamines and diamines are expected (Sarode et al., 2019).

Even if these studies describe the use of biocrystallization to assess oxidative stress induced by internal metabolic conditions, these results can allow future research using this test to monitor the oxidative stress induced by sport activities, physical or mental stress or exogenous stressors such as ultraviolet light, environmental pollutants, cigarette smoke and radiation.

Conclusions

1. The test can be useful for monitoring the oxidative stress induced by sport activities, physical or mental stress.
2. The superiority of biocrystallization can reside in providing an overview of the health status and thus allowing discrimination between oxidative eustress and the development of oxidative distress as well as its progression.
3. The biocrystallization test is especially sensitive to blood protein levels, so it can evidence variations of serum protein oxidative stress markers.
4. This test can be useful to evaluate carbonyl stress related to prediabetic and diabetic conditions.
5. It can be useful for early detection of precancerous cases.
6. It is a possible screening method for malignancy, especially in individuals with high risk or genetic predisposition.
7. It can be useful especially when the localization of malignancy or precancerous lesions is inaccessible to biopsy, and is correlated well with the histopathological grades I and II.

Conflict of interest

The authors declare no conflict of interest. The funding laboratories had no role in the study design, in the collection, analysis and interpretation of data, in the writing of the report and in the decision to submit the paper for publication.

Declarations

Author contribution statement

Cristina Cîmpean: analyzed and interpreted the data; wrote the paper.

Mihai Berteanu: analyzed and interpreted the data; wrote the paper, revised the paper.

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References

- Aly DG, Shahin RS. Oxidative stress in lichen planus. *Acta Dermatovenerol Alp Pannonica Adriat.* 2010; 19(1):3-11.
- Amer J, Ghoti H, Rachmilewitz E, Koren A, Levin C, Fibach E. Red blood cells, platelets and polymorphonuclear neutrophils of patients with sickle cell disease exhibit oxidative stress that can be ameliorated by antioxidants. *Br J Haematol.* 2006;132(1):108-113. doi:10.1111/j.1365-2141.2005.05834.x.
- Arican O, Kurutas EB. Oxidative stress in the blood of patients with active localized vitiligo. *Acta Dermatovenerol Alp Pannonica Adriat.* 2008;17(1):12-16.
- Bakony T, Radak Z. High altitude and free radicals *J Sports Sci Med.* 2004;3(2):64-69.
- Bali S, Fulzele RR. Study of Crystallisation Pattern of CuCl₂ Solution in Benign and Premalignant Conditions at a Tertiary Care Teaching Hospital. *Int J Med Res Prof;* 2017;3(2):410-413. doi:10.21276/ijmrp.2017.3.2.085.
- Bali S, Marathe RR. Crystallisation Test for Early Detection of Malignancy. *Int Arch BioMed Clin Res.* 2017;3(2):46-49. doi:10.21276/iabcr.2017.3.2.10
- Barth JG. Empfindliche Kristallisation. *Krebs und Präkanzerose. Elemente Naturwiss* 1990;52:42-50. doi:10.18756/edn.52.42.
- Barth JG. Image de cristallisation du chlorure cuivrique et structure chimique de l'additif. *Elemente Naturewiss.* 1997;66:16-42. doi: 10.18756/edn.66.16.
- Bercy H. Biocrystallisation analysis of low and high dilutions and homoeopathically treated blood of patients. *Brit Hom J.* 1995;84 (3):172, doi: [https://doi.org/10.1016/S0007-0785\(05\)80077-8](https://doi.org/10.1016/S0007-0785(05)80077-8).
- Bessenich F. Les forces formatrices et la methode des cristallisations sensibles. *Triades.* 1953;1(2):137-177.
- Bidian C, Tache S. Smoking and exercise. *Palestrica Third Mill - Civiliz Sport.* 2007;8(4):225-231. Available at at: [http://pm3.ro/pdf/30/PM3_Nr.4\(30\)_2007m.pdf](http://pm3.ro/pdf/30/PM3_Nr.4(30)_2007m.pdf). Accessed: 2019, October 17.
- Bonomini F, Tengattini S, Fabiano A, Bianchi R, Rezzani R. Atherosclerosis and oxidative stress. *Histol. Histopathol.* 2008;23(3):381-390. doi:10.14670/HH-23.381.
- Charpentier D, Barth JG, Cocude M. Influence of electric and magnetic fields on sensitive crystallisation. In: *Colloque cristallisations sensibles Ministère de l'Economie, des*

- Finances et de l'Industrie, Secrétariat d'Etat à l'Industrie, Commission des recherches scientifiques et techniques sur la sécurité et la santé dans les industries extractives. 1998, Paris. <http://www.admi.net/industrie/corss/ccs/PDF/EV.pdf>.
- Cocude M, Barth JG, Bruyet B, François P. La pneumoconiose des houilleurs et son suivi médical. La méthode des cristallisations sensibles au banc d'essai. Industrie Minérale. 1992;74:41-47.
- de Diego-Otero Y, Romero-Zerbo Y, el Bekay R, Decara J, Sanchez L, Rodriguez-de Fonseca F, del Arco-Herrera I. Alpha-tocopherol protects against oxidative stress in the fragile X knockout mouse: an experimental therapeutic approach for the Fmr1 deficiency. Neuropsychopharmacology. 2009;34(4):1011-1026. doi:10.1038/npp.2008.152.
- de Souza-Pinto NaC, Eide L, Hogue BA, Thybo T, Stevnsner T, Seeberg E, Klungland A, Bohr VA. Repair of 8-Oxodeoxyguanosine Lesions in Mitochondrial DNA Depends on the Oxoguanine DNA Glycosylase (OGG1) Gene and 8-Oxoguanine Accumulates in the Mitochondrial DNA of OGG1-defective Mice. Cancer Res. 2001;61(14):5378-5381.
- Dean OM, van den Buuse M, Berk M, Copolov DL, Mavros C, Bush AI. N-acetyl cysteine restores brain glutathione loss in combined 2-cyclohexene-1-one and D-amphetamine-treated rats: relevance to schizophrenia and bipolar disorder. Neurosci. Lett. 2011;499(3):149-153. doi:10.1016/j.neulet.2011.05.027.
- Dejica D (sub red). Stresul oxidativ în bolile interne. Cap. Stresul oxidativ. Ed. Casa Cărții de Știință Cluj-Napoca, 2000, 77-130.
- Dejica D (sub red). Antioxidanți și terapie antioxidantă. Cap. Stresul oxidativ și antioxidanții în efortul fizic Ed. Casa Cărții de Știință Cluj-Napoca, 2001, 198-237.
- Donadio V. Crystallization method in the study of blood serum changes in the course of tuberculosis infection. Minerva Med. 1950;41(15):511-555. PMID: 15416658.
- Evans MD, Cooke MS. Factors contributing to the outcome of oxidative damage to nucleic acids. Bioessays. 2004;26(5):533-542. doi:10.1002/bies.20027.
- Gruner OC. Experience with the Pfeiffer crystallisation method for diagnosis of cancer. Can Med Assoc J. 1940;43(2):99-106.
- Gulati SP, Sachdeva OP, Sachdeva A, Adlakha RP, Kakkar V. Crystallisation test for detection of head and neck cancer. ORL J Otorhinolaryngol Relat Spec. 1994;56(5):283-286. <https://doi.org/10.1159/000276675>.
- Halliwell B. Oxidative stress and cancer: have we moved forward?. Biochem J. 2007;401(1):1-11. doi:10.1042/BJ20061131.
- Hamilton ML, Van Remmen H, Drake JA, Yang H, Guo ZM, Kewitt K, Walter CA, Richardson A. Does oxidative damage to DNA increase with age? Proc. Natl. Acad. Sci. U.S.A. 2001. 98 (18): 10469-10474. doi:10.1073/pnas.171202698.
- Hawkins CL, Morgan PE, Davies MJ. Quantification of protein modification by oxidants. Free Radical Biol Med; 2009;46:965-988 DOI: 10.1016/j.freeradbiomed.2009.01.007.
- Himmelfarb J, McMonagle E, McMenamin E. Plasma protein thiol oxidation and carbonyl formation in chronic renal failure. Kidney Int. 2000;58:2571-2578. DOI: 10.1046/j.1523-1755.2000.00443.x.
- Hwang O. Role of oxidative stress in Parkinson's disease. Exp Neurol. 2013;22(1):11-17. doi:10.5607/en.2013.22.1.11.
- James SJ, Cutler J, Melnyk S, Jernigan S, Janak L, Gaylor DW, Neubrander JA. Metabolic biomarkers of increased oxidative stress and impaired methylation capacity in children with autism. Am. J. Clin. Nutr. 2004;80(6):1611-1617. doi:10.1093/ajcn/80.6.1611.
- Jiménez-Fernández S, Gurpegui M, Díaz-Atienza F, Pérez-Costillas L, Gerstenberg M, Correll CU. Oxidative stress and antioxidant parameters in patients with major depressive disorder compared to healthy controls before and after antidepressant treatment: results from a meta-analysis. J Clin Psychiatry. 2015;76(12):16581667. doi:10.4088/JCP.14r09179.
- Joseph N, Zhang-James Y, Perl A, Faraone SV. Oxidative Stress and ADHD: A Meta-Analysis. J Atten Disord. 2015;19(11):915-924. doi:10.1177/1087054713510354.
- Kehre JB, Smith CV. Free radicals in biology: sources, reactivates and roles in the etiology of human diseases. In: Frei B, Ed. Natural antioxidants in human health and disease. Orlando: Academic Press; 1994,25-62.
- Kuczkowsky J, Zaorski P, Betlejewski A. Crystallisation test in patients with head and neck neoplasms. Otolaryngol Pol; 1995;49 Suppl 20:121-124.
- Leray J. Growth Kinetics of hydrated cupric chloride. J Crystal Growth. 1968;3-4:344-349. [https://doi.org/10.1016/0022-0248\(68\)90172-3](https://doi.org/10.1016/0022-0248(68)90172-3).
- Manolescu BN, Berteau M, Oprea E, Chiriac N, Dumitru L, Vladiu S, Popa O, Ianas O. Dynamic of oxidative and nitrosative stress markers during the convalescent period of stroke patients undergoing rehabilitation. Ann Clin Biochem, 2011, doi: 10.1258/acb.2011.010243.
- Manolescu BN. Correlations between the dynamics of biochemical and inflammatory parameters and the recovery of patients with stroke. Dissertation. 2011, Carol Davila University of Medicine and Pharmacy, Bucharest.
- Masahiro I, Shinya A, Nagata S, Miyata M, Hiroshi K. Relationships between perceived workload, stress and oxidative DNA damage. Int Arch Occup Environ Health. 2001;74(2):153-157. doi: 10.1007/s004200000209.
- Mehrotra H, Sadiq H, Anjum R, Goyal P, Kasana P, Shaikh SM. Crystallize to Definitize Cancer. Int J Sci Res. 2017;6(10):312-315. <https://www.journals.com/index.php/ijsr/article/view/8500>.
- Mureșan A, Tache S, Orăsan R. Stresul oxidativ în procesele fiziologice și patologice. Ed. Toderescu. Cluj-napoca, 2006,28-35.
- Nemes-Nagy Enikő, et al.: Evaluation of Oxidative Stress and the Efficacy of Antioxidant Treatment In Diabetes Mellitus, in: Oxidative Stress and Diseases, Ed. InTech, 2012. 281-302. doi: 10.5772/35002
- Nie B, Gan W, Shi F, Hu GX, Chen LG, Hayakawa H, Sekiguchi M, Cai JP. Age-dependent accumulation of 8-oxoguanine in the DNA and RNA in various rat tissues. Oxid Med Cell Longev. 2013;2013:303181. doi:10.1155/2013/303181.
- Oprea E, Berteau M, Cintează D, Manolescu BN. The effect of the ALAnerv nutritional supplement on some oxidative stress markers in postacute stroke patients undergoing rehabilitation. Appl Physiol Nutr Metab. 2013;38(6):613-620 DOI: 10.1139/apnm-2012-0436.
- Parellada M, Moreno C, Mac-Dowell K, Leza JC, Giraldez M, Bailón C, Castro C, Miranda-Azpiazu P, Fraguas D, Arango C. Plasma antioxidant capacity is reduced in Asperger syndrome. J Psychiatr Res. 2012;46(3):394-401. doi:10.1016/j.jpsychires.2011.10.004.
- Pizzino G, Irrera N, Cucinotta M, Pallio G, Mannino F, Arcoraci V, Squadrito F, Altavilla D, Bitto A. Oxidative Stress: Harms and Benefits for Human Health. Oxid Med Cell Longev.; 2017;8416763. doi: 10.1155/2017/8416763. Epub 2017 Jul 27.
- Pfeiffer E. Kristalle. Orient-Occident Verlag. Stuttgart, 1930, 24-46.
- Pfeiffer E. Sensitive crystallisation processes. Steiner Books, Stuttgart, 1968, 32-67.
- Piva MT, Lumbroso S, Sieso V, Monnin E, Mion H, Blanc F, Bernard de Bornier M. Cupric chloride crystallization

- with human blood. Study of pictures obtained in different pathologies. *Elemente Naturewiss.* 1994;61:25-39 doi: 10.18756/edn.61.25.
- Ploesteanu RL, Nechita AC, Turcu D, Manolescu BN, Stamate SC, Berteau M. Effects of neuromuscular electrical stimulation in patients with heart failure - review. *J Med Life.* 2018, 11 (2):107-118.
- Radak Z, Asano K, Lee KC, Ohno H, Nakamura A, Nakamoto H, Goto S. High altitude training increases reactive carbonyl derivatives but not lipid peroxidation in skeletal muscle of rats. *Free Radical Biology and Medicine.* 1997;22(6):1109-1114 doi: 10.1016/S0891-5849(96)00350-4.
- Radak Z, Nakamura A, Nakamoto H, Asano K, Ohno H, Goto S. A period of anaerobic exercise increases the accumulation of reactive carbonyl derivatives in the lungs of rats. *Pflügers Arch. Eur J Physiol.* 1998;435(3):439-441. doi: 10.1007/s004240050537.
- Ramond A, Godin-Ribuot D, Ribaut C, Totoson P, Koritchneva I, Cachot S, Levy P, Joyeux-Faure M. Oxidative stress mediates cardiac infarction aggravation induced by intermittent hypoxia. *Fundam Clin Pharmacol.* 2013;27(3):252-261. doi:10.1111/j.1472-8206.2011.01015.x.
- Rawat G, Kureel K, Urs AB. An insight into crystallisation test: A neoteric approach for screening premalignant and malignant lesions. *J Can Res Ther.* 2018, Ahead of Print. doi: 10.4103/jcrt.JCRT_275_17.
- Re R, Pellegrini N, Proteggente A, Pannala A, Yang M, Rice-Evans C. Antioxidant activity applying an improved ABTS radical cationic decolorization assay. *Free Radic Biol Med* 1999;26(10-11):1231-1237. DOI:10.1016/s0891-5849(98)00315-3.
- Reiter R, Barth JG. Some general remarks on crystallisation in the presence of additives. *Elemente d. N.*; 2010; 92:30-61.
- Romá-Mateo C, Aguado C, García-Giménez JL, Ibáñez-Cabellos JS, Seco-Cervera M, Pallardó FV, Knecht E, Sanz P. Increased oxidative stress and impaired antioxidant response in Lafora disease". *Mol. Neurobiol.* 2015;51(3):932-946. doi:10.1007/s12035-014-8747-0.
- Sarode SC, Sarode GS, Barpande S, Tupkari JV. Efficacy of crystallisation test for screening of oral squamous cell carcinoma with clinico-pathological correlation. *Indian J Dent Res*; 2013;24(4):464-467 doi: 10.4103/0970-9290.118398.
- Sarode SC, Sarode GS, Panta P. Sensitive Crystallization Patterns in Oral Cancer: Novel Strategies and Clinical Impact. In: *Oral Cancer Detection.* 2019,255-262. doi: 10.1007/978-3-319-61255-3_13.
- Schafer FQ, Buettner GR. Redox environment of the cell as viewed through the redox state of the glutathione disulfide/glutathione couple. *Free Radic. Biol. Med.* 2001;30(11):1191-1212. doi:10.1016/S0891-5849(01)00480-4.
- Selawry A, Selawry O. Die Kupferchlorid - Kristallisation in Naturwissenschaft und Medizin, Gustav Fischer Verlag, Stuttgart, 1957.
- Selawry A. Functional types of metals in psychology and medicine (in Romanian), Triade, Cluj-Napoca, 2008.
- Selawry A. La cristallisation sanguine comme test diagnostique d'orientation. *Cahiers med anthroposophique.* 1980;14(1):1-20.
- Shaikh SI, Kawale DN, Diwan CV, Quadeer A, Kharkar AR. Crystallization test for detection of malignancy of female genital tract. *Int J Basic Med Sci.* 2012;3(4):118-124.
- Shibata T, Shirasaka R, Ogawa T, Takakuwa Y, Furiya K, Tanaka A, Kogure M, Obata H. Effect of human blood addition on dendritic growth of cupric chloride crystals in aqueous solutions. *J Crystal Growth.* 1994;142(1-2):147-155. [https://doi.org/10.1016/0022-0248\(94\)90282-8](https://doi.org/10.1016/0022-0248(94)90282-8).
- Shibata T, Takakuwa Y., Tanaka A. et al. Doping effect of human blood on surface microstructure of cupric chloride dendrites grown from aqueous solutions. *J Crystal Growth.* 1996, 167 : 716-718, [https://doi.org/10.1016/0022-0248\(96\)00274-6](https://doi.org/10.1016/0022-0248(96)00274-6)
- Shibata T, Takakuwa Y, Tanaka A, Kogure M, Iguchi T, Obata H, Furiya K, Shirasaka R, Ogawa T. Crystal structure of blue and green hydrated cupric chloride grown from aqueous solutions with and without human blood addition: single crystal X-ray diffraction analysis and differential scanning calorimetry (DSC). *J Tokyo Wom Med Univ.* 1998;6-7:358-369.
- Sies H. Oxidative stress: introductory remarks. *Oxidative Stress*, ed. H Siess. London Academic. 1985. 1-8.
- Sies H. Oxidative stress: Oxidants and antioxidants. *Experim Physiol.* 1997;82(2):291-295. DOI:10.1113/expphysiol.1997.sp004024.
- Sies H, Berndt C, Jones DP. Oxidative stress. *Annu. Rev. Biochem.* 2017;86:715-748. doi:10.1146/annurev-biochem-061516-045037.
- Singh N, Dhalla AK, Seneviratne C, Singal PK. Oxidative stress and heart failure. *Mol. Cell. Biochem.* 1995;147(1-2):77-81. doi:10.1007/BF00944786.
- Srivastava KK, Kumar R. Stress, Oxidative Injury and Disease. *Indian J Clin Biochem.* 2015;30(1):3-10. doi: 10.1007/s12291-014-0441-5.
- Sunderman FW, Nomoto S. Measurement of human serum ceruloplasmin by its p-phenylenediamine oxidase activity. *Clin Chem*, 1970;16:903-910.
- Tache S. Stresul oxidativ în condiții fiziologice. În:Dejica D (sub red.) Stresul oxidativ în bolile interne. Ed. Casa Cărții Șt, Cluj-Napoca 2000,103-104.
- Tache S. Stresul oxidativ și antioxidanții în efortul fizic. În: Dejica D (sub red.) Antioxidanți și terapie antioxidantă. Ed Casa Cărții Șt, Cluj-Napoca 2001,198-237.
- Tarigoppula RK, Ahmed Mujib B R, Naik R. Effectiveness of crystallization test in screening of potentially malignant oral disorders and oral cancer. *Indian J Dent Res.* 2018;29(5):556-561 <http://www.ijdr.in/text.asp?2018/29/5/556/244943>
- Valavanidis A, Vlachogianni T, Fiotakis K, Loridas S. Pulmonary oxidative stress, inflammation and cancer: respirable particulate matter, fibrous dusts and ozone as major causes of lung carcinogenesis through reactive oxygen species mechanisms. *Int J Environ Res Public Health.* 2013;10(9):3886-3907. doi:10.3390/ijerph10093886.
- Valko M, Leibfritz D, Moncol J, Cronin MT, Mazur M, Telser J. Free radicals and antioxidants in normal physiological functions and human disease. *Int. J. Biochem. Cell Biol.* 2007;39(1):44-84. doi:10.1016/j.biocel.2006.07.001.
- Vara JT, Puneeth HK, Anuradha A, Kiresur MA, Srinivas GV, Bagalad SB. Crystallization test: a diagnostic savvy of diabetes mellitus. *Asian Acad Res J Multidisc.* 2015;2(4):54-65.
- Yan LJ. Positive oxidative stress in aging and aging-related disease tolerance. *Redox Biol.* 2014;2:165-169. doi: 10.1016/j.redox.2014.01.002.

Intermittent fasting in athletes: PROs and CONs

Valeria Laza

Hygiene Discipline, Department of Community Medicine, “Iuliu Hatieganu” University of Medicine and Pharmacy Cluj-Napoca, Romania

Abstract

Weight loss is nowadays a hot topic for average people as well as for athletes. Intermittent fasting, an alternation between fast periods and normal eating periods, is the newest, in vogue diet trend to lose weight. It is not a calorie-restricted eating plan, it is a time-restricted approach. Whether intermittent fasting is good or bad, that depends on many factors. Although it could be considered a part of normal life, a life changer for some people, it might become a disaster for others.

There are many fasting protocols depending on the extent of fasting hours (from 12 to 20 hours a day) or days (from 1 to 2 days a week or more), the most observed type being the 16:8 model. The best individual plan for eating is seldom found by experimentation; what is important is to focus on healthy eating, to avoid/limit junk food, and to avoid dehydration.

In athletes, competing during intermittent fasting is contraindicated, and endurance training in fasting periods might boost the post-exercise recovery. So far, studies sustaining intermittent fasting have been contradictory and inconclusive, and the research methodology is not yet standardized. This type of eating habit could have many advantages as long as fasting is done wisely, and many disadvantages, with extra risks in athletes compared to average people.

Keywords: athletes, intermittent fasting, weight loss.

Introduction

Alongside water, air, shelter and a stable global environment, food is one of the 5 fundamental human needs. The criticism of rational nutrition was mentioned 2,500 years ago, and the accumulation of food and nutrition information during the last century was explosive. Nowadays we are witnessing a real “nutritional cacophony” in which it is difficult to choose between true and false, good and bad (Laza, 2017).

Human beings need a proper and energetically adequate diet, any (totally/partially) excessive or (totally/partially) poor nutrition regimen having serious effects on their health status.

The world population is currently confronted with a lack of food (famine, poverty), which affects over 800 million people, as well as with an excess of food, which in association with a sedentary lifestyle determines overweight and obesity, with serious obesity-associated conditions (Alamgir Khan et al., 2018).

Over centuries, physical beauty standards have evolved, and nowadays being overweight/obese is no longer a sign of wellness. Global epidemic obesity has allowed some companies to develop a plethora of more or less efficient and sustainable weight loss schemes. In

recent years, weight loss has been a hot topic for average people, as well as for athletes, regardless of the level of exercise. Intermittent fasting (IF) is the newest, in vogue diet trend to lose weight. IF means an alternation between fast periods and normal eating periods (non-fasting or feast days/hours). So far, studies sustaining IF have been contradictory and inconclusive, showing both health benefits and detriments (the research methodology is not yet standardized) (De Cabo & Mattson, 2019).

IF is not a diet, it is a time-restricted (scheduled approach) and not a calories-restricted eating plan, recreating the forced fasting of ancient humans during hunter-gathering periods. Our ancestors did not have the luxury of having a meal every 2 to 3 hours, yet they still enjoyed better physical health than most of us today. Some people might fast unknowingly by eating an early dinner and skipping breakfast the next day, so IF could be considered a part of normal life. Whether IF is good or bad, that depends on many factors; it could be a life changer for some people or a disaster/nightmare for others, depending on the aim, health status, and sex (Patterson & Sears, 2017).

Fasting is not similar to starvation. While starvation is an involuntary and severe absence of food for a long

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Address for correspondence: „Iuliu Hatieganu” University of Medicine and Pharmacy Cluj-Napoca, Romania, 400349, Louis Pasteur Str. No. 6

E-mail: v_laza@yahoo.com

Corresponding author: Valeria Laza v_laza@yahoo.com

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period of time, leading to serious suffering or even death, fasting is deliberated, controlled deprivation of some or all foods, beverages or both for a set period of time (a few hours up to a few days or weeks).

Fasting periods are often called “purification”, “detoxification”, or “cleanses”. Intermittent fasting has no standard duration and could follow many models.

There are many fasting protocols: shorter fasts (less than 24 hours), longer fasts (over 24 hours), and extended fasts (over 48 hours) (De Cabo & Mattson, 2019).

Shorter fasts

Are the most frequent intermittent fasting type:

The *12:12 model* means that a person fasts 12 hours out of 24, and the 12 remaining hours has a normal calories intake. Most of the types of fasting also include sleep hours.

The *16:8 model* is the most indicated and used type of IF, meaning that 8 hours represent the “eating window”, and 16 hours represent the “fast window”. This form is applied daily or almost daily, being very flexible. Practically, the first meal of the day could be at 9:00 am and the last one at 5:00 pm, so the “fast period” is between 5:00 pm (day 1) and 9:00 am (day 2), or between 6:00 pm and 10:00 am, or from 7:00 pm to 11:00 am, or 8:00 pm - 12:00 am, respectively. During the feast window, all daily calories can be consumed without restriction. This protocol is easy to follow, being supported by the daily circadian rhythm, and can be adapted to a person’s preference. It is important to consume dinner 2-3 hours prior to sleep (eating within 2-3 hours interferes with sleep quality and could promote weight gain) (Yamaguchi et al., 2013). Sometimes, the best individual plan for eating is found by experimentation. It is also important to focus on healthy eating (high-fiber, vegetable-rich diets), and to avoid/limit junk food. During the 16 fasting hours, regularly drinking water is extremely important to avoid dehydration. Other calorie-free beverages are tea (e.g. cinnamon herbal tea may suppress appetite) and coffee.

The *20:4 model* (also named *the warrior diet*) extends the fast period to 20 hours, the eating window being within the 4 remaining hours (e.g. from 2:00 pm to 6:00 pm) (1).

Longer fasts

Full day fasting (FDF) spans 24 hours (from dinner to dinner, or from lunch to lunch), 2 to 3 times a week (it is known as the Eat-Stop-Eat diet). Practically, people eat at 10:00 pm on day 1, the next meal being at 10:00 pm on day 2. The meal is quite low in calories, and so the weekly caloric intake is diminished. Despite some benefits, this regimen is highly contraindicated in athletes competing in endurance sports, because through it the body uses fat for energy, and endurance sports demand a quicker way to obtain the necessary fuel (Horne et al., 2013).

Weekly 24-hour fasting: during 24 hours per week, the person fasts completely and consumes only liquids (Leonard, 2018; Gunnars, 2017). For different reasons (spiritual, dietary, medical), along with meditation, *water fasting* is nowadays quite popular in the wellness movements. Some people may not eat and drink nothing

but water, but this is not safe for everyone. Long water fasting for days is not advised, a safer alternative being preferable.

The *5:2 fast* represents the most popular and studied protocol, involving 5 regular eating days and two fasting days (which should not be consecutive). During the fasting days, the diet offers no much than 500-600 calories as a single meal or spread throughout the day. A model related to 5:2 is to fast every other day (*alternate day fasting* - ADF), which implies a caloric intake restriction to around 25% of the usual intake (Leonard, 2018; Gunnars, 2017). In humans, ADF might boost the ability of aerobic exercise to increase endurance (the muscle uses fats and ketones as fuel instead of carbohydrates), improves overall health and reduces risk factors for diabetes and cardiovascular diseases (Kroeger et al., 2018; Varady et al., 2013).

The *36-hour fast* means that the fasting window is for 36 hours (from dinner on day 1 to breakfast on day 3).

Extended fasts

They are from 7 to 14 days most frequently and are only possible for some people, the risks of complications being high (vitamin, mineral and fluid imbalance) (Bertile et al., 2016).

Metabolic changes during fasting

Human daily calorie needs are 1,600-2,400 for women, and 2,000-3,000 for men, depending on age, size, height, lifestyle, health status, and activity level. As people get older, caloric needs diminish because their metabolic rate also decreases (1,600 calories a day after 51 years of age). Caloric intake is covered by glycogen and fat ingested or deposited. During the fed state, the blood insulin level rises and stores the glucose (sugar) in liver and muscle as glycogen (Chaouachi et al., 2009). When the storage space for glycogen (limited but easily accessible) is reached, the liver turns the excessive glucose into fat (fat deposits in the body are huge, but more difficult to access). The liver glycogen deposit is rapidly depleted, and then liver glycogenolysis starts to properly supply glucose to the brain, while the muscle glycogen stores are little affected or unaffected.

During the fasting state, the insulin level falls and the body burns the stored glycogen and fat. The low level of insulin causes the blood vessels to expand and hence, there is more flow of oxygen and nutrients serving the working muscle and the other organs. After 8 to 12 hours of fasting – depending on the level of blood glucose - the body tries to preserve the little amount of blood sugar and rely on fat. As the body starts using fat as fuel, the hormones which regulate sugar and fat (growth hormone, cortisol, glucagon, adiponectin) and the growth hormone and adrenaline (also called epinephrine) are very high. Hormonal changes during IF could elevate blood sugar production (the dawn phenomenon) (Rybicka et al., 2011). The dawn phenomenon (the dawn effect) is an abnormal increase in blood sugar in people with diabetes between 2 am and 8 am. It is explained by a natural overnight release of counter-regulatory hormones which increases insulin resistance, raising the blood sugar.

PROs and CONs of IF in athletes

Time-restricted eating regimens allow people to eat anything they want with rapid weight loss (Patterson & Sears, 2017).

IF is not a miracle weight-loss treatment, but is indicated for those who are lightly/moderately physically active, if they want to lose weight, to reduce glycemia, to reduce gut inflammation or to improve their intestinal microbiome.

Health effects of IF

Some of which have been known since ancient times:

* *Weight and fat loss* while the muscle mass is maintained: 0.2 to 0.8 kg/wk (Davis et al., 2016), or 4-15% weight loss in overweight (Tinsely et al., 2015; Varady, 2011; Wilson et al., 2018).

* *Diminished hunger and food cravings.* Hunger comes and goes like a wave; it should be ignored and disappear after drinking a cup of tea/coffee (2). In longer fasts, hunger might increase on the next day and recede gradually to completely disappear by days 3-4, when the body energy is covered by fat. Eating a low-carb, ketogenic diet between fasting periods will reduce hunger (3).

* *Improved metabolic health and restored insulin sensitivity* (by 20-31%) and *lower cholesterol* (LDL cholesterol decreases by 21% and triglycerides by 32%) and *lower belly fat* (Patterson et al., 2015; Chung et al., 2011; Chung et al., 2016). When the body cells are resistant to insulin, the body is more likely to store the eaten food as fat, and insulin resistance causes inflammation (4).

* *Decreased blood pressure and heart rate*, and hence the heart health may improve, notably when weight loss is associated (5).

* *The body becomes metabolically flexible* (easily able to burn fat as fuel and preventing the loss of lean mass). Varady showed in obese people only a 10% lean mass loss during IF, compared with 25% lean mass loss during daily caloric restriction (Varady, 2011; Barnosky et al., 2014).

* *Human growth hormone (HGH) levels increase* by 2,000% during 24-hour fasting in men and by 1,300% in women. HGH enhances muscle recovery and growth (increased protein synthesis), wound healing, and speeds up fat loss (Varady et al., 2008).

* *Great for the brain:* in fasting environment, a hormone named brain-derived neurotrophic factor (BDNF) is increased and as a result new nerve cells will grow more effectively (Shojaie et al., 2017; Malinowski et al., 2019; Fann et al., 2017).

* *Activates the sympathetic nervous system* responsible for our fight-or-flight response (heart rate increases, digestion slows, and muscle tension increases) (Malinowski et al., 2019).

* *Chronic disease prevention.* IF is good in preventing diabetes (but is not indicated for those who already have this disease) and cardiovascular diseases (in mice and rats, IF seems to reduce the risk of coronary artery disease; in humans, skipping breakfast and eating a late big meal at dinner elevates 5 times the risk to die from a heart attack, but these people are also likely to have other bad habits such as smoking, sedentary lifestyle, high stress, and long working hours); in some cancers, hypertension, non-alcoholic fatty

liver disease, and inflammatory bowel disease. How and why fasting reduces inflammation is probably explained by the fact that it produces fewer monocytes, the main reason for a healthy and long life in fasting subjects (Harvie et al., 2011; Harvie et al., 2013; Varady et al., 2013).

* *Delayed aging.* One hypothesis is that fasting can activate cellular mechanisms that boost immune function and reduce inflammation associated with chronic diseases (4). Despite the complexity of aging, the common process is a structural and functional progressive decline of the whole body, often preceded by a phase of chronic morbidity, which leads to death. Caloric restriction (CR) during fasting periods is a powerful, efficient approach influencing 9 cellular markers of aging (Picca et al., 2017; Carmona & Michan, 2016; Kenyon, 2011; Longo et al., 2015; Lopez-Otin et al., 2013; Lopez-Lluch & Navas, 2016). The goal of extended longevity in Western societies shifts to that of healthy aging, plus a longer lifespan, called "healthspan" (Passarino et al., 2016). The aging process is plastic, being accelerated or attenuated by many genetic and epigenetic (dietary) interventions (Kenyon, 2011). CR represents a nutrient-dense, well-balanced diet, with a reduction of caloric input by 20-40% without malnutrition. CR extends lifespan in rodents, and prevents some age-related diseases (obesity, type 2 diabetes, neurodegeneration, cardiomyopathy, cancer) (Most et al., 2017). Human studies in the area are rather limited and the benefits are not yet known. The "hormesis hypothesis" of CR suggests that the adaptive responses of cells and organs (induced by moderate stress) prevent worse damage caused by stronger similar stress (Mattson et al., 2017; Rattan, 2008; Testa et al., 2014; Horne et al., 2015; Anton et al., 2018).

The major question is whether the cause of extended longevity is due to daily caloric restriction (Most et al., 2017) or to protein intake restriction (Speakman et al., 2016). The positive effect of CR on human longevity was observed in the Kyushu Island, in the Okinawan population where the increased life expectancy was attributed to caloric restriction (Wilcox & Wilcox, 2014). This effect could be explained by neuroendocrine system modulation, hormetic stress response, increased systemic production of neurotrophic factors, reduced mitochondrial oxidative stress, decreased pro-inflammatory cytokine production and insulin resistance, decreased aging-associated signal and autophagy promotion (Moro et al., 2016; Mattson, 2017; Desgorges et al., 2016).

Short-term CR (10 weeks, 20% CR) tends to reduce the resting metabolic rate per kg of fat-free mass, systolic and diastolic blood pressure (Nicoll Rachel & Henein, 2018), glucose concentration (Velthuis-te et al., 1995), total cholesterol, LDL cholesterol, triglycerides, C-reactive protein, tumor necrosis factor (TNF-alpha1), insulin concentration, and to increase HDL cholesterol (Ravussin et al., 2015), insulin sensitivity (Larson-Meyer et al., 2006; Fontana & Partridge, 2015; Omodei & Fontana, 2011; Most et al., 2017). Short-term CR also promotes mitochondrial biogenesis in skeletal muscles. Long-term CR with optimal nutrition (CRON) means that caloric intake is restricted for an average of 15 years and the person consumes about 30% fewer calories than another one fed with a regular Western diet. This kind of diet decreases metabolic and hormonal

risk factors for type 2 diabetes, cardiovascular diseases, stroke, cancer, vascular dementia (Fontana & Partridge, 2015; Maughan et al., 2012). CR has a positive effect on DNA repair and telomere machinery, promoting genomic stability and healthy longevity (Vera et al., 2013).

* *Fighting depression and anxiety.* During short fasting, the human body releases ghrelin, a hormone associated with an elevated mood (Zhang et al., 2015).

* *Improved gut health.* Fasting refreshes the gut microbiome and improves digestion, reducing gas, diarrhea or bloating (Sutton et al., 2018).

* *Effects on performance and muscle strength.* Although IF increases the growth hormone, which enhances lean body mass, it does not improve strength, and may even reduce exercise capacity (Moro et al., 2016). Early studies on this topic seem to indicate that IF might be an aid in rapid post-exercise recovery. Endurance training in a fasted state can facilitate more rapid re-activation of muscle protein translation (protein kinase levels indicating muscle growth doubled compared to those during training in a fed state) (Jaleel et al., 2013). Also, endurance training in a fasted state increases the capacity for fat oxidation in the trained muscle (Burke & Kiens, 2006), but feeding before, during and after each training session might have other potential benefits (Hawley et al., 2007).

Potential side effects and risks

Intermittent fasting works well for some people and turn into a disaster for others depending on a number of lifestyle factors (Patterson & Sears, 2017). Hunger is seldom intense, at least during the adjustment stage, and the risk to develop binge eating behavior is possible.

- Headache. Some extra salt or mineral water might alleviate headache (Danielsson et al., 2019).

- Mental and physical tiredness/exhaustion, especially in morning exercisers (when exercising on an empty stomach), due to modest hypoglycemia (Grajower & Horne, 2019).

- Risk of hypoglycemia in patients with thyroid disease: weakness, dizziness, nausea, shakiness, irritability, blurred vision, sweating, paleness (Rothschild et al., 2014).

- Inability to focus, frustration

- Excessive eating during the 8-hour eating window (during fasting, appetite hormones and the hunger center are drifting, and hence fasters eat more; it is in the human nature to crave for a reward after an intense workout or exercise, so plunging into unhealthy eating behavior is possible) (Schiavo-Cardozo et al., 2013; Crispim et al., 2011).

- Negative effect on female fertility. In animal studies, 2 weeks of IF in female rats stopped the menstrual cycle (while their ovaries shrank); in male rats, it resulted in lower testosterone production. In athletic women with a low body fat percentage, IF might increase the risk of irregular menses, and lower the chance of conception (He et al., 2019). Lean women are more susceptible to neuroendocrine dysfunction, anovulation and a lengthened follicular phase compared to normal weight females (Alvero, 1998; He et al., 2019).

- Constipation

- Fasting diets are rigid and rule-based

- IF is a good strategy for cutting mindless late-night snacking, but it can also work against mindful eating habits (when simply eating by the clock).

Extra concerns of IF in athletes

- Female athletes have a high level of hepcidin (a hormone that regulates iron absorption: high hepcidin levels inhibit iron absorption, possibly due to inflammation). During intensive training sessions, females have a high level of hepcidin, and therefore they have an increased risk for anemia. The best window of opportunity for peak iron absorption is in the morning, when hepcidin is lowest. IF most frequently means skipping breakfast, and could increase the risk for anemia (Pakkir Maideen et al., 2017).

- IF could reduce testosterone. Testosterone is important for muscle synthesis, performance, strength, and general vitality. During the fasting window, a drop in testosterone was observed, especially in male subjects (Peos et al., 2019).

- Since fasting is associated with a variable calorie restriction, it could be difficult for athletes to cover their calorie intake through a 4 or 8 hours eating window (Moro et al., 2016; Tinsley et al., 2017; Levy & Chu, 2019). It is indicated to consume a meal within 2 hours after a competition in order to restore glycogen deposits (Burke et al., 2017).

Contraindications of IF

For professional athletes training twice a day or more, 16+ hours of fasting might not be a good idea.

The other contraindications to adopting such a type of diet are (Stockman et al., 2018):

- Diabetes (IF is beneficial in diabetes prevention, not for patients with diabetes or other metabolic diseases).

- People on medication for blood pressure or cardiovascular diseases (they are prone to electrolytic anomalies), and those under treatments requiring food (Danielsson et al., 2019).

- Eating disorders

- Depression and anxiety (depression is relieved in short-term, not in long-term calorie restriction).

- Pregnancy, breastfeeding, and women trying to conceive

- Low blood pressure (IF decreases blood pressure)

- Underweight

- Older adults (fasting can have negative effects on their immune system)

- Subjects under 18 years of age (children and teenagers)

- Uncontrolled migraines

- Subjects undergoing blood transfusion

Conclusions

1. The newest diet trend in the last decades is intermittent fasting, adopted by numerous athletes, celebrities and average people. Part of the fascination with intermittent fasting arises from research on animals showing that fasting may reduce cancer risk and slow aging.

2. Intermittent fasting means eating within a certain window and fasting the rest of the time (hours/days).

3. Although fasting between dinner and breakfast the next day (12 to 14 hours) could be considered a part of normal life and might have numerous positive effects, there are many disadvantages.

4. There are many short-term or long-term/extended-term fasting protocols. Competing in endurance sports (which demand a quicker way to obtain the energy, e.g. from digesting food) during fasting is contraindicated. Some sports could be more affected than others, and partial or total fast may be challenging for athletes, who need to develop effective and appropriate coping strategies to adapt.

5. Endurance training in a fasted state could have some metabolic advantages, but feeding before, during and after each training session might have other potential benefits.

6. Many athletes need a morning meal; the results are better when eating before training. For athletes, there are other safe, healthy and less extreme ways to lose weight.

Conflict of interest

Nothing to declare

References

- Alamgir Khan, Sami Ullah Khan, Salahuddin Khan, Syed zia-ul-islam, Naimatullah Khan Baber, Manzoor Khan. Nutritional complications and its effects on human health. *J Food Sci Nutr*. 2018; 1(1):17-20. DOI: 10.35841/food-science.1.1.17-20.
- Alvero R. Effects of Fasting on Neuroendocrine Function and Follicle Development in Lean Women. *Journal Clin Endocrinol Metab*. 1998;83(1):76-80. doi:10.1210/jc.83.1.76.
- Anton S D., Moehl K., Donahoo W T, Marosi K, Lee S, Mainous AG, Mattson MP. Flipping the Metabolic Switch: Understanding and Applying Health Benefits of Fasting. *Obesity (Silver Spring)* 2018; 26(2):254-268. doi: 10.1002/oby.22065.
- Barnosky A, Hoddy KK, Unterman TG, Varady KA. Intermittent fasting vs. daily calorie restriction for type-2 diabetes prevention: a review of human findings. *Transl Res*. 2014; 164(4):302-311. doi: 10.1016/j.trsl.2014.05.013.
- Bertile Fabrice, Fouillen Laetitia, Wasselin T, Maes Pauline, Le Maho Yvon, Van Dorsselaer A, Raclot T. The Safety Limits of an Extended Fast: Lessons from a Non-Model Organism. *Sci Rep*. 2016; 6:39008. doi: 10.1038/srep39008.
- Burke LM, Kiens B. "Fat adaptation" for athletic performance: the nail in the coffin? *J Appl Physiol* 2006;100(1):7-8. DOI:10.1152/jappphysiol.01238.2005.
- Burke LM, van Loon LJ, Hawley JA. Post-exercise muscle glycogen resynthesis in humans. *J Appl Physiol*. 2017;122(5):1055-1067. doi: 10.1152/jappphysiol.00860.2016.
- Carmona JJ, Michan S. Biology of healthy aging and longevity. *Rev Invest Clin*. 2016; 68(1):7-16.
- Chaouachi A, Leiper JB, Souissi N, Coutts AJ, Chamari K. Effects of Ramadan Intermittent Fasting on Sports Performance and Training: A Review. *Int J Sports Physiol Perform*. 2009; 4(4):419-34. DOI: 10.1123/ijsp.4.4.419-34.
- Chung H, Chou W, Sears DD, Patterson R E, Webster N, Ellies LG. Time-restricted feeding improves insulin resistance and hepatic steatosis in a mouse model of postmenopausal obesity. *Metabolism*. 2016;65(12):1743-1754. doi: 10.1016/j.metabol.2016.09.006.
- Chung HY, Lee EK, Choi YJ, et al. Molecular inflammation as an underlying mechanism of the aging process and age-related diseases. *J Dent Res*. 2011;90(7):830-840. doi: 10.1177/0022034510387794.
- Crispim CA, Waterhouse J, Damaso AR, Zimberg IZ, Padilha HG, Oyama LM, Tufik S, de Mello MT. Hormonal appetite control is altered by shift work: a preliminary study. *Metab Clin Exp*. 2011; 60(12):1726-1735. doi: 10.1016/j.metabol.2011.04.014.
- Danielsson EJD, Lejbman I, Akeson J. Fluid deficits during prolonged overnight fasting in young healthy adults. *Acta Anaesthesiol. Scand*. 2019;63(2):195-199. doi: 10.1111/aas.13254.
- Davis C Clarke RE, Coulter SN, Rounsefell KN, Walker RE, Rauch CE, Huggins CE, Ryan L. Intermittent energy restriction and weight loss: A systematic Review. *Eur J Clin Nutr*. 2016; 70(3):292-299. doi: 10.1038/ejcn.2015.195.
- De Cabo R, Mattson MP. Effects of Intermittent Fasting on Health, Aging, and Disease. *N Engl J Med* 2019;381(26):2541-2551. DOI: 10.1056/NEJMr1905136.
- Desgorges FD, Breuillard C, Police C, Neveux N, Cottart CH, Blanc MC, Toussaint JF, Noirez P. Short-term Effects of Diet and Activity Changes on Inflammation and Insulin Resistance. *Int. J. Sports Med*. 2016; 37:1032-1037. doi: 10.1055/s-0042-100914. DOI:10.1055/s-0042-100914
- Fann DY, Ng GY, Poh L, Arumugam TV. Positive effects of intermittent fasting in ischemic stroke. *Exp. Gerontol*. 2017;89:93-102. doi: 10.1016/j.exger.2017.01.014.
- Fontana L, Partridge L. Promoting health and longevity through diet: from model organisms to humans. *Cell*. 2015;161(1):106-118. doi: 10.1016/j.cell.2015.02.020.
- Grajower MM and Horne BD. Clinical Management of Intermittent Fasting in Patients with Diabetes Mellitus. *Nutrients*. 2019;11(4): 873. doi: 10.3390/nu11040873.
- Gunnars K. 6 popular ways to do intermittent fasting. *Healthline*, 2017. Available at: <https://www.healthline.com/nutrition/6-ways-to-do-intermittent-fasting>. Accessed December 2019.
- Harvie MN, Pegington M, Mattson MP, Frystyk, J., Dillon, B., Evans, G, Cuzick J, Jebb SA, Martin B, Cutler RG, Son TG, Maudsley S, Carlson OD, Egan JM, Flyvbjerg A, Howell A. The effects of intermittent or continuous energy restriction on weight loss and metabolic disease risk markers: a randomized trial in young overweight women. *Int J Obes Suppl*. 2011; 35(5):714-727. doi: 10.1038/ijo.2010.171.
- Harvie MN, Wright C, Pegington M, McMullan D, Mitchell E, Martin B, Cutler RG, Evans G, Whiteside S, Maudsley S, Camandola S, Wang R, Carlson OD, Egan JM, Mattson MP, Howell A. The effect of intermittent energy and carbohydrate restriction v. daily energy restriction on weight loss and metabolic disease risk markers in overweight women. *Br J Nutr*. 2013;110(8):1534-1547. doi: 10.1017/S0007114513000792.
- Hawley JA, Gibala MJ, Berman S. Innovations in athletic preparation: role of substrate availability to modify training adaptation and performance. *J Sports Sci*. 2007;25(Suppl 1):S115-S124. DOI:10.1080/02640410701607411.
- He Y, Lu Y, Zhu Q, Wang Y, Lindheim SR, Qi J, Li X, Ding Y, Shi Y, Wei D, Chen ZJ, Sun Y. Influence of metabolic syndrome on female fertility and in vitro fertilization outcomes in PCOS women. *Am J Obstet Gynecol*. 2019;221(2): 138.e1-138.e12. doi: 10.1016/j.ajog.2019.03.011.
- Horne BD, Muhlestein JB, Anderson JL. Health effects of intermittent fasting: Hormesis or harm? A systematic review. *Am. J. Clin. Nutr*. 2015;102(2):464-470. doi: 10.3945/ajcn.115.109553.
- Horne BD, Muhlestein JB, Lappe DL, May HT, Carlquist JF, Galenko O, Brunisholz KD, Anderson JL. Randomized cross-over trial of short-term water-only fasting: Metabolic and cardiovascular consequences. *Nutr Metab Cardiovasc Dis*. 2013;23(11):1050-1057. doi: 10.1016/j.numecd.2012.09.007.

- Jaleel M, Fathima FN, Jaleel Bushra N.F. Nutrition, energy intake- output, exercise, and fluid homeostasis during fasting in Ramadan. *J Med Nutr Nutraceutic*. 2013;2(2): 63-68. DOI: 10.4103/2278-019X.114722.
- Kenyon C. The first long-lived mutants: discovery of the insulin/IGF-1 pathway for ageing. *Philos Trans R Soc Lond B Biol Sci*. 2011;366(1561):9-16. doi: 10.1098/rstb.2010.0276.
- Kroeger CM, Trepanowski JF, Klempel MC, Barnosky A, Bhutani S, Gabel K, Varady KA. Eating behavior traits of successful weight losers during 12 months of alternate-day fasting: An exploratory analysis of a randomized controlled trial. *Nutr Health*. 2018;24(1):5-10. doi: 10.1177/0260106017753487.
- Larson-Meyer DE, Heilbronn LK, Redman LM, Newcomer BR, Frisard MI, Anton S, Smith SR, Alfonso A, Ravussin E. Effect of calorie restriction with or without exercise on insulin sensitivity, beta-cell function, fat cell size, and ectopic lipid in overweight subjects. *Diabetes Care*. 2006;29(6):1337-1344. DOI:10.2337/dc05-2565.
- Laza V. Contradictions and controversies in contemporary nutrition. *Palestrica of the Third Millennium – Civilization and Sport*. 2017;18(4):220-224. <https://doi.org/10.26659/pm3.2017.18.4.220>.
- Leonard J. Seven ways to do intermittent fasting. *Medical News Today*, 2018. Available at: <https://www.medicalnewstoday.com/articles/322293.php>. Accessed December 2019.
- Levy Emily, Chu Th. Intermittent Fasting and Its Effects on Athletic Performance. A Review. *Curr Sports Med Rep*. 2019;18(7):266-269. doi: 10.1249/JSR.0000000000000614.00614.
- Longo VD, Antebi A, Bartke A, Barzilai N, Brown-Borg HM, Caruso C, Curiel TJ, de Cabo R, Franceschi C, Gems D, Ingram DK, Johnson TE, Kennedy BK, Kenyon C, Klein S, Kopchick JJ, Lepperdinger G, Madeo F, Mirisola MG, Mitchell JR, Passarino G, Rudolph KL, Sedivy JM, Shadel GS, Sinclair DA, Spindler SR, Suh Y, Vijg J, Vinciguerra M, Fontana L. Interventions to slow aging in humans: are we ready? *Aging Cell*. 2015;14(4):497-510. doi: 10.1111/ace1.12338.
- Lopez-Lluch G, Navas P. Calorie restriction as an intervention in aging. *J Physiol*. 2016;594(8):2043-2060. doi: 10.1113/JP270543.
- Lopez-Otin C, Blasco MA, Partridge L, Serrano M, Kroemer G. The hallmarks of aging. *Cell*. 2013; 153(6):1194-1217. doi: 10.1016/j.cell.2013.05.039.
- Malinowski B, Zalewska Klaudia, Węsierska Anna, Sokołowska Maya, Maciej Socha M, Liczner G, Pawlak-Osińska Katarzyna, Wiciński M. Intermittent Fasting in Cardiovascular Disorders - An Overview. *Nutrients*. 2019;11(3):673. <https://doi.org/10.3390/nu11030673>.
- Mattson MP, Longo VD, Harvie M. Impact of intermittent fasting on health and disease processes. *Ageing Res. Rev*. 2017;39:46-58. doi: 10.1016/j.arr.2016.10.005.
- Maughan, RJ, Zerguini, Y, Chalabi, H, Dvorak, J. Achieving optimum sports performance during Ramadan: Some practical recommendations. *J Sports Sci* 2012;30(Suppl 1): S109-S117. doi: 10.1080/02640414.2012.696205.
- Moro T, Tinsley G, Bianco A, Marcolin G, Pacelli Q F, Battaglia G, and Paoli A. Effects of eight weeks of time-restricted feeding (16/8) on basal metabolism, maximal strength, body composition, inflammation, and cardiovascular risk factors in resistance-trained males. *J Transl Med* 2016; 14(1):290. doi:10.1186/s12967-016-1044-0.
- Most J, Tosti Valeria, Redman LM, and Fontana L. Calorie restriction in humans: an update. *Ageing Res Rev*. 2017;39:36-45. doi: 10.1016/j.arr.2016.08.005.
- Nicoll Rachel and Henein MY. Caloric restriction and its effect on blood pressure, heart rate variability and arterial stiffness and dilatation: a review of the evidence. *Int J Mol Sci*. 2018; 19(3): pii: E751. doi: 10.3390/ijms19030751.
- Omodei D, Fontana L. Calorie restriction and prevention of age-associated chronic disease. *FEBS Lett*. 2011;585(11):1537-1542. doi: 10.1016/j.febslet.2011.03.015.
- Pakkir Maideen MM, Abdurazak Jumale, Rajkapoor Balasubramaniam. Adverse Health Effects Associated with Islamic Fasting: A Literature Review. *J Fasting Health*. 2017;5(3):113-118. Doi:10.22038/JFH.2017.25419.1095.
- Passarino G, De Rango F, Montesanto A. Human longevity: genetics or lifestyle? It takes two to tango. *Immun Ageing*. 2016;13:12-17. doi: 10.1186/s12979-016-0066-z.
- Patterson RE, Sears DD. Metabolic Effects of Intermittent Fasting. *Annu. Rev. Nutr*. 2017;37:371-393. annualreviews.org/doi/full/10.1146/annurev-nutr-071816-064634.
- Patterson Ruth E, Gail A. Laughlin GA, Villaseñor A. Intermittent fasting and human metabolic health. *J Acad Nutr Diet*. 2015;115(8):1203-1212. doi: 10.1016/j.jand.2015.02.018.
- Peos JJ, Norton LE, Helms ER, Galpin AJ, Fournier P. Intermittent Dieting: Theoretical Considerations for the Athletes. *Sports (Basel)*. 2019;16;7(1):E22. doi: 10.3390/sports7010022.
- Picca Anna, Pesce V, and Lezza AMS. Does eating less make you live longer and better? An update on calorie restriction. *Clin Interv Aging*. 2017;12:1887-1902. doi: 10.2147/CIA.S126458.
- Rattan SI. Hormesis in aging. *Ageing Res Rev*. 2008;7(1):63-78. DOI:10.1016/j.arr.2007.03.002
- Ravussin E, Redman LM, Rochon J, Das SK, Fontana L, Kraus WE, Romashkan S, Williamson DA, Meydani SN, Villareal DT, Smith SR, Stein RI, Scott TM, Stewart TM, Saltzman E, Klein S, Bhapkar M, Martin CK, Gilhooly CH, Holloszy JO, Hadley EC, Roberts SB; CALERIE Study Group. A 2-year randomized controlled trial of human caloric restriction: feasibility and effects on predictors of health span and longevity. *J Gerontol Ser A Biol Sci Med Sci*. 2015;70(9):1097-1104. doi: 10.1093/gerona/glv057.
- Rothschild J, Hoddy KK, Jambazian P, Varady KA. Time-restricted feeding and risk of metabolic disease: A review of human and animal studies. *Nutr Rev*. 2014;72(5):308-318. doi: 10.1111/nure.12104.
- Rybicka M, Krysiak R, Okopień B. The dawn phenomenon and the Somogyi effect - two phenomena of morning hyperglycaemia. *Endokrynol Pol*. 2011;62(3):276-284.
- Schiavo-Cardozo D, Lima MM, Pareja JC, Geloneze B. Appetite-regulating hormones from the upper gut: disrupted control of xenin and ghrelin in night workers. *Clin Endocrinol*. 2013;79(6):807-811. doi: 10.1111/cen.12114.
- Shojaie M, Ghanbari F, Shojaie N. Intermittent fasting could ameliorate cognitive function against distress by regulation of inflammatory response pathway. *J Adv Res*. 2017;8(6):697-701. doi: 10.1016/.
- Speakman JR, Mitchell SE, Mazidi M. Calories or protein? The effect of dietary restriction on lifespan in rodents is explained by calories alone. *Exp Gerontol*. 2016; 86:28-38. doi: 10.1016/j.exger.2016.03.011.
- Stockman M, Thomas D, Burke J. Apovian CM. Intermittent Fasting: Is the Wait Worth the Weight? *Curr Obes Rep*. 2018;7(2):172-185. doi:10.1007/s13679-018-0308-9.
- Sutton EF, Beyl R, Early KS, Cefalu WT, Ravussin E, Peterson CM. Early Time-Restricted Feeding Improves Insulin Sensitivity, Blood Pressure, and Oxidative Stress Even without Weight Loss in Men with Prediabetes. *Cell Metab*. 2018; 27(6):1212-1221.e3. doi: 10.1016/j.cmet.2018.04.010.
- Testa G, Biasi F, Poli G, Chiarpotto E. Calorie restriction and dietary restriction mimetics: a strategy for improving healthy aging and longevity. *Curr Pharm Des*. 2014;20(18):2950-2977. DOI:10.2174/13816128113196660699.

- Tinsely G, Gann J, La Bounty P. Intermittent fasting programs and their effect on body composition. Implication for weight restricted sports. *Strength Cond Res.* 2015; 35(5):60-71..
- Tinsley G, Forsse JS, Butler NK, Paoli A, Bane AA, La Bounty PM, Morgan GB, Grandjean PW. Time-restricted feeding in young men performing resistance training: A randomized controlled trial. *Eur J Sport Sci.* 2017;17(2):200-207. doi: 10.1080/17461391.2016.
- Varady KA, Bhutani S, Klempel MC, et al. Alternate day fasting for weight loss in normal weight and overweight subjects: a randomized controlled trial. *Nutr J.* 2013;12(1):146. doi:10.1186/1475-2891-12-146.
- Varady KA, RoohkDJ, McEvoy-Hein BK, Gaylinn BD, Thorner MO, Hellerstein MK. Modified alternate-day fasting regimens reduce cell proliferation rates to a similar extent as daily calorie restriction in mice. *FASEB J.* 2008;22(6):2090-2096. doi: 10.1096/fj.07-098178.
- Varady KA. Intermittent fasting vs. daily calorie restriction: which diet regimen is more effective for weight loss? *Obesity Reviews.* 2011;12(7):e593-e601. It is important to consume moderate fat, protein-rich, high-fiber diets. doi: 10.1111/j.1467-789X.2011.00873.x.
- Velthuis-te Wierik EJ, Westerterp KR, van den Berg H. Impact of a moderately energy-restricted diet on energy metabolism and body composition in non-obese men. *Int J Obes Relat Metab Disord.* 1995;19(5):318-324.
- Vera E, Bernardes de Jesus B, Foronda M, Flores JM, Blasco MA. Telomerase reverse transcriptase synergizes with calorie restriction to increase health span and extend mouse longevity. *PLoS One.* 2013;8(1):e53760. doi: 10.1371/journal.pone.0053760.
- Willcox BJ, Willcox DC. Caloric restriction, caloric restriction mimetics, and healthy aging in Okinawa: Controversies and clinical implications. *Curr. Opin. Clin. Nutr. Metab. Care.* 2014; 17(1):51-58. doi: 10.1097/MCO.000000000000019.
- Wilson RA, Deasy W, Stathis CG, Hayes A, Cooke MB. Intermittent Fasting with or without Exercise Prevents Weight Gain and Improves Lipids in Diet-Induced Obese Mice. *Nutrients.* 2018;10(3): pii: E346. doi: 10.3390/nu10030346.
- Yamaguchi M, Uemura H, Katsuura-Kamano S, Nakamoto M, Hiyoshi M, Takami H, Sawachika F, Jutta T, Arisawa K. Relationship of dietary factors and habits with sleep-wake regularity. *Asia Pac J Clin Nutr.* 2013; 22(3):457-465. doi: 10.6133/apjcn.2013.22.3.01.
- Zhang Y, Changhong Liu, Zhao Y, Zhang X, Li B, Cui R. The Effects of Calorie Restriction in Depression and Potential Mechanisms. *Current Neuropharmacology,* 2015;13(4):536-542. DOI:10.2174/1570159x13666150326003852.

Websites

- (1) <https://iheartthenewme.com/the-most-popular-intermittent-fasting-protocols/>. Accessed December 2019.
- (2) <https://www.dietdoctor.com/intermittent-fasting> Dr. Fung. Accessed December 2019.
- (3) <https://www.bulletproof.com/diet/intermittent-fasting/intermittent-fasting-weight-loss/>. Accessed December 2019.
- (4) <https://www.health.harvard.edu/blog/intermittent-fasting-surprising-update-2018062914156>. Accessed December 2019.
- (5) <https://www.smh.com.au/lifestyle/health-and-wellness/is-fasting-for-16-hours-a-day-really-the-secret-to-long-term-weight-loss-20190814-p52h6y.html>. Accessed December 2019.

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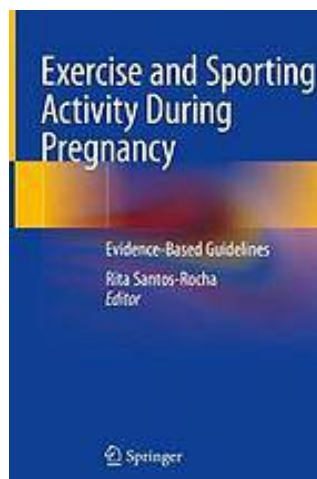
Exercise and sporting activity during pregnancy.

Evidence-based guidelines

Editor: Rita Santos-Rocha

Publisher: Springer, 2019

345 pages; price: €135.19 (paper) /€106.99 (eBook)



It is clearly well documented that exercise and a healthy lifestyle are crucial for both pregnant and postpartum women, and fetus and child health and development. So, in addition to improved fitness, the most evident and positive benefits for the mother are prevention of excessive weight and fat gain, and also of diabetes, hypertension and depression, while from the perspective of the fetus and child, having an appropriate weight at birth seems to represent a very relevant target and a much wanted advantage.

However, even if these benefits are well known and there is no doubt that physical activity should be a mandatory component of a healthy lifestyle, the percent of pregnant women regularly performing appropriate exercise and sport is far from being sufficient. One explanation for this unsatisfactory status could be the fact that healthcare providers do not insistently recommend and stimulate pregnant women to practice sport and exercise, whereas some fitness professionals are not sufficiently informed and prepared to design and manage adapted exercise programs in order to promote the benefits of physical activity without generating unwanted effects, such as musculoskeletal disorders, urinary incontinence, or low back pain. In other words, not all fitness instructors know “what types of exercise are the best, the safest and the most effective” in these cases.

In such circumstances, a clinical and practice oriented exhaustive book providing state of the art information to all professionals potentially involved in recommending, prescribing and supervising exercise and sport for pregnant and postpartum women is more than welcome. And the volume edited by Rita Santos-Rocha, from the Faculty of Human Kinetics within the University of Lisbon, and warmly foreworded by Dr. Michelle F. Mottola, Director of the R. Samuel McLaughlin Foundation – Exercise and Pregnancy Laboratory, Ontario, Canada, seems to be that long awaited work.

The fact that this textbook fills a gap indeed and provides the readers with evidence-based knowledge on the physiological and psychological changes occurring during pregnancy, and on the other hand with practical expertise (ideas, tools and solutions) to optimally advise and supervise the exercisers, including the most efficient points and tips for ruling out their frequently experienced fear/anxiety, is obvious just by reading its table of contents and the chapter abstracts.

So, after the authors present in the first chapter the importance of an active style and health education during different periods of pregnancy, also pointing out how important it is that health professionals promote the benefits of physical activity, the second chapter highlights the relevance of psychological, social and behavioral support, which is crucial for convincing the women to begin and/or maintain this activity. Then, the next three sections elaborate on the physiological - main adaptations and discomforts - (chapter 3), body composition (4) and biomechanical (5) changes accompanying pregnancy, as well as on their implications for physical activity.

Besides the above mentioned changes and adaptations, pregnancy can also generate significant impairments and disorders of the musculoskeletal system, which are accompanied by pain and embarrassing dysfunctions, as is the case of the relatively frequent urinary incontinence. This is why the 6th chapter comes not only with comprehensive up-to-date evidence-based information about these aspects, known as having negative effects on daily activities, but also with specific recommendations for their treatment and recovery of the functional capacity. The utility and the way in which exercise and physical activity help prevent and cure these musculoskeletal conditions and disorders will be presented in the 10th chapter.

The purpose of the three authors (coming from Poland, Portugal and Spain) of the 7th chapter was “to review the information provided in the current guidelines for exercise during pregnancy in different countries”. The resulting

overview takes into consideration both the specific pre-pregnancy habits of the subjects – inactive, active women, or competitive female athletes - and the different targeted exercise classes, whether based on aerobic, resistance, or stretching exercises. Next, chapter 8 teaches us how to correctly perform medical screening and exercise testing. The accuracy of medical screening is crucial to make sure the pregnant woman will have no risk once engaged in exercise, while the correctness of exercise testing is vital because its results help us to choose the most appropriate types and modes of exercises, their duration, frequency and intensity; these conditions are required to design effective, safe, individualized exercise programs. Even more practical than the above described chapter, the next chapter presents the ideal structure of an exercise session for pregnant women, which apart from compulsory

warm-up and cool-down must contain the following four groups of exercises: aerobic, resistance plus postural plus neuromotor, flexibility, and pelvic floor muscle exercises. This chapter ends with no less than 11 examples of practical exercise programs.

Finally, the 11th chapter offers detailed nutritional recommendations, being known that energy and macronutrient intake depend on the volume and intensity of exercise, on whether the exerciser is an adult or an adolescent woman, and of course, on the moment of the day when the exercise program is performed. This means that exercisers must also be advised and taught how to properly distribute foods before, during and after exercise.

Gheorghe Dumitru
ghdumitru@yahoo.com

EVENTS



INSPECTORATUL ȘCOLAR
JUDEȚEAN CLUJ



In search of snow for the ski competitions in the mountain centers of Cluj county - 2020

In the 2019-2020 winter season that has now ended, snow was not abundant, so that the last competition scheduled to take place in Sâncraiu, was no longer held.

The other competitions took place under normal conditions, between 18 January and 16 February 2020, in the following order: Rogojel, Beliș, Râșca, Mărișel, Măguri Bogdănești, Băișoara. Tradition develops slowly but surely. Băișoara has the longest tradition in organizing these mountain cross-country skiing competitions, with the *Little Mountain Hunters Cup* as a competition in its own right. The competition was initiated in 1973, and this year its 41st edition was held.

The following year, in 1974, the first edition of the *Pelaghia Roșu Cup* took place in Mărișel, a competition of rural mountain localities that has continued with some interruptions until the present day, reaching its 34th edition. At the first 1974 edition

held in Mărișel, a cup was launched to be passed on between the participating localities, and as a general rule, it was established that this cup should remain in the possession of the team winning it 3 times consecutively. In 1989, this cup was definitively won by the cross-country skiing team of Râșca, led by Prof. Ilea Ardelean, who still participates in this circuit and can be seen in the photos of our report, alongside his colleague from Mărișel, teacher Dana Feneșan.

The cross-country skiing competitors and team of Măguri Bogdănești (Măguri Răcătău commune), situated at an altitude of over 1260 m, a mountain locality inhabited throughout the year, are in real progress, competing with Fundata commune of Brașov county, which is also situated at 1260 m altitude. The merits belong to the mayor Petru Prigoană, to the director of the Middle School, Carmen Prigoană, and to the physical education teacher Maria Toader.

1. Rogojel Center - The *Vlădeasa Cup*, 8th edition, 18 January 2020

Place	Girls 11-12 years	Boys 11-12 years	Girls 13-14 years	Boys 13-14 years	Relay	Team ranking
1	Tomoș Estera - Râșca	Pleș Claudiu - Rogojel	Tomoș Ioana - Râșca	Dobra Flaviu - Beliș	Răchițele	Răchițele
2	Abrudan Alexandra - Răchițele	Dinescu Andrei - Beliș	Șchiop Gabriela - Răchițele	Todoruț Paul - Răchițele	Râșca	Măguri Bogdănești
3	Toader Denisa - Măguri Bogdănești	Matîș Sorin - Mărișel	Ianc Denisa - Măguri Bogdănești	Tomoș Daniel - Râșca	Măguri Bogdănești	Râșca

Physical education teacher: Aurel Dan Crișan; Director: Prof. Mariana Pașcalău; Mayor: Gheorghe Cuc; Cluj-Napoca mountain rescue - organization and assistance

2. Beliș Center - The *Scorușet Cup*, 25th edition, 25 January 2020

Place	Girls 11-12 years	Boys 11-12 years	Girls 13-14 years	Boys 13-14 years	Relay	Team ranking
1	Tomoș Estera - Râșca	Pleș Claudiu - Rogojel	Tomoș Ioana - Râșca	Dobra Flaviu - Beliș	Râșca	Râșca
2	Negrea Denisa - Măguri Bogdănești	Török Zolán - Sâncraiu	Bîlc Ioana - Beliș	Todoruț Paul - Răchițele	Măguri Bogdănești	Măguri Bogdănești
3	Abrudan Alexandra - Răchițele	Dinescu Andrei - Beliș	Ianc Denisa - Măguri Bogdănești	Tomoș Daniel - Râșca	Răchițele	Răchițele

Physical education teacher: Răzvan Făurică; Director: Mihaela Mocean; Mayor: Viorel Matîș; Cluj-Napoca mountain rescue - organization and assistance

3. Râșca Center - The *Sălânducu Cup*, 22nd edition, 26 January 2020

Place	Girls 11-12 years	Boys 11-12 years	Girls 13-14 years	Boys 13-14 years	Relay	Team ranking
1	Tomoș Estera - Râșca	Török Zolán - Sâncraiu	Tomoș Ioana - Râșca	Dobra Flaviu - Beliș	Măguri Bogdănești	Măguri Bogdănești
2	Negrea Denisa - Măguri Bogdănești	Dinescu Andrei - Beliș	Ianc Denisa - Măguri Bogdănești	Todoruț Paul - Răchițele	Râșca	Râșca
3	Toader Denisa - Măguri Bogdănești	Pleș Claudiu - Rogojel	Bîlc Ioana - Beliș	Roba Marius - Măguri Bogdănești	Răchițele	Răchițele

Physical education teacher: Ardelean Ilea; Director: Gelu Petru Săvărășan; Mayor: Teodor Petre; Cluj-Napoca mountain rescue - organization and assistance

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Events

4. Mărișel Center - The *Pelaghia Roșu* Cup, 34th edition, 1 February 2020

Place	Girls 11-12 years	Boys 11-12 years	Girls 13-14 years	Boys 13-14 years	Relay	Team ranking
1	Tomoș Estera - Râșca	Pleș Claudiu - Rogojel	Bîlc Ioana - Beliș	Roba Marius - Măguri Bogdănești	Râșca	Măguri Bogdănești
2	Negrea Denisa - Măguri Bogdănești	Török Zolán - Sâncraiu	Tomoș Ioana - Râșca	Dobra Flaviu - Beliș	Măguri Bogdănești	Râșca
3	Purcel Ioana - Mărișel	Mariș Darian - Măguri Bogdănești	Ianc Denisa - Măguri Bogdănești	Todoruț Paul - Răchițele	Răchițele	Răchițele

Physical education teacher: Ionuț Bal; Director: Prof. Dana Mirela Feneșan; Mayor: Viorel Ghic; Cluj-Napoca mountain rescue - organization and assistance

5. Măguri Bogdănești Center - The *Avram Iancu* Cup, 4th edition, 12 February 2020

Place	Girls 11-12 years	Boys 11-12 years	Girls 13-14 years	Boys 13-14 years	Relay	Team ranking
1	Toader Denisa - Măguri Bogdănești	Török Zolán - Sâncraiu	Ianc Denisa - Măguri Bogdănești	Dobra Flaviu - Beliș	Măguri Bogdănești	Măguri Bogdănești
2	Negrea Denisa - Măguri Bogdănești	Pleș Claudiu - Rogojel	Bîlc Ioana - Beliș	Todoruț Paul - Răchițele	Râșca	Râșca
3	Tomoș Estera - Râșca	Dinescu Andrei - Beliș	Tomoș Ioana - Râșca	Roba Marius - Măguri Bogdănești	Beliș	Răchițele

Physical education teacher: Maria Toader; Director: Prof. Carmen Prigoană; Mayor: Petru Prigoană; Cluj-Napoca mountain rescue - organization and assistance

6. Băișoara Center - The *Little Mountain Hunters* Cup, 41st edition, 16 February 2020

Place	Girls 11-12 years	Boys 11-12 years	Girls 13-14 years	Boys 13-14 years	Relay	Team ranking
1	Negrea Denisa - Măguri Bogdănești	Török Zolán - Sâncraiu	Ianc Denisa - Măguri Bogdănești	Roba Marius - Măguri Bogdănești	Măguri Bogdănești	Măguri Bogdănești
2	Toader Denisa - Măguri Bogdănești	Mariș Darian - Măguri Bogdănești	Tomoș Ioana - Râșca	Dobra Flaviu - Beliș	Râșca	Râșca
3	Abrudan Alexandra - Răchițele	Pleș Claudiu - Rogojel	Popa Cosmina - Rogojel	Todoruț Paul - Răchițele	Rogojel	Răchițele

Organizers: ISJ Cluj, Prof. Cristian Potoră – School Inspector - physical education; Director: Prof. Lenuța Chiș - Children's Palace Cluj

Rogojel Center



Arnica boarding house in Rogojel, where the members of the referee commission were accommodated.



Waiting for the award ceremony.



Mayor Gheorghe Cuc awarding prizes to the team leading teachers.

Beliș Center



Award ceremony for 11-12-year-old girls, conducted by School Inspector Laura Ionescu.

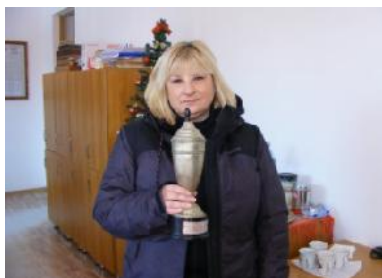


Special prizes awarded to the youngest participants in the competition. Award ceremony conducted by the director of the *Avram Iancu* Middle School, Mihaela Mocean. Physical education teacher Răzvan Făurică – left and Dumitru Stamate, a member of the referee commission, are also in the picture.



Awarding prizes to the team leaders; I-Ardelean Ilea-Râșca; II-Claudiu Roșu-Răchițele; III-Maria Toader-Măguri Răcătău. Also winning prizes: Răzvan Făurică; Cătălin Ionuț Chiș; Dana Feneșan; Csudom Norbert. Award ceremony conducted by School Inspector Cristian Potoră and School Inspector Laura Ionescu.

Râșca Center



The director of Mărișel School, Dana Feneșan, in Râșca in 2020, holding the first cup put at stake in 1974 by predecessors.



The director of Mărișel School, Dana Feneșan, alongside the winner of three consecutive editions of the *Pelaghia Roșu Cup* competition, veteran Ilea Ardelean from Râșca.



Ramona Ilea awarding prizes to 13-14-year old boys.

Mărișel Center



Opening of the award ceremony by the director of the *Pelaghia Roșu* Middle School, Dana Feneșan.



School Inspector Cristian Potoră awarding prizes to the winning relay teams.



The deputy mayor of Mărișel commune, Nicolae Ghic, awarding prizes to the team leaders; First place-Maria Toader-Măguri Răcătău; Second place-Ardelean Ilea-Râșca; Third place-Claudiu Roșu-Răchițele. Also winning prizes: Răzvan Făurică, Ionuț Bal, Mariana Pașcalău, Csudom Norbert.

Măguri Bogdănești Center



The most difficult route of all the organized competitions, with a very difficult to climb slope.



Opening of the award ceremony, conducted by the mayor of Măguri Răcătău commune, Cluj county.



The director of the Măguri Bogdănești Middle School, Carmen Prigoană, awarding prizes to participants in the relay event.

Băișoara Center



Group picture with all participants in the *Little Mountain Hunters Cup*, Băișoara.



View of the 13-14-year-old girls' race.



Group picture after the award ceremony.

Laura Ionescu
lauraionescu2005@yahoo.com
Cristian Potoră
cristianpotor@gmail.com

PORTTRAITS – Personalities of Romanian science and culture

Petru Derevenco - the man and his work

Călin Gabriel Șarlă¹, Daniela Ciobanu²

¹"Vasile Goldis" Western University, Arad

²University of Medicine and Pharmacy, Craiova

Abstract

Romanian physiology had a lot of recovery to do in the field of characterizing the physiology of stress and the therapy of its manifestations, and Dr. Petre Derevenco managed to establish national and international relations which opened collaboration channels in the closed communism period.

Despite his distinguished and discrete personality, who preferred an internalized attitude, his work as a doctor and a researcher built the scaffolding for a public figure of national and international reference.

Keywords: Petru Derevenco, physiology, scientific research, the man, his work.



His personality

Petru Derevenco was a renowned physiologist, an exceptional figure of the scientific world, a member of the Academy of Medical Sciences and a member of four international scientific societies (Italy, Great Britain, Germany and the Republic of Moldova). He was probably among the first specialists (if not the very first) who studied and brought to the attention of Romanian scientists the notion of *stress*, thus managing to open a path for medical intervention to treat patients both directly and through the development of compliance.

The first thing one noticed in him was his outstanding politeness, shared and potentiated by Mrs Stela Râmboiu, his wife. A sensitive, warm and humane couple, devoid of any shadow of arrogance, they had the gift of making one feel comfortable regardless of one's situation – difficult or triumphant.

This presentation is one of the hardest challenges because Petru Derevenco, PhD, was one of the most complex human beings. In his manuscript "*Petru Derevenco – Memoir Indicators*" (1) sent to Prof. Aurel Saulea (former Head of the Physiology Department of the *Nicolae Testemițanu* State University of Medicine and Pharmacy in Chișinău), he characterizes himself as follows: "*I was very solitary, almost autistic, I would prefer to play alone with my toy soldiers or read something from my father's ample library, including unintelligible medical books or I would study the medicine that, in that time, medics would receive from various companies*". Then: "*I am a bivalent person. On the one hand, I am schizoid, sceptical, an atheist, certain of the primacy of science, proven by my adherence to the evolutionist doctrine, which was materialised by the publication of the book "Darwin and Darwinism" in 2011*". Or: "*I am often willing to help the spiritually and materialistically under-privileged. In other circumstances, I have shown negligence and insensitivity towards my family, especially towards my mother and Vera (his first wife), being left with remorse*". Political attitude: "*During Communism I was not a nonconformist and I made some concessions (becoming and rebecoming (emphasis added) a member of the RCP). At the same time, I was independent in my behaviour: in the '70s I joined "Amnesty International", an organization for the protection of human rights. I used to frequent Western libraries in Bucharest that were being targeted by the Security*". And lastly: "*I was always and consistently siding with the discriminated (especially gypsies and homosexuals), on whom I have*

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Address for correspondence: No. 30, Părului Street, 200346, Craiova, Romania
E-mail: gabriel_sarla2001@yahoo.com
Corresponding author: Călin Gabriel Șarlă, gabriel_sarla2001@yahoo.com
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written plenty articles. On the other side, I am sentimental, musically deaf, but passionate about musical auditions and shy around women, which has led me to many failures in the erotic department”.

Despite this otherwise somber picture, it must also be mentioned that during an informal meeting in which Mr. Derevenco and I participated, which was organized by the department of a Southern university and dedicated to establishing “*The Medium and Long-Term Strategic Research Plan*”, Professor Derevenco intervened very ambiguously and evasively. After the meeting, upon being asked about the meaning of the speech, he clarified: “*If you understood what I said, then the matters presented are serious; if you did not understand, please forgive me, I was joking*” (2).

His family

Petru Derevenco was born on the 26th of March (8th of April according to the old calendar) 1924 in Chişinău, his mother tongue being Russian, and he died on the 9th of October 2017.

His father, Leonid Nicolaevici Derevenco, born on the 6th of August 1881 in Putineşti (Bessarabia), and his mother, Ana Petrovna Alexandrovski Derevenco, born on the 22nd of September 1886 in Chişinău, had met in Sankt Petersburg. Their connection led to the birth of his older sister - Olga - born in Livni (Ukraine) in 1919, who died hit by a car on the pedestrian crossing in 1992.

Leonid Nicolaevici Derevenco began his medical studies in Kazan (the capital of the Republic of Tatarstan, the Russian Federation). Due to the fact that he had joined an anti-tsarist socialist circle, he had to leave for Switzerland, where he studied and graduated from the Zürich Faculty of Medicine. He returned to Bessarabia in 1909, where he first became a countryside doctor. Although he had socialist convictions, a few years later he arrived in Sankt Petersburg, with the recommendation of his older brother Vladimir Nicolaevici Derevenco, who was the personal doctor of Tsarevich Alexei, who had haemophilia.

In 1949, Petru Derevenco married Vera Kohn, who died on the 2nd of December 1972 - “*a terrible shock to me*” (2). He met her during a training program as a posted worker at the Institute of Hygiene in Cluj, at the Physiology Department of the Faculty of Medicine in Cluj, led by Grigore Alexandru Benetato (Grigore Alexandru Benetato was born on the 18th of November 1905 in Ialoveni and he attended the “Alexandru Donici” high school in Chişinău. He pursued higher education at the Faculty of Medicine in Cluj and in 1929 he got his PhD in Medicine and Surgery).

After being released from the camp, in 1958, she got her PhD in physiology with the thesis “*The role of the CNS in the process of glucoregulation*”, led by Prof. Grigore Benetato MD. Then she became a consultant doctor of functional medicine in the Nuclear Medicine Department, a field where she worked and published. Her research focused on the isotope exploration of the blood flow, the thyroid and liver and on the treatment of different illnesses.

This marriage led to the birth of twins Nadia and Andrei Derevenco on the 21st of December 1950.

Nadia Derevenco emigrated to Israel in 1976 and, a

few months later, after a short stay in Paris, to the USA. There, Nadia married Greg Gorman, an American citizen, a well-known artist, who created stained glass. Now they live in Lyme Center, New Hampshire. Before emigrating, Nadia graduated from the Faculty of Chemistry in Cluj and worked in a state-of-the-art biochemistry laboratory. The Gormans have a son, Alex, who, after serious study, became a police officer.

Andrei Derevenco and his wife, Maria Dimitriu, a psychologist, emigrated to New York. With the support of his family, he managed to graduate from the Faculty of Business Administration. He was successful in his work, becoming a financial counselor for some prestigious banks.

In 1980, after the death of his first wife, Vera Kon, in 1972, Mr. Derevenco remarried to Stela Râmboiu, a Doctor of Science in Radiation Hygiene.

Stela has two daughters, Corina Cîrstea, with a PhD in Informatics at Oxford, who now teaches at Southampton University in the United Kingdom of Great Britain, and Ramona Covington – adopted, who is a research doctor at the Ohio State University, USA.

Studies (3)

- Doctor of Science in medical science (1970)
- Consultant doctor (functional medicine, 1962)
- PhD in Medicine, specialization in Physiology (1961)
- In the session of September 1944, he was admitted to the Faculty of Medicine in Sibiu/Cluj, from which he graduated in 1950
- He had his baccalaureate in June 1944 in Craiova, where the archive of the A. Russo High School in Chişinău had been evacuated. He ranked second out of approximately 90 candidates, with a 9.11 grade
- He attended the primary school in Chişinău, on Viilor street, then the “Alec Russo” High School in Chişinău – nowadays the Faculty of Philology on Puşkin street.

The main landmarks of his career (3)

- He was an honorary member of the Academy of Medical Sciences (since 1995)
- He worked in institutes of the Academy and the Ministry of Health as a scientific researcher/main researcher - 1986-1987: The role of stress in the aetiology of illnesses: the Academy of Medical Sciences, Romania, project leader: Dr. P. Derevenco
- He was a professor at the “Avram Iancu” University in Cluj-Napoca (1996-2007)
- He attended specialization and documentation programs in Italy, Czech Republic and USA and had a scholarship at the Deutscher Akademischer Austauschdienst (1972).
- He contributed works to congresses in England, Hungary, the USSR, Germany.
- He was a specialty reviewer of the magazine “Berichte über die gesamte Physiologie” by Deutsche Pharmakologische Gesellschaft; Deutsche Physiologische Gesellschaft.
- At the beginning of his activity, he had didactic functions for 6 years (tutor and assistant at the Institute of Medicine and Pharmacy in Cluj).

Scientific fields of interest

- Psychoneuroendocrine physiology, stressology, exertion and sports, ergonomics, psychosomatics.

- He continued his publishing activity and was involved in the editing of the Cluj journal *The Palestrica of the Third Millennium* and sports.

Awards and distinctions

- Honorary member of the Academy of Medical Sciences (Romania, 1996)

- The "Scientific Merit" Order (1967);

- First Prize of the Ministry of Education (1963, in collaboration: I. Baci, P. Derevenco et al. for studies on work physiology)

- The *Iuliu Hațieganu* Medal (2014, "Iuliu Hațieganu" University of Medicine and Pharmacy)

Representative work

1. "Darwin and Darwinism", 2011, Home of the Science Book Publishing, Cluj-Napoca, which explores the life and work of Darwin, from his biography to the impact of Darwinism in science and culture.

2. "Elements of physiology of the sports effort" 1998, Argonaut Publishing, Cluj

3. "Stress in health and illness", 1992 (co-writers I. Anghel and A. Băban), Dacia Publishing, Cluj – the first comprehensive monograph in the field ever printed in Romania: the 3000-copy printing was shortly sold out.

4. "The physiological bases of ergonomics", vol. I in 1984, vol. II in 1986 (co-writer I. Baci), Dacia Publishing, Cluj.

5. "Exertion and the Endocrine System", 1976, Dacia Publishing, Cluj, is probably the first book dedicated to this subject.

These books have summaries and tables of contents in English.

Book chapters

1. 2005, Influence of mental and physical stress on the cardiovascular system in rest and exertion by P. Derevenco, In *Cardiovascular pathology of athletes* (E. Gligor ed., in Romanian), Home of the Science Book Publishing, Cluj-Napoca, 48-66.

2. 1988, Some psychological features of children and youth in Romania by A. Baban, P. Derevenco, A. Coasan. In *Individual differences in children and adolescents*, (D. Saklofske, S. Eisenck eds.), Hodder & Stoughton, London, 182-194.

Works published abroad (a selection of over 40 titles)

1. 1998, Psychophysiological and behavioural characteristics related to risks for cardiovascular diseases and to occupational stress, by P. Derevenco et al., *Activitas nervosa superior* (Praha), 30, 99.

2. 1997, Cardiovascular changes during some types of occupational stress, by P. Derevenco, I. Anghel, in *Proceedings of the 13th Congress of the International Ergonomics Association*, Tampere, vol. 5, 338-340.

3. 1986, Central and peripheral effects of 6 hydroxydopamine on exercise performance in rats by P. Derevenco et al., *Psychoneuroendocrinology* (London),

11, 141-153.

4. 1980, *Beitrage zum Studium des Stress*, by P. Derevenco, I. Baci, *Activitas nervosa superior* (Praha), 22, 46-54.

5. 1971, Wirkung der akuten und der chronischen physischen Belastung sowie einiger humoralen Faktoren auf die Durchblutung von endokrinen Drüsen, by P. Derevenco et al., *Endokrinologie* (Leipzig), 57, 297-304.

6. 1969, Effort physique et effets pharmacologiques by P. Derevenco et al., *Agressologie* (Paris), 10, 127-133.

7. Einige physiologische Aspekte des Übertrainings, by P. Derevenco et al. *Sportarzt* (Köln), 4, 151-156, 1967.

8. 1966, Methode zum Provozieren von Stress by P. Derevenco et al. *Naturwissenschaften* (Heidelberg), 53, 201.

9. 1963, Modifications endocriniennes et hémodynamiques chez les jeunes sportifs by P. Derevenco and al., *Medicina dello Sport* (Torino), 10, 1118-1123.

10. 1963, Izucenie vklucenia P 32, v eritrotiti v uslviah napriajeniah, by I. Szantai, P. Derevenco et al., *Patofiziol. Experm. Terap.* (Moskva), 5, 53-55.

11. 1962, Ergebnisse experimenteller Untersuchungen über die Ausscheidung von ACTH bei physischer Anstrengung, by V. Derevenco, P. Derevenco, *Endokrinologie* (Leipzig), 42, 172-180.

Works published in Romania (selections regarding stress from a total of over 200 works)

1. 2006, Romanian scientific progress in international stress research and stress-aging medicine, by P. Derevenco, *Physiology, Official Journal of the Romanian Society of Physiological Sciences*; vol. 16, no. 1 (49).

2. 2004, The physiological activity of the hypothalamo-pituitary-adrenocortical axis during physical exercise, by P. Derevenco (in Romanian), *Palestrica of the Third Millennium*, V (15), 20-25.

3. 2001, Aspects of posttraumatic stress in Romania, by P. Derevenco, *Cognitie, Creier, Comportament, Fiziologie*, Official Journal of the Romanian Society of Physiological Sciences. 5 (1), 29-34.

4. 2001, Psychosomatic disorders and stress syndromes: outcomes for the sport medicine, (in Romanian), by R. Nechita-Derevenco, P. Derevenco, *Palestrica of the Third Millennium* (5), 42-50.

5. 2000, Stress assessment by means of questionnaires, by P. Derevenco et al., *Physiology, Official Journal of the Romanian Society of Physiological Sciences*, 37, 39-49.

6. 2000, Psychological and medical consequences of Holocaust on its survivors, by P. Derevenco, *Cognition, Brain, Behaviour, Physiology, Official Journal of the Romanian Society of Physiological Sciences* 8 (1), 75-79.

7. 1998, Newer issues on the topics of stress and of exercise physiology by P. Derevenco, R. Nechita-Derevenco, *Physiology, Official Journal of the Romanian Society of Physiological Sciences*, 35, 237-246.

8. 1997, Immunity and stress by P. Derevenco, *Physiology, Official Journal of the Romanian Society of Physiological Sciences*, 34, 83-93.

9. 1996, Romanian contribution to stress research by P. Derevenco, *Physiology, Official Journal of the Romanian Society of Physiological Sciences*, 33, 101-112.

10. 1993, Post-traumatic stress disorders; psycho-physiological and medical aspects, by P. Derevenco et al., *Physiology, Official Journal of the Romanian Society of Physiological Sciences.*, 30, 199-206.

11. 1989, Towards an interdisciplinary analysis of stress, by P. Derevenco, *Physiology, Official Journal of the Romanian Society of Physiological Sciences*, 26, 183-188.

12. 1987, A survey of half a century of international stress research in Romania, by P. Derevenco, *Physiology, Official Journal of the Romanian Society of Physiological Sciences.*, 33, 327-334.

13. 1986, Some specific features of exercise stress in athletes, by P. Derevenco et al., *Physiology, Official Journal of the Romanian Society of Physiological Sciences.*, 23, 107-114.

14. 1976, The influence of moderate hyperbaric environment on some nervous functions and on the sympatho-adrenal and adreno-cortical activity in man by P. Derevenco et al., *Physiology, Official Journal of the Romanian Society Of Physiological Sciences.* 13, 175-180.

The summaries and oral presentations performed

at different scientific meetings in London, Prague, Magdeburg, Dresden, Moscow, Padova, Chişinău, Paris, Budapest since 1972 are not mentioned.

References on Petru Derevenco

Fornade V., 2007, "Personalities from Cluj" (1800-2007), Home of the Science Book Publishing, Cluj-Napoca, p. 183-184.

Marin F., 2004, Faculty of Medicine, Cluj Medical School and Cluj Hospitals, Home of the Science Book Publishing, Cluj-Napoca. pp. 701-703.

Ursea N., 2001, "Romanian Medical Encyclopaedia", Twentieth Century, "Carol Davila" University of Medicine and Pharmacy, the Romanian Kidney Foundation, Bucharest, pp. 480.

Riga S, Riga D., 2008, "Stressology, adaptology and mental health", University Book Publishing Bucharest.

References

- (1) Petru Derevenco - memoir indicators - manuscript
- (2) Friendly discussions (sometimes registered, other times an opportunity to meditate and reflect)
- (3) Petru Derevenco - Curriculum Vitae

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 sections are: “Original studies” and “Reviews”.

Regarding “Reviews”, the main subjects that are presented are: oxidative stress in physical effort; mental training; psychoneuroendocrinology of sport effort; physical culture in the practice of family doctors; extreme sports and risks; emotional determinants of performance; 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 sports 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 research, we are particularly interested in the following: methodology in physical education and sport; influence of some ions on effort capacity; psychological profiles of students regarding physical education; methodology in sport gymnastics; 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 sections are doctors, professors and educators from university and pre-university education, trainers, scientific researchers etc.

Other sections of the journal are: the editorial, editorial news, reviews of the latest books in the field and others that are rarely presented (inventions and innovations, university and pre-university programs, forum, memories, competition calendar, portraits, scientific events).

We highlight the section “The memory of the photographic eye”, where photos, some of which extremely 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, the variability of 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 in the achievement of necessary scores by the teaching staff in university and pre-university education, as well as by doctors in the medical network (through recognition of the journal by the Romanian College of Physicians), regarding didactic and professional promotion.

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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).

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- 5000-6000 words for review articles.

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Font: Times New Roman, size 11 pt.; it should be edited on a full page, with diacritical marks, double spaced, with equal margins of 2 cm.

Illustrations:

The images (graphics, photos, etc.) should be numbered consecutively in the text, with Arabic numerals. They should be edited with EXCEL or SPSS programs, and sent as distinct files: “figure 1.tif”, “figure 2. jpg”, to the editors. Every graphic should have a legend, written under the image.

The tables should be numbered consecutively in the text, with Roman numerals, and sent as distinct files, accompanied by a legend that will be placed above the table.

PREPARATION OF THE ARTICLES

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

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

Orientation articles and case studies should have an unstructured summary (without respecting the structure of experimental articles) up 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 information), Results, Discussing results, Conclusions and suggestions. Other types of articles, such as orientation articles, case studies, editorials, do not have an obligatory format. Excessive abbreviations are not recommended. The first time an abbreviation is used in the text, it should follow the term *in extenso*, being placed in parentheses, and thereafter the short form should be used.

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

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The bibliography should include the following data:

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

Articles: Carlos S, de Irala J, Hanley M, Martínez-González MÁ. The use of expensive technologies instead of simple, sound and effective lifestyle interventions: a perpetual delusion. See comment in PubMed Commons below 2014;68(9):897-904. doi:10.1136/jech-2014-203884.

Books: Fox SI. Human Physiology. Twelfth Ed. Publ MCGraw Hill. New York, 2011,403-470.

Chapters from books: Sternfeld B, Lee IM. Physical activity and cancer: the evidence, the issues and the challenges. In: Lee IM, Eds. Physical Activity and Health Epidemiologic Methods and Studies. New York: Oxford University Press, 2009.

Starting with issue 4/2010, every article should include a minimum of 15 and a maximum of 100 bibliographic references, mostly journal 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 the recent international literature (not older than 10 years).

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- 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.

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

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