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## ORIGINAL STUDIES

# The effect of paliperidone treatment and exercise on the memory and learning ability in experimental depression

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### Abstract

**Background.** Depression is a mental disorder characterized by pervasive low mood and loss of pleasure or interest in usual activities, which induces cognitive, especially memory and learning dysfunctions.

**Aims.** We aimed to study neurobehavioral changes in depressed animals, based on the effects of paliperidone and exercise on the motor memory and learning ability.

**Methods.** The research was conducted in 4 groups of animals, divided as follows: group I – control animals, group II – animals with reserpine-induced depression, group III – animals with reserpine-induced depression and paliperidone administration, group IV – animals with reserpine-induced depression, paliperidone administration and exercise.

**Results.** Long-term paliperidone treatment alone and associated with exercise has favorable effects on the learning ability of depressed animals at T<sub>30</sub> compared to controls and compared to values at T<sub>14</sub>. Paliperidone treatment associated or not with exercise has an unfavorable influence on the memory ability of depressed animals at T<sub>14</sub> and T<sub>30</sub>.

**Conclusions.** Exercise has favorable effects on the learning ability of depressed animals treated with an atypical antipsychotic.

**Key words:** depression, reserpine, paliperidone, Morris test, exercise.

## Introduction

Depression is a mental disorder characterized by pervasive low mood and loss of pleasure or interest in usual activities, which induces cognitive, especially memory and learning dysfunctions.

A series of preclinical and clinical studies have suggested the favorable effect of co-treatment with atypical antipsychotics and antidepressants in drug-resistant depression.

Our previous research on reserpine-induced experimental depression in rats evidenced a decrease in the locomotor activity of sedentary animals based on the open field test. The use of paliperidone – an atypical antipsychotic – in sedentary depressed animals also induced a decrease in locomotor activity. Exercise in depressed animals treated with paliperidone has favorable effects on locomotor activity (Manea et al., 2019).

## Objectives

We aimed to study neurobehavioral changes in depressed animals, based on the effects of paliperidone and exercise on the motor memory and learning ability.

## Hypothesis

The use of atypical antipsychotics to enhance pharmacological treatment in depression and the favorable effect of exercise in the kinesiotherapeutic treatment of depression led us to study the effect of pharmacological (paliperidone) and physical co-treatment on the motor memory and learning ability in experimental depression.

## Material and methods

The studies were conducted in the Experimental Research Laboratory of the Physiology Department of “Iuliu Haieganu” University of Medicine and Pharmacy

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Cluj-Napoca, with the approval of the Bioethics Committee and the Sanitary Veterinary Authority Cluj-Napoca regarding the protection of animals used for experimental and scientific purposes.

#### Research protocol

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

The studies were performed on white male Wistar rats, aged 4 months, with a weight of 200-250 g, from the animal facility of the "Iuliu Haieganu" University of Medicine and Pharmacy Cluj-Napoca. Throughout the duration of the research, 1 October - 30 November 2018, the animals were kept under adequate *vivarium* conditions: temperature, humidity, lighting, feeding and hydration. At the end of the experiment, the animals were euthanized with ketamine. The duration of the experiment was 30 days.

##### b) Subjects and groups

The animals were assigned to four groups (G) (n = 10 animals/group), as follows:

- G I – control animals, which were administered 5 ml/kg body weight/24 h physiological serum for 14 days
- G II – animals with depression induced by reserpine (DIR), 1 mg/kg body weight/24 h, administered intraperitoneally for 14 days
- G III - animals with DIR and paliperidone, 0.5 mg/kg body weight/24 h, administered intraperitoneally for 14 days, after induction of depression
- G IV – animals with DIR, paliperidone administration and exercise training by the swimming test, for 14 days

##### c) Tests applied

The research calendar, by objectives, days and tests applied, included:

- induction of depression  $T_0$ - $T_{14}$  by reserpine (the preparation used was Reserpinum, Sigma) (Arora & Chopra, 2013; Ruiz et al., 2018)
- control of depression  $T_{11}$  based on the tail suspension test, for antidepressant activity - TST (Steru et al., 1985)
- treatment program  $T_{15}$ - $T_{30}$  with paliperidone administration (the preparation used was Invega<sup>R</sup>, Janssen-Cilag SpA, Italy)
- treatment program  $T_{15}$ - $T_{30}$  with paliperidone and exercise by the swimming test, according to Nayanatara et al., 2005, one hour daily
- The Morris Water Maze Test (MWM) (1981) was used for spatial learning and memory based on water navigation. The learning and control values, expressed in seconds, indicate the learning and memory ability. The time points analyzed were days 0- $T_0$ , 14- $T_{14}$  and 30- $T_{30}$ .

##### d) Statistical processing

Statistical analysis was performed with StatsDirect v.2.7.2 software. The results were graphically represented using Excel application (Microsoft Office 2010).

## Results

The statistical analysis of the *Morris test values* (Table I, Fig. 1) showed the following:

- taking into consideration the 3 groups of rats studied in the learning period
  - at time  $T_{14}$  – very statistically significant differences between at least two of the groups ( $p < 0.01$ )
  - at time  $T_{30}$  – highly statistically significant differences

between at least two of the groups ( $p < 0.001$ )

- taking into consideration the 3 groups of rats studied in the control period

- at times  $T_{14}$  and  $T_{30}$  – highly statistically significant differences between at least two of the groups ( $p < 0.001$ )

The statistical analysis of the Morris test values in the learning period showed the following for *unpaired samples*:

- at time  $T_{14}$  – highly statistically significant differences between groups I-II, I-III and I-IV ( $p < 0.001$ ), very statistically significant differences between groups II-III ( $p < 0.01$ ) and statistically significant differences between groups III-IV ( $p < 0.05$ )
- at time  $T_{30}$  – highly statistically significant differences between groups I-II, I-III, I-IV, II-III, II-IV and III-IV ( $p < 0.001$ )

The statistical analysis of the Morris test values in the control period showed the following for *unpaired samples*:

- at time  $T_{14}$  - highly statistically significant differences between groups I-II, I-III, I-IV, II-III and II-IV ( $p < 0.001$ )
- at time  $T_{30}$  - highly statistically significant differences between groups I-II, I-III, I-IV, II-IV and III-IV ( $p < 0.001$ ) and very statistically significant differences between groups II-III ( $p < 0.01$ )

The statistical analysis of the Morris test values showed for *paired samples between  $T_{14}$ - $T_{30}$*  – in the learning period, highly statistically significant differences for groups III and IV ( $p < 0.001$ ), and in the control period, highly statistically significant differences for groups III and IV ( $p < 0.001$ ) and statistically significant differences for group II ( $p < 0.01$ ).

The statistical analysis of the Morris test values showed the following for *paired samples between the learning period and the control period*:

- for group I – highly statistically significant differences ( $p < 0.001$ )
- for group II – very statistically significant differences ( $p < 0.01$ ) at times  $T_{14}$  and  $T_{30}$
- for groups III and IV – highly statistically significant differences ( $p < 0.001$ ) at times  $T_{14}$  and  $T_{30}$

## Discussions

The MWM test was used by many authors, who found in experimental depressed rat models an activation and an improvement of the learning ability and cognitive skills after treatment with/administration of:

- antidepressants such as Dormicum, Valdoxan and Cipralex (Puiu, 2014);
- mesoporous hydroxyapatite olanzapine (Shyong et al., 2017);
- non-steroidal anti-inflammatory drugs (Perveen et al., 2018);
- banana fruit pulp and peel extract (Samad et al., 2017);
- n-3 polyunsaturated fatty acid (Pérez et al., 2018);
- helicid (Li et al., 2019);
- liraglutide and sitagliptin (Kamble et al., 2016).

Other experimental studies showed the unfavorable effect of some agents on the cognitive functions tested by MWM in depression:

- blue light filtered white light (Meng et al., 2018);
- the lithium-pilocarpine model (Vrinda et al., 2017;

Table I

Comparative analysis of the Morris test values in the studied groups and statistical significance.

Time		Group	Mean	SE	Median	SD	Min	Max	Statistical significance (p)							
Learning	T0	I	262.56	3.439	262.33	10.875	242.92	281.83	Learning	T14	II-III-IV	0.0022	CTRL	T14	II-III-IV	< 0.0001
		II	372.63	2.326	371.75	7.356	361.25	383.92		T30	< 0.0001	T30		< 0.0001		
	T14	III	387.58	3.578	387.96	11.315	375.08	408.08		T14	I-II	< 0.0001		T14	I-II	< 0.0001
		IV	375.43	2.513	377.79	7.948	359.58	384.00			I-III	< 0.0001			I-III	< 0.0001
	T30	II	376.27	3.376	376.88	10.676	352.83	388.58			I-IV	< 0.0001			I-IV	< 0.0001
		III	297.83	2.779	299.42	8.789	285.83	312.50			II-III	0.0026			II-III	< 0.0001
		IV	317.73	2.170	317.13	6.861	303.33	328.33			II-IV	0.4243			II-IV	< 0.0001
											III-IV	0.0124			III-IV	0.4327
CTRL	T0	I	85.43	2.384	88.00	7.539	74.00	98.33	Learning-CTRL	T30	I-II	< 0.0001	T30	I-II	< 0.0001	
		II	22.90	0.965	22.33	3.051	20.33	31.00			I-III	< 0.0001		I-III	< 0.0001	
	T14	III	12.97	0.612	12.67	1.934	10.67	17.33			I-IV	< 0.0001		I-IV	< 0.0001	
		IV	13.60	0.499	13.33	1.578	11.33	16.00			II-III	< 0.0001		II-III	0.0016	
	T30	II	15.07	0.730	14.33	2.308	12.67	21.00			II-IV	< 0.0001		II-IV	< 0.0001	
		III	18.13	0.362	18.17	1.146	16.00	19.67			III-IV	< 0.0001		III-IV	< 0.0001	
		IV	21.97	0.308	21.83	0.974	20.33	23.67								
T14-T30			Learning			CTRL			Learning-CTRL	T0	T14			T30		
			II	III	IV	II	III	IV		I	II	III	IV	II	III	IV
			0.4786	< 0.0001	< 0.0001	0.002	0.0002	< 0.0001		< 0.0001	< 0.0001	0.002	< 0.0001	< 0.0001	0.002	< 0.0001

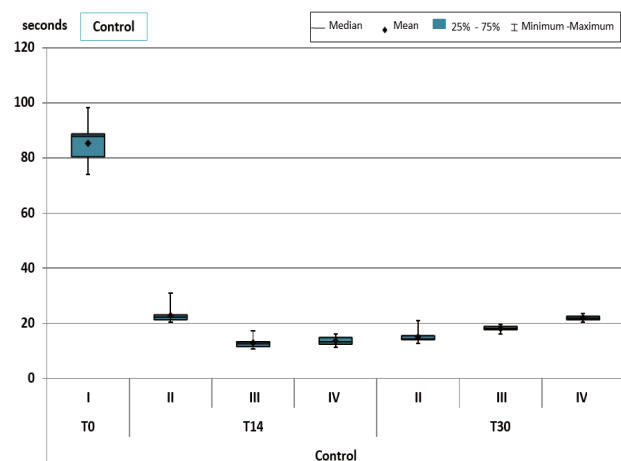
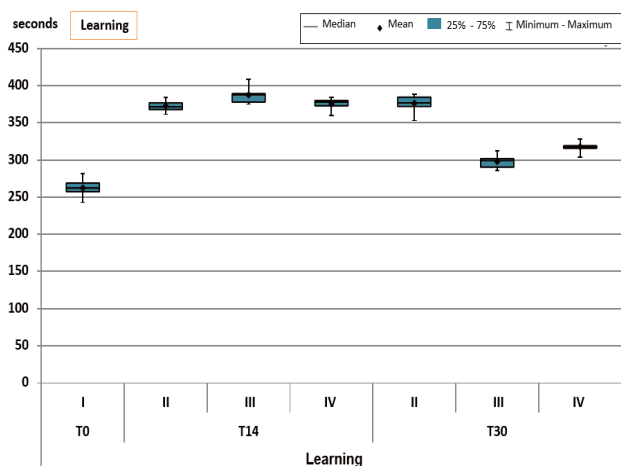


Fig. 1 – The Morris test in the studied groups.

Kalemenev et al., 2015);

- electroconvulsive shock (Chen et al., 2018; Ren et al., 2016).

Our learning assessment results indicate a significant decrease in the learning ability of all groups at  $T_{14}$  and a significant increase at  $T_{30}$  compared to control values and  $T_0$ .

Learning control for memory assessment indicates a significant decrease at  $T_{14}$  and  $T_{30}$  compared to initial values at  $T_0$  and control values in all groups.

## Conclusions

1. Long-duration paliperidone treatment alone and associated with exercise has favorable effects on the learning ability of depressed animals at  $T_{30}$  compared to controls and compared to values at  $T_{14}$ .

2. Paliperidone treatment associated or not with

exercise has an unfavorable influence on the memory ability of depressed animals at  $T_{14}$  and  $T_{30}$ .

## Conflicts of interest

There are no conflicts of interest.

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## Analyzing the attack players in volleyball through statistical methods

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### Abstract

**Background.** Volleyball has developed into one of the fastest, strongest and spectacular sports nowadays, improving the speed of the game, strength of attacks and long rallies with a good defence technique. Statistics are often used for an objective analysis of volleyball parameters, coaches seeking to improve weaker aspects of the game and find new ways of training.

**Aims.** The aim of the study was to calculate the effectiveness of all the attack players distributed in three positions, in the case of the CSU Medicina Tîrgu Mureş team, during the 2016-2017 National Volleyball Championship.

**Methods.** Following our objective, we determined the quintiles and divided the value range of effectiveness: round 1-22 into five parts, with 5 grades from 1 to 5. The analysis of the relationship between the two variables and the intensity of this relationship was calculated with the Spearman rho r correlation coefficient.

**Results.** For service in the first part of the championship, we registered the average score of 2.8 points, whereas in the second part the score was 3.2 points. As far as attack was concerned, in the first part of the championship the average score was 3 points compared with 2.4 points in the second part. The 3.5 points average in receiving was better in the first part of the championship than the 3 points in the second part.

**Conclusions.** The data provided by us are important, but not exclusively as a support for training; the athletes' level of training and the way they interact with the court remain a determining factor in winning games.

**Key words:** volleyball, sports performance, training, athletes, attack.

### Introduction

Starting from the premise that “the evolution of contemporary society generates quantitative growth and unprecedented qualitative development in all fields, including performance sports, direct training for competition requires the setting of objectives that will maximise the capacity to mobilise the biological, motor and psychological potential of the athlete” (Teodorescu, 2009a) through exploitation of the current level of knowledge in the field. This explains why “the level attained today by the development of sports practice, like any activity with interdisciplinary characteristics, is permanently subject to alert dynamics, leaving behind the techniques and means used in training because they no longer correspond today to the demands of high performance in sport.” (Simion et al., 2011).

All the knowledge that ensures the best results in large-scale competitions, based on a logical organisation of the

training process and its corresponding structure, in the form of stages, periods, different cycles, can be brought together in the general theory of training periodization (Platonov, 2015), according to which the periodization of performance and high-performance sports training requires a division of the modern training process into elements with separate structures, which differ qualitatively and quantitatively under the existing principles and laws.

Sports performance as a way of valuing and asserting the human personality through the exceptional situations that it creates demands and emphasizes the high level of perfection attained by athletes (Teodorescu, 2009b), while competition develops the latent resources, highlighting the skills, spontaneity, creativity, and aesthetics. Performance in collective sports is mirrored by a series of inter-relational components, in the middle of a complex universe where there is a variety of phenomena expressed through general and specific systemic relationships that act synergistically to achieve sporting performances.

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In general, volleyball players have a body height which is higher than average, a slim shape, endurance, power, and the skill of jumping (Malousaris et al., 2008; Carvajal et al., 2012). It has been determined that being successful in volleyball is directly related to power (vertical jump), which is one of the basic motor functions, to speed, flexibility and a low body fat percentage (Imek et al., 2007; Ivanovic, 2009; Koç & Aslan, 2010; Con et al., 2012).

In a volleyball match, the attack may occur either from receiving the service or from a counterattack. These two components have been differentiated to gain access to new and more detailed information (total number of attacks = number of attacks from receiving + number of counterattacks). The game of volleyball, relatively simple, once, by training players and multilateral actions, speed of the game, has gained widespread popularity and is being increasingly accepted by the audience (Cojocar & Cojocar, 2018).

Some authors (Zetou et al., 2007) argued that attacks present an increased efficiency in situations of starting from service.

Attack is the component which is the most used and efficient in the game to gain points; it is also the most common element of the match. Therefore, if it is possible to increase the effectiveness of a point by counterattack or attack after receiving the service, then the probability of winning also increases.

If a team is effective in attacking from receiving the service, then it can keep a balanced score to continue playing. By adding an effective counterattack, this team will most certainly ensure the conditions to win the match, as it can score points after an attack in a counterattack situation.

There are, however, two non-complete elements distinguished as failure-related differentiation variables: receiving from service error and error from setting the ball. In volleyball, points can only derive from finalization skills (for example, service, attack, blocking), but all previous abilities influence the final decision and therefore the result of the match. The role of information technology in our lives must not be neglected; electronic devices are very useful in nowadays sports performance, as many scientific papers prove it (Szabo et al., 2019a).

## Material and methods

### *Period and place of the research*

The research was conducted at the “George Emil Palade” University of Medicine, Pharmacy, Science, and Technology of Târgu Mureș, during the first and second part of the 2016-2017 National Volleyball Championship, and it was performed under the Declaration of Helsinki (2013). It also met the ethical standards for Sport and Exercise Science Research (Harriss & Atkinson, 2013).

### *Subjects and groups*

The subjects of our investigation were all the attack players distributed in three positions; 6 players were analyzed in the case of the CSU Medicina Târgu Mureș team, during the 2016-2017 National Volleyball Championship.

### *Test applied*

The analysis of the relationship between the two variables and the intensity of this relationship was

calculated with the Spearman rho  $r$  correlation coefficient. This is a number between -1 and 1, as  $r$  approaches 1 in absolute value; the greater the linear relationship intensity between 2 variables, the stronger the link. If the coefficient is a minus, there is a negative correlation, so a variable increases and the other decreases, and if the coefficient is a plus, the correlation is positive, so both variables grow. The following are empirical rules for interpreting the correlation coefficient:

- $r$  ranging from -0.25 to 0.25: poor or null correlation;
- $r$  ranging from 0.25 to 0.50 or between -0.25 and -0.50: acceptable correlation;
- $r$  ranging from 0.50 to 0.75 or between -0.50 and -0.75: moderate to good correlation;
- $r$  higher than 0.75 or lower than -0.75: very good correlation.

This link was graphically represented with the scatter diagram of dispersion, which by the orientation and dispersion of the cloud point provides an image of the relationship between the two variables.

To make these correlations, we used the following encoding: a score of 3-0 was coded with 3 (3 minus 0), a score of 3-1 was coded with 2 (3 minus 1), a score of 3-2 was coded with 1 (3 minus 2). We considered a clear victory 3-0 to be coded with a high number and a close victory 3-2 with a smaller number. These correlations were made for the matches won. A correlation was established between the efficiency of a particular position/technical parameter and the result.

However, a poor and statistically insignificant correlation has to be pointed out: the two players in this position did not have a spectacular contribution to winning.

Based on the effectiveness of all the players distributed in the three positions, over the 22 rounds of the championship, we could calculate the quintiles (by dividing the value range of effectiveness: round 1-22 into five parts), 5 grades from 1 to 5. The table below summarises the efficiency of the three positions. For each player, we calculated a median of efficiency over the 22 rounds (Table I and II).

Interpretation: if a player at the service parameter has a median of 55 (for player IV), then he fits between the 60th percentile and the 80th percentile, so he has grade 4. We can also calculate the player's mark by rounds, rank the effectiveness of the player in the round pursued according to the percentiles in the table, and so the corresponding score can be highlighted. Based on this table, the score for each player can be seen below.

### *Statistical processing*

For statistical analysis, Click & Scout software for volleyball was used, based on the match report file in all the championship games, over 22 rounds (1); (Szabo, 2016; Szabo & Sopa, 2015; Szabo et al., 2019a).

In the first stage, all the data files from Click&Scout software were extracted and the effectiveness of the attack players for the technical components attack, receiving and service was computed.

Keeping in mind that one aim of this study was to highlight the difference between efficiency in the first round and the second round of the tournament (Table I and II), we applied the statistical Z test. Great differences between the first and the second rounds were considered as statistical significance expressed by the p-value.

## Results

Comparative analysis of attack player performances

*Opposite* - Player IV and *TS* - After service and attack parameter

Regarding the evolution of player IV, at service and in attack during the 22 rounds, it can be concluded that:

- at service, the player had a high efficiency curve in rounds 6, 7 and 16, and a reduced efficiency in round 20;
- in attack, efficiency was high in rounds 1, 8, 15, and 21, and low in round 20.

*Player TS* had the following results:

- high efficiency at service in rounds 11, 15, and 18, and reduced efficiency in round 13, 14, and 20;
- in attack, efficiency was high in rounds 1, 8, 15, and 21, whereas low values were recorded for rounds 2, 14, and 22.

*Middle blockers* - Players *LU* and *IA* - after service and attack:

*Player LU*

At service, the player had a high efficiency in rounds 1, 4 and 13, and a low efficiency in rounds 3, 6, 7, and 15. In attack, the effectiveness of the executions was high in rounds 1, 3, 5, and 19, while low values were recorded in rounds 13, 15, and 17.

*Player IA*

At service, this player had a high efficiency in rounds 4, 17, and 21, and a low efficiency in rounds 6, 20, and 22. In attack, the player scored high in rounds 4, 15, 19, and 21, and low in rounds 10, 14, and 18.

*Outside hitters* - Players *TR* and *RA* - After service, receiving, and attack:

*Player TR*

At service, player TR achieved a high efficiency in rounds 11, 15, and 22, and a low efficiency in rounds 7 and 14. Effective receiving was recorded in rounds 3, 6, 12, and 17, and reduced efficiency was registered in rounds 15 and 18.

In attack, effectiveness was high in rounds 1 and 5, while it had low values in rounds 4, 14, and 18.

*Player RA*

At service, the player had a high efficiency in rounds 3, 6 and, 14, and a reduced efficiency in rounds 5 and 20.

During receiving, high efficiency indices were recorded in rounds 1, 8, and 20, and low values were found in rounds 9 and 12.

Regarding the attack, efficiency was high in rounds 1 and 3, and it was low in rounds 14 and 16.

**Table I**  
Example of ranking grades identified for efficiency in the first part – the second part

Parameters	E service	E receiving	E attack	Score-grade
Number of values	177	122	169	
Minimum	11.00	13.00	3.00	
20% percentile	33.00	50.00	19.00	1
40% percentile	40.20	57.00	29.00	2
60% percentile	47.00	65.00	38.00	3
80% percentile	55.40	75.00	59.00	4
Maximum	100.0	100.0	100.0	5
Mean	45.41	62.53	39.02	
Std. deviation	17.12	18.55	24.56	
Median	44.00	62.00	33.00	

Table I presents the efficiency score interval for each technical item. For example, if a player had an efficiency of 59 at service, his mark is 5 because it ranges between 55.40 and 100.

## Discussions

In recent years, as shown during the European Championships and the World Championships, there has been an increase in the topspin jumping service in both male and female volleyball games (Agelonidis, 2004). The increase is due to the use of this type of service which aims to improve performance by power and speed. Increasing the number of players performing this kind of service in competitions has determined the need to increase the volume of training for its accurate reception. Due to the physical requirements needed to carry out the topspin jump service, the use of service machines during training has become standard practice as they enable specific training for this type of receiving with no physical overload of players (Palao & Valadés, 2014). Most of the volleyball studies focus on the skills that determine the serve, the block, and the attack, and how these skills are the most

**Table II**

Ranking grades identified based on efficiency in the first and the second parts

Play.	Position	Service				Receiving				Attack			
		FP	Grade	SP	Grade	FP	Grade	SP	Grade	FP	Grade	SP	Grade
BA	Outside hitter	40	2	50	4								
TR	Outside hitter	33	2	45	3	70	4	59	3	20	2	21	2
RA	Outside hitter	47	4	44	3	61	3	57	3	21	2	19	2
IA	Middle block	47	4	42	3					38	4	32	3
LU	Middle block	41	3	39	2					44	4	33	3
PE	Middle block	40	2	52	4					67	5	26	2
TS	Opposite	50	4	46	3					23	2	25	2
IV	Opposite	38	2	53	4					23	2	34	3
Average of the grades		42	2.8	46.3	3.2	65.5	3.5	58	3	33.7	3	27.1	2.4

important ones for the team in winning the match (Marques, 2015; Oliveira, 2016). Some scientific papers discovered a statistical influence of sports on preventing deficiencies (Szabo et al., 2019b).

According to a recent study from 2014, the characteristics of service in males are: service from foot (7.1% of all services) performed at a speed of 42.0-55.0 km/h, the float jump service (40.7% of all services) performed at a speed of 40.0-75.0 km/h, and the topspin jump service (52.2% of all services) conducted at a speed of 73.0-104.0 km/h. The service features in the female game are: service from foot (45.9% of all services) performed at a speed of 43.0-61.0 km/h, the float jump service (37.5% of all services) at a speed of 40.0-61.0 km/h, and the topspin jump service (16.6% of all services) carried out at a speed of 66.0-89.0 km/h (Palao & Valadés, 2014). For women's volleyball, the effectiveness of service is higher due to: a lower net height; a lower capacity of the parameters of force and slower movement parameters on the court (\*\*\*, 2012).

Receiving, service and defense in volleyball literature are considered to be very important in winning a game (Sánchez et al., 2015). Volleyball research has determined the relationship between reception, set, and attack (Costa et al., 2017; Rocha & Barbanti, 2004). Good reception causes a good set and the attack can be more successful (Marques, 2018). Other volleyball skills of importance during the match have been determined in volleyball literature; a good block is important for successful defense (Mesquita et al., 2013).

On court, technical skills are highly sought after although they require a continuous reassessment of the playing situation, as each game is influenced by the previous games and in turn influences the future games (Durkovic et al., 2008).

Volleyball match analysis has focused on the importance of team success and failure (Drikos et al., 2009). Some studies have concentrated on the receiving area associated with its variables, attack, and gaining the point from receiving the service (Amasay, 2008). These studies have shown that fixation of the receiving area determines the quality of the action both regarding the correlation between the efficacy of the receiving and the attack area, and the relationship between the moment and the effect of the attack and the number of players blocking the ball. However, these studies do not refer to the variables of the setter position.

## Conclusions

1. The analysis of the tactical behavior of the players of the CSU Medicina Tîrgu Mure volleyball team highlighted the following aspects: service

2. The scores calculated based on the efficiency of the execution achieved by the players during service show that an average score of 2.8 points was registered in the first part of the championship and 3.2 points in the second part, which allows us to state that service was the only technical element with better results in the second part of the championship.

3. An analysis of the attack in the 22 rounds of the championship reveals the lack of efficiency of technical and tactical attack actions: in the first part of the championship

the average score was 3 points compared with 2.4 points in the second part, as this technical element correlates with winning.

4. Receiving was the best performed technical element in this championship, as evidenced by the scores gained (the 3.5 points average was better in the first part of the championship than the 3 points in the second part), the libero and the outside hitter players performing their full duties.

## Conflicts of interest

There are no conflicts of interest.

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## The effects of resveratrol and quercetin administration in experimental pleural inflammation

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### Abstract

**Background.** Pulmonary diseases associated with inflammation are largely found in humans. The lungs are continuously exposed to oxidative stress, a process that, through the release of reactive oxygen species, leads to tissue damage and to an increase in the initial inflammatory reaction. Therefore, it is necessary to find a therapy that is able to counteract the noxious effects of reactive species and of inflammation. Resveratrol is a natural polyphenol with anti-inflammatory effects, having the capacity to limit the production of pro-inflammatory factors such as interleukins and prostaglandins. Quercetin, a flavonoid with known anti-inflammatory and antioxidant effects, inhibits phospholipase A2 and the enzymes of lipid peroxidation, reducing the synthesis of leukotrienes.

**Aims.** The antioxidant effects of resveratrol and quercetin were studied in an experimental model of carrageenan-induced pleural inflammation.

**Methods.** The study was performed using male rats, divided into 2 groups, each group containing a further 4 groups (control, administration of carrageenan, resveratrol and carrageenan, and quercetin and carrageenan, respectively). The oxidant/antioxidant balance was evaluated in the serum and in the lung tissue at 4 hours (groups I-IV) and at 24 hours (groups V-VIII).

**Results.** In serum, at 4 and at 24 hours after carrageenan administration, the malondialdehyde levels were decreased significantly by resveratrol and quercetin, and the ceruloplasmin concentration in the rats that were pre-treated with these chemicals was increased significantly, in comparison with the control and carrageenan groups. In lung homogenate, at 4 and at 24 hours, significant decreases of malondialdehyde in the groups that received antioxidants were recorded, compared to unprotected groups; increases of glutathione levels were recorded at 24 hours only in the resveratrol group.

**Conclusions.** In serum, both compounds, resveratrol and quercetin, presented antioxidant effects. In the lungs, at 24 hours, resveratrol had superior antioxidant effects.

**Keywords:** pleural inflammation, oxidative stress, carrageenan, resveratrol, quercetin.

### Introduction

Inflammatory lung diseases are very common in the human population. Inflammation represents a nonspecific local response, as a defence mechanism of the body, triggered by different agents: chemical (toxic substances), biological (bacteria, viruses, parasites), physical (ionizing radiation, thermal variations, trauma) and immunological factors (\*\*\*, 2019). During inflammation, several processes occur: local vasodilation with the increase of blood flow, increased capillary permeability, plasma extravasation into the interstitial space with fluid and protein accumulation, granulocyte and monocyte migration into the tissue, and

cellular oedema in the lesion area.

Oxidative stress (OS) can be defined as a disequilibrium between oxidative substances and antioxidants, in favour of oxidative substances, leading to tissue destruction. The lungs are primarily exposed to OS caused by reactive oxygen species (ROS). In the lungs, ROS determine the amplification of the initial inflammatory-immune reaction through the mediators and the products of unsaturated free fatty acid peroxidation, and also through the concomitant destruction of the vessels' endothelium, with hyperpermeability and interstitial oedema (Genestra, 2007). Therefore, it is necessary to find a treatment that can counteract the noxious effects of free radicals and

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inflammation. Antioxidants are endogenous or exogenous substances that protect the biological systems against the destructive action of ROS, inhibiting enzymatic reactions, blocking the synthesis of inflammatory mediators, or eliminating the products of excessive oxidation.

Resveratrol, a natural polyphenol identified in grapes, berries or nuts, has anti-inflammatory effects, limiting the release of pro-inflammatory factors (interleukins or prostaglandins), reducing chemotaxis and immune cell recruitment at the inflammation site (Lançon et al., 2016). Resveratrol inhibits the synthesis of: eicosanoids, activator protein-1 (AP-1), cyclooxygenases (COX-1, COX-2) and nuclear factor kappa-light-chain-enhancer of activated B cells (NF- $\kappa$ B) (Das and Das, 2007). Resveratrol has protective effects in respiratory diseases such as acute pulmonary lesions, asthma, chronic obstructive pulmonary disease (COPD) and pulmonary fibrosis (Conte et al., 2015). This polyphenol also has antioxidant potential through three mechanisms: competition with coenzyme Q in the decrease of oxidative chain complex activity (the mechanism that generates ROS), removal of reactive oxygen species synthesized in mitochondria, and inhibition of lipid peroxidase (de la Lastra and Villegas, 2005).

Quercetin, part of a group of pigments named flavonoids, produces the colour of many fruits, flowers and vegetables. Food sources with a high content of flavonoids include: citrus fruits, onion, parsley, berries, green tea and red wine. Quercetin has anti-inflammatory, antioxidant, anti-allergic, antiviral and anti-carcinogenic effects (Middleton et al., 2000). It inhibits the metabolism of eicosanoids acting directly on the enzymatic cascades: phospholipase A<sub>2</sub> and lipid peroxidation enzymes are inhibited, and the synthesis of leukotrienes is reduced (LT).

Carrageenan, a high molecular weight sulphated polysaccharide, extracted from red seaweeds, has been largely used over the last decade in studies performed in animals. Carrageenan may induce acute inflammation, and many models of inflammation were developed to test the efficiency of anti-inflammatory drugs (Duarte et al., 2016).

## Objectives

The present research studied the antioxidant effects of resveratrol and quercetin on a carrageenan-induced pleural inflammation model.

## Material and methods

### a. Place of the research

The research was performed in the Experimental Research Laboratory of the Physiology Department, at "Iuliu Haieganu" University of Medicine and Pharmacy, Cluj-Napoca. Adult male Wistar rats with weights between 150-160 g, provided by the University Biobase were used. The rats were kept in cages in the same room, at 21°C degrees, with 12 h light/12 h dark cycle, with access to food and water *ad libitum*. The tests were carried out under the guidelines of Directive 89/609/EEC and of the Ethical Committee of "Iuliu Haieganu" University of Medicine and Pharmacy, Cluj-Napoca (nr. 444/31.07.2015).

### b. Chemicals

All reagents were acquired from Sigma-Aldrich, Germany. Resveratrol and quercetin were dissolved in

carboxymethyl cellulose 0.5% (CMC 0.5%).

### c. Experimental design

The research was performed using white male Wistar rats, with weights between 150-160 g, divided into 2 groups, each group containing a further 4 groups with 8 animals/group (control, administration of carrageenan, resveratrol and carrageenan, and quercetin and carrageenan, respectively).

The experimental groups were the following:

- groups I and V (control groups): 0.5 ml CMC 0.5% by oral gavage for three days; on the fourth day, 0.2 ml physiological salt, in intrapleural injection
- groups II and VI: 0.5 ml CMC 0.5% by oral gavage for three days; on the fourth day, 0.2 ml carrageenan 1% in intrapleural injection
- groups III and VII: 10 mg/kg/day resveratrol dissolved in 0.5 ml CMC 0.5% by oral gavage for three days; on the fourth day, 0.2 ml carrageenan 1% in intrapleural injection
- groups IV and VIII: 10 mg/kg/day quercetin dissolved in 0.5 ml CMC 0.5% by oral gavage for three days; on the fourth day, 0.2 ml carrageenan 1% in intrapleural injection

At 4 hours (groups I, II, III and IV) and at 24 hours (groups V, VI, VII and VIII) after carrageenan administration, venous blood (from the retro-orbital sinus) and lung tissue were taken. The surgical procedure was performed under general anaesthesia with ketamine 10% and xylazine 2% by intramuscular injection. An incision was made through the sixth intercostal space, the subjacent musculature was sectioned, and inside the pleural cavity 0.2 ml carrageenan 1% were injected. The incision was closed after surgery (adapted technique from Petronilho et al., 2010).

### d. Biochemical determinations

Biochemical determinations were performed in the Oxidative Stress Research Laboratory of the Physiology Discipline, at "Iuliu Haieganu" University of Medicine and Pharmacy Cluj-Napoca. Oxidative stress and antioxidant protection were investigated in serum and lung tissue based on malondialdehyde (MDA) (technique of Conti et al., 1991), reduced glutathione (GSH) (Hu method, 1994) and ceruloplasmin (Cp) (Ravin method, 1961).

### e. Data analysis

The obtained results were analysed using GraphPad Prism version 5.03 for Windows, GraphPad Software, (San Diego, California, USA), by performing one-way ANOVA followed by the Bonferroni post-test. The significance level was set at  $p < 0.05$  ( $p < 0.001$  noted with \*\*\*;  $p < 0.01$  with \*\* and  $p < 0.05$  with \*).

## Results

### a. Comparative statistical analysis among the groups, in serum

#### at 4 hours

In serum, the MDA level presented significant increases in the rats that received only carrageenan (group II) in comparison with the control group (I), and also in comparison with the groups that received resveratrol or quercetin (groups III or IV) as protection. Significant increases of MDA were seen in the control group (I), compared to the group pre-treated with resveratrol (III).

Serum GSH presented significant increases in the rats

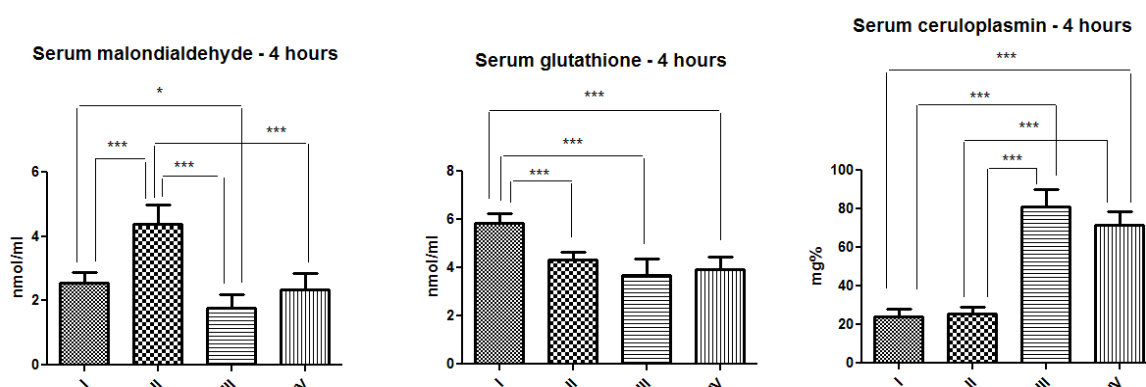


Figure 1. Serum levels of malondialdehyde, glutathione and ceruloplasmin, at 4 hours.

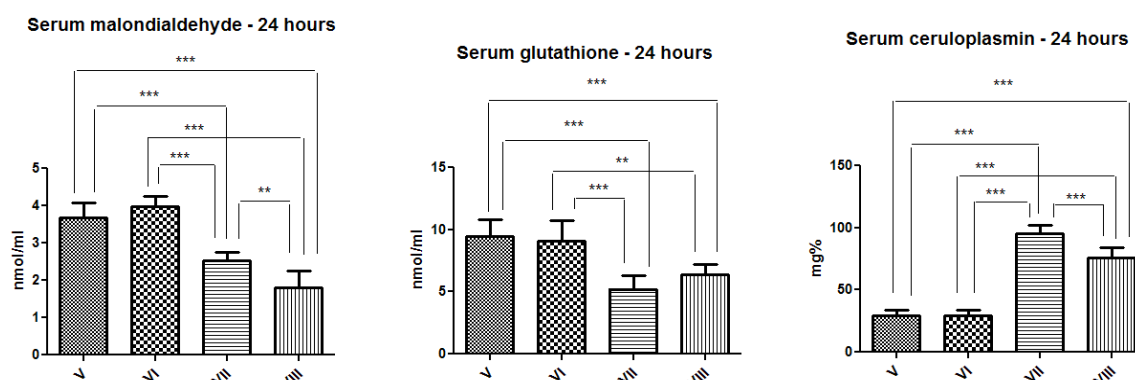


Figure 2. Serum levels of malondialdehyde, glutathione and ceruloplasmin, at 24 hours.

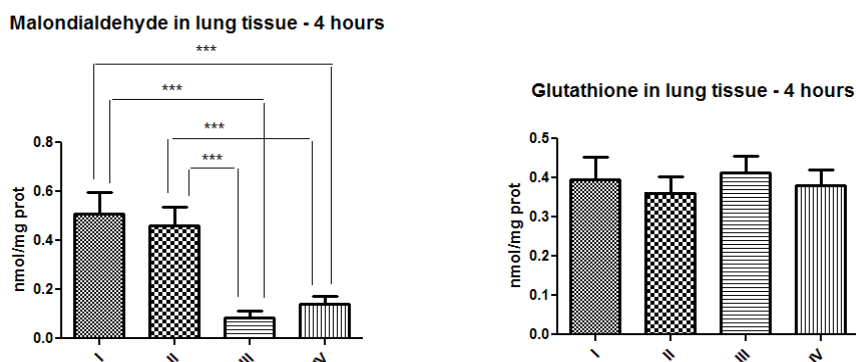


Figure 3. Malondialdehyde and glutathione in lung tissue, at 4 hours.

of the control group (I) compared to the other groups of rats (II, III and IV).

Cp increased significantly in the serum of rats that received antioxidants (groups III and IV), in comparison with both the control group (I) and the carrageenan group (II) (Figure 1).

at 24 hours

Serum MDA, at 24 hours after intrapleural carrageenan administration, increased significantly in the control (V) and carrageenan (VI) groups, compared to the groups that received antioxidants as pre-treatment (groups VII and VIII). MDA presented significant differences between the groups that received antioxidants, with higher values in

rats pre-treated with resveratrol (VII), in comparison with the quercetin group (VIII).

GSH decreased significantly in the serum of rats that received resveratrol (group VII) and quercetin (group VIII) compared to the control group (V) and the carrageenan group (VI).

Cp registered significant increases in the rats that received resveratrol (group VII) or quercetin (group VIII), compared to the rats of the control (V) and carrageenan (VI) groups. Significant differences were seen between the groups of rats that received antioxidants, with the highest values of Cp in the serum of rats with resveratrol as pre-treatment (group VII) (Figure 2).

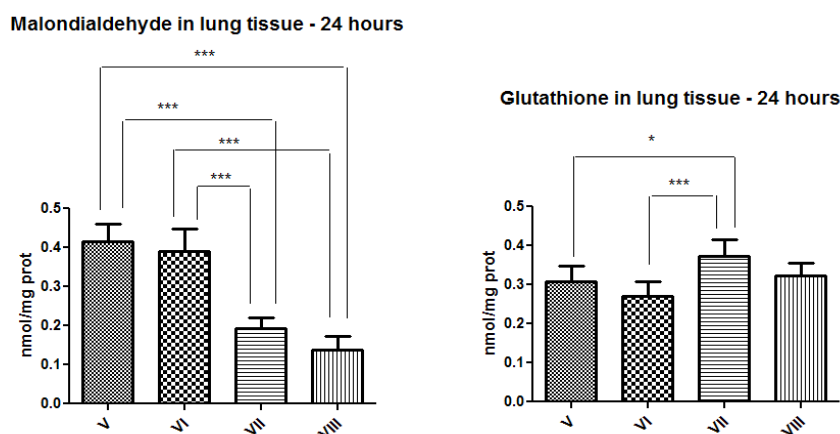


Figure 4. Malondialdehyde and glutathione in lung tissue, at 24 hours.

**b. Comparative statistical analysis among the groups, in lung tissue at 4 hours**

In lung homogenate, MDA presented significant increases in the control (I) and carrageenan (II) groups, in comparison with the groups pre-treated with antioxidants (groups III and IV).

GSH did not present any significant variations among the groups, in lung tissue (Figure 3).

**at 24 hours**

In lung tissue, at 24 hours after carrageenan administration, MDA level was increased significantly in the control (V) and carrageenan (VI) groups, compared to the groups that received antioxidants as protection (VII and VIII).

Significant increases of GSH levels in the lung homogenate were seen at 24 hours after intrapleural carrageenan administration only in the rats that received resveratrol (group VII), in comparison with the rats of the control (V) and carrageenan (VI) groups (Figure 4).

## Discussions

Our study evidenced the presence of OS in serum at 4 and also at 24 hours after intrapleural carrageenan administration.

MDA levels presented significant increases in the rats that did not receive antioxidants, compared to the rats pre-treated with resveratrol or quercetin. The pro-inflammatory action of carrageenan was observed at 4 hours after inflammation induction, through significantly increased levels of MDA in the rats that received only carrageenan, compared to the rats of the control group, which received only physiological salt. The differences between these groups were not observed at 24 hours after carrageenan inflammation.

Cp presented significant increases in the rats that were treated with resveratrol and quercetin, in comparison with the unprotected rats, showing the antioxidant effects of these substances in inflammation, at 4 and at 24 hours after inflammation induction.

The serum GSH level decreased significantly at 4 hours after carrageenan administration in both groups pre-treated

with antioxidants, compared to the control groups. The decrease of GSH was also recorded at 24 hours, a long-term decrease of this parameter being observed.

OS was revealed in the lung tissue at 4 and at 24 hours after carrageenan administration, MDA levels being significantly increased in the rats that did not receive antioxidants, compared to the rats pre-treated with resveratrol or quercetin. At 24 hours after carrageenan inflammation, GSH level in lung homogenate presented significant increases only in the rats that received resveratrol.

Donnelly et al. (2004) studied the anti-inflammatory effects of resveratrol and quercetin on epithelial cells of the respiratory pathways and observed their inhibitory effects on NF- $\kappa$ B activation, AP-1 dependent transcription, cAMP response element-dependent transcription, effects that were stronger than the effects of dexamethasone. Their study showed that in human primary airway epithelial cells, resveratrol inhibited nitrite synthesis by reducing the expression of cytokine-stimulated inducible nitric oxide synthase, inhibited COX-2 expression, granulocyte-macrophage colony-stimulating factor, and IL-8 release.

In their study performed in 2014, Zhang et al. tested the effects of resveratrol on OS in endotoxemia-induced acute lung injury and presented the beneficial effects of this antioxidant that inhibited OS, decreasing pro-oxidant biomarkers (MDA and  $H_2O_2$ ) and increasing antioxidant biomarkers (GSH, catalase - CAT and superoxide dismutase - SOD).

Yeh et al. (2014) presented the protective effects of resveratrol on mitochondrial biogenesis in lungs with ischemia-reperfusion injury. Pulmonary inflammation and OS were investigated through leukocyte and MDA determinations. Their study showed that in the lung with ischemia-reperfusion injuries, OS was increased, but treatment with resveratrol protected the lung against these lesions, reducing OS and leukocyte infiltration.

Özdemir et al. (2014) studied the biochemical and histopathological effects of resveratrol in newborn rats with hyperoxia-induced lung injuries and demonstrated that this polyphenol had a protective role through its anti-inflammatory and antioxidant effects.

Wang et al. (2017) studied the analgesic and anti-inflammatory effects of resveratrol on different experimental models. Their results showed that in acetic acid-induced pleural effusion in rats, resveratrol significantly inhibited leukocytes and decreased exudate, decreased nitric oxide (NO) synthesis and increased SOD activity in serum, being a potential drug in the treatment of pain and inflammation.

Hamza and El-Shenawy (2017) studied the anti-inflammatory and antioxidant effects of resveratrol on nicotine-induced pulmonary modifications in an experimental model of male rats and showed that nicotine administration significantly increased lipid peroxidation and significantly reduced the activity of lung antioxidant enzymes. The levels of IL-2, IL-6,  $\alpha$ -fetoprotein and tumour necrosis factor alpha (TNF- $\alpha$ ) increased in animals exposed to nicotine, while resveratrol administration followed by nicotine exposure ameliorated pulmonary lesions and was associated with an enhancement of all the mentioned parameters, demonstrating the protective effect of this antioxidant through OS modulation and antioxidant defence (enzymatic/non-enzymatic) amelioration.

In a recent study, Fan et al. (2019) showed that amurensin H, a resveratrol dimer derived from *Vitis amurensis* Rupr., reduced the lung inflammatory modifications caused by cigarette smoke, decreasing the levels of IL-6, TNF- $\alpha$  and interferon- $\gamma$  (IFN- $\gamma$ ) in bronchoalveolar lavage fluid. Amurensin H may ameliorate the inflammation of respiratory passageways *in vivo* and *in vitro* and may be useful in the treatment of inflammation in COPD.

Xu et al. (2019) studied the anti-inflammatory effects of resveratrol and dexamethasone in prevention of ischemia-reperfusion injuries in rats with transplanted lung and demonstrated that the levels of IL-6 and TNF- $\alpha$  in serum and in the bronchoalveolar lavage fluid were reduced in the groups pre-treated with resveratrol or dexamethasone, compared to the control group.

Çiftçi et al. (2016) investigated the efficiency of resveratrol and quercetin in experimental spinal cord lesions and showed a significant increase of the total antioxidant capacity and paraoxonase activity in groups that were treated with resveratrol, quercetin, or with both antioxidants, without significant differences among the groups.

Tripathi et al. (2019) studied in rats the effect of quercetin administration in different doses before exposure to hypobaric hypoxia and observed that the optimal dose was 50 mg/kg administered 1 hour before exposure, a dose that determined the inhibition of OS (ROS and MDA), a concomitant increase of antioxidants (GSH, glutathione peroxidase - GPx and SOD), a decrease of pro-inflammatory cytokines (TNF- $\alpha$  and IFN- $\gamma$ ), and a significant reduction of pulmonary oedema.

Zhang et al. (2018) established in a study performed *in vitro* on human embryonic pulmonary fibroblasts and *in vivo* on an experimental mouse model that quercetin ameliorated bleomycin-induced pulmonary fibrosis, inhibiting sphingosine kinase 1 and sphingosine-1-phosphate signaling.

Huang et al. (2015) studied the effects of quercetin in pulmonary lesion induction and found that this flavonoid decreased the MDA level and increased the activity of

SOD, CAT and GPx in rats with lipopolysaccharide administration.

A different study performed on rats evaluated the protective capacity of melatonin and quercetin against pulmonary lesions induced by carbon tetrachloride (CCl<sub>4</sub>). The level of MDA was increased significantly in the rats exposed to CCl<sub>4</sub> compared to the rats that received antioxidants. GSH level was significantly increased in the rats treated with melatonin or quercetin, compared to the rats that were only exposed to CCl<sub>4</sub> (Taslidere et al., 2014).

Yang et al. (2012) studied the antioxidant and anti-inflammatory effects of quercetin in prevention of chronic respiratory diseases induced by cigarette smoke. The results demonstrated the role of quercetin in mitigating the increased mucin synthesis induced by cigarette smoke, inhibiting OS and inflammation, thus presenting a great potential for treating chronic respiratory diseases.

Komaravelli et al. (2015) investigated the protective role of resveratrol and quercetin in metapneumovirus infection and observed significant decreases in oxidative cellular lesions, in inflammatory mediator production and viral replication, supporting the use of food antioxidants as an efficient treatment in modulation of oxidative lesions and of inflammation in metapneumovirus infection.

The present study registered results that are concordant with those presented in the literature on different experimental models of pulmonary inflammation and showed the positive effects of resveratrol and quercetin. These antioxidants could be used in inflammatory lung diseases as an alternative or as an adjuvant medication, without the adverse reactions of the usual anti-inflammatory drugs.

## Conclusions

1. In serum, both natural compounds had antioxidant actions. At 4 hours and at 24 hours after carrageenan administration, resveratrol and quercetin significantly reduced MDA and significantly increased Cp levels in the serum of rats that received these substances, compared to the rats of the control and carrageenan groups.

2. In lung homogenate, at 4 hours and at 24 hours, MDA decreased significantly in the rats that were pre-treated with antioxidants compared to the untreated rats. At 24 hours, at the pulmonary level, resveratrol presented higher antioxidant effects than quercetin, evidenced by significant increases of GSH only in the resveratrol group.

3. Our results support the use of these substances in the treatment of inflammatory lung diseases.

## Conflicts of interest

There are no conflicts of interest.

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# Sport anxiety, test anxiety and academic performance of primary school pupils: a correlational study

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All authors have equal contributions to this study

## Abstract

**Background.** School evaluation is an important component of the educational process in educational institutions in Romania, but little is known about the influences of academic performances and test anxiety on the anxiety in sports played by primary school pupils.

**Aims.** The objective of the study is to identify the level of anxiety in sports and the level of test anxiety in primary school pupils. At the same time, the study aims to highlight the influences of the academic performances of the students in three of the educational disciplines, and of test anxiety on anxiety in sports played by the pupils.

**Methods.** Subjects ( $N = 65$ ) are 4<sup>th</sup> and 3<sup>rd</sup> grade students aged 9 to 10/11. The tools used are the *Sport Anxiety Scale-2* (SAS-2, 15 items), developed by Benson & Wren in 2004 and the *Children's Test Anxiety Scale* (CTAS, 30 items), developed by Smith et al. in 2006.

**Results.** The results obtained in the Sport Anxiety Scale for the whole group of students included in the study, in the total score of the scale, indicate an average level of anxiety in sports ( $m=25.206$ ,  $s.d=8.277$ ). Similar results in the Children's Test Anxiety Scale are obtained: above average levels ( $m=2.033$ ;  $s.d=0.4558$ ) for the whole group of subjects, in the global score of the scale. At the same time, the results obtained from the Pearson correlation indicate a direct or positive relationship between sport anxiety and test anxiety ( $r=.721$ ,  $p<0.001$ ;  $r^2=.519$ , indicating a very strong effect size) and a negative association relationship with the academic performances of the students in the disciplines of Romanian language and literature ( $r(63)=-0.426$ ,  $p<0.001$ , and sport,  $r(63)=-0.426$ ,  $p<0.001$ , but not mathematics).

**Conclusions.** The obtained results confirm the hypothesis of the study: anxiety in sports is influenced by test anxiety and the academic performances of the students. Thus, students with higher levels of anxiety in sport will have higher levels in test anxiety and lower school performance in the disciplines of Romanian language and literature, and in sport.

**Keywords:** sport anxiety, test anxiety, correlation study, primary school, pupils.

## Introduction

There has been an intense concern about defining anxiety, describing its components, types, and assessing it as a multidimensional concept. Anxiety was defined by Spielberger as a trait-state construct. Anxiety is an "existing or immediate emotional state characterized by apprehension and tension. Trait anxiety is defined as a predisposition to perceive certain situations as threatening and to respond to them with varying levels of state anxiety" (Spielberger, 1966 cited by Roberts et al., 1986). More recent concerns are also directed towards identifying the level of anxiety in different situations or contexts such as before an exam or during sports competitions, finding that a person's performance may be negatively influenced by the level of anxiety (Martens et al., 1990; Jarvis, 2002). Anxiety

consists of two sub-components, namely, cognitive and somatic anxiety. Cognitive anxiety defined by Morris et al. (1981) is the conscious awareness of unpleasant feelings about oneself or external stimuli, worry or disturbing visual images. Somatic anxiety is the physiological and affective elements of the anxiety experience that develops from autonomic arousal (Martens et al., 1990).

In defining test anxiety, the authors included these two components of anxiety in the context of an assessment or examination: test anxiety refers to the negative effects on cognitive, physiological and biological factors during a test or exam process (Sarason & Stoops, 1978 cited by Mok & Chan, 2016). A similar approach is that of Zeidner (1998), which defines test anxiety as a state of distress encompassing phenomenological, physiological, and behavioral responses that accompany concerns about

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possible negative consequences of failure on an exam or similar evaluative situation. From a theoretical perspective, two major components of test anxiety can be distinguished: 1- worry, which includes all cognitive processes and 2- emotionality, which refers to the psychological changes resulting from the autonomic nervous system arousal (Spielberger & Vagg, 1995). Worry presents a cognitive interference as it concerns cognitive distortions and self-depreciating thoughts rather than skill deficiencies (Parkinson & Creswell, 2011). The emotionality component is physiological, i.e. autonomic arousal, and associated with body symptoms such as increased heart rate, sweaty palms, or shaking (McDonald, 2001).

Similarly to sport anxiety, the cognitive component is characterized by negative expectations about success or self-assessment, negative self-talk, negative thoughts, fear of failure, loss of self-esteem, low self-confidence, worries about performance, images of failure, inability to concentrate and disrupted attention (Martens et al., 1990; Jarvis 2002), while the somatic component activates negative symptoms such as feelings of nervousness, difficulty in breathing, high blood pressure, dry throat, and butterflies in the stomach. It was reported that test anxiety involves a tendency for a child to expect failure in test situations, so this type of anxiety is more closely related to cognitive school performance than general anxiety (Martens et al., 1990; Jarvis, 2002; Nicholls et al., 1967 cited by Robu, 2011).

Taking this into account, in the present study we will highlight issues related to the level of anxiety in situations where students have to prove intellectual and cognitive abilities on the one hand, and motor and sports skills on the other hand. Based on the findings of Freud cited by Robu (2011), related to the fact that in objective anxiety the intensity of the emotional reaction is proportional to the magnitude of the external danger or threat, we aim to highlight the level of test anxiety and sport anxiety given by the level of threat experienced by students in these two contexts. A series of investigations have shown that assessment situations or those involving a possible failure are generally perceived as more threatening by individuals; trait anxiety is at a high level (Spielberger, 1966; Spielberger & Smith, 1966 cited by Spielberger, 1983). Highly test-anxious students tend to perceive tests as opportunities for catastrophic failure (McDonald, 2001). Their attention to the task at hand is overly drawn to their excessive worry about being tested, which disrupts the retention of information (Morris et al., 1981; Spielberger & Vagg, 1995 cited by Mok & Chan, 2016). In sport, the case of performance athletes, competition may lead to what Martens (1977) called competitive trait anxiety, understood as a tendency to perceive competitive situations as threatening and responding to these situations with feelings of apprehension or tension; competitive trait anxiety is a concept which denotes how anxious an individual typically becomes in competitive situations.

At the same time, we aim to highlight the association of sport anxiety with test anxiety in pupils, and with the school performance of primary school pupils.

If, usually, primary school assessment has a diagnostic function (assessing the pupils' level of knowledge and

skills at the time of testing) and is performed by individual written tests or practical tests in team games, pupils are in a position to prove, in addition to leadership skills, cooperative skills with the team members, as well as competition with the opponent team members.

## Objectives

The objective of the study is to identify the level of anxiety in sports and the level of test anxiety in primary school pupils. At the same time, the study aims to highlight the influences of the academic performances of the pupils in three of the educational disciplines, and of test anxiety on anxiety in sports.

## Hypothesis

There is a statistically significant association relationship between the level of anxiety in sports and the level of test anxiety and the school performance of primary school pupils.

## Material and methods

The current study obtained the approval of the University of Oradea Ethics Committee. All participants and their parents provided an informed consent before entering the study protocol.

### Research protocol

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

The current study took place during the academic years 2018-2019, between May-June.

#### b) Subjects and groups

Sixty-five pupils in the third grade (66.2%) and fourth grade (33.8%) from the Gymnasium School No. 11 in Oradea, Bihor county, Romania, participated in the study. They were aged between 9 and 10/11 years. Depending on gender, 50.8% were boys and 49.2% were girls.

#### c) Tests applied

The following tools were used:

- *Child Test Anxiety Scale* (CTAS), developed by Wren & Benson (2004). The scale includes 30 items grouped into three subscales: *Thoughts* (e.g. I think I will get a lower score), *Distracting behavior* (e.g. I move my legs under the bench) and *Automatic reactions* (e.g. My hands are shaking). The response variants are on a Likert scale, each question having 4 variants of response. CTAS assesses an individual's level of apprehension or anxiety about testing on a 1-4 Likert scale, asking for participants' response about how anxious they would feel in response to various settings and experiences. The internal consistency of the responses was assessed by calculating Cronbach's alpha value, which was 0.899.

- *Sport Anxiety Scale-2* (SAS-2), developed by Smith et al., in 2006. SAS-2 consists of 15 items, with five items on each of the 3 subscales: *worry* as cognitive anxiety (e.g. *I worry that I will not play well*), *somatic anxiety* (e.g. *My muscles feel tight because I am nervous*), and *concentration disruption* (e.g. *It's hard for me to focus on what I'm supposed to do*). Participants responded on a 4-point scale of experience with the following anchors: 1 (not at all), 2 (a bit), 3 (pretty much), and 4 (very much). The internal consistency of the responses was evaluated by calculating Cronbach's alpha value, which was 0.875.

Table I

Results obtained in the Pearson correlation test in the overall score of the scales used and school performance

Parameters	Test anxiety	School performance in Romanian language and literature	School performance in mathematics	School performance in sports
Pearson Correlation	0.721**	-0.426**	-0.111	-0.430**
Sig. (2-tailed)	.000	.000	.385	.000
N	63	63	63	63

The scales were administered frontally to pupils in the class, after specifying the working instructions, the manner of completing the answers being an individual one.

At the same time, students were asked to complete the grades obtained in the disciplines of Romanian language and literature, mathematics, and sport. In Romania, scoring in primary school is based on four school grades: *Very Good, Good, Sufficient, and Insufficient*.

#### d) Statistical processing

The data in this paper were primarily presented using descriptive statistics, and then were analyzed using Pearson Correlation Coefficient with SPSS 18.

## Results

Regarding the test anxiety level, the results obtained for the whole group of students enrolled in the study, in the total CTAS scale score, indicate an over-average level of test anxiety ( $m=2.03$ ,  $s.d.=0.455$ ). The highest averages were obtained for the indicators: *I think about what my grade will be* ( $m=2.96$ ;  $s.d.=0.999$ ), *I worry about doing something wrong* ( $m=2.8$ ;  $s.d.=0.921$ ), *I feel nervous* ( $m=2.73$ ;  $s.d.=1.004$ ), *I think I am going to get a bad grade* ( $m=2.49$ ;  $s.d.=0.986$ ). Except for an item (*I feel nervous*), the others saturate the *Thoughts* subscale. The lowest averages were obtained for items: *My head hurts* (Automatic Reactions) ( $m=1.46$ ;  $s.d.=0.73$ ), *It is hard to remember the answers* (Thoughts) ( $m=1.44$ ;  $s.d.=0.662$ ), *I look at other people* (Of-Task Behaviors) ( $m=1.46$ ;  $s.d.=0.730$ ). According to the results obtained on the level of the test anxiety of the students participating in the study, it was found by reference to the standard (Popa et al., 2018) that 3.1% had a low level of test anxiety, 29.93% had levels below the average, 30.06% average, 32.30% above average, and 4.61% had high levels of test anxiety. One aspect that we would like to emphasize is that 36.91% of students had above average and high test anxiety levels, which could have a negative impact on school performance. The results obtained in the Sport Anxiety Scale indicate an average level of sport anxiety ( $m=25.20$ ,  $s.d.=8.277$ ), the highest averages being obtained in items that saturate the *Worry* subscale: *I worry that I will let others down* ( $m=2.21$ ,  $s.d.=1.049$ ), *I worry that I will not play well* ( $m=2.031$ ,  $s.d.=0.841$ ), *I worry that I will mess up during the game* ( $m=1.98$ ,  $s.d.=0.991$ ), *I worry that I will play badly* ( $m=1.90$ ,  $s.d.=0.976$ ). The lowest averages were obtained in items that saturate the *Somatic Anxiety* subscale: *My stomach feels upset* ( $m=1.32$ ,  $s.d.=0.667$ ), *My muscles feel shaky* ( $m=1.47$ ,  $s.d.=0.8$ ) and *Concentration Disruption: I lose focus on the game* ( $m=1.38$ ,  $s.d.=0.05$ ). A percentage of 74.6% of the participating students had medium and low levels of sport anxiety, and 25.4% had

above average and high levels of sport anxiety. According to subscale averages, the highest average in CATS was obtained for the *Thoughts* subscale ( $m=2.19$ ,  $s.d.=0.546$ ). A similar result was obtained for SAS-2, where the average *Worry* subscale was the highest ( $m=9.95$ ,  $s.d.=3.708$ ). Regarding somatic manifestations, the lowest average was obtained for SAS-2 ( $m=7.55$ ,  $s.d.=3.073$ ) among subscale results, and in CATS, the lowest average was obtained for the *Out of task* subscale ( $m=1.86$ ,  $s.d.=0.547$ ).

The distribution of data for the scores obtained using the administered instruments was normal and was verified by the Kolmogorov-Smirnov test (CTAS:  $z = 0.791$ ,  $p > 0.05$ , SAS-2:  $z=1.023$ ,  $p > 0.05$ ).

To verify the study hypothesis, the results obtained in the Pearson correlation test were included in Table I.

According to the results, a positive association relationship was obtained between sport anxiety and test anxiety,  $r(63)=0.721$ ,  $p < 0.001$ , which means that students showing high levels of test anxiety in the assessed disciplines will have high levels of anxiety in sports and vice versa. This means that the level of test anxiety influences by 51.98% the variance of results in sport anxiety ( $r^2=0.519$ ,  $r=0.721$ , which indicates a very strong effect size).

Also, sport anxiety is negatively influenced by the school performances of students in Romanian language and literature,  $r(63)=-0.426$ ,  $p < 0.001$ , and in sport,  $r(63)=-0.430$ ,  $p < 0.001$ , with above average effect sizes. As a result, the increased level of anxiety in sports in primary school students may be due to poor performance in the two school disciplines, the relationship between these being a negative one.

The association between the results obtained on the subscales of the working tools is presented in Table II.

The analysis of the data included in Table II shows that statistically significant results were obtained between all the subscales of the working instruments used, with positive or direct association relationships between *Automatic Reactions* and *Somatic Anxiety*,  $r(63)=0.665$ ,  $p < 0.001$ , *Thoughts* and *Worry*,  $r(63)=0.621$ ,  $p < 0.001$ , *Of-Task Behaviors* and *Concentration*,  $r(61)=0.567$ ,  $p < 0.001$ . To conclude, it can be said that the results confirm the existing theories about anxiety as a trait and state; so students with high levels of anxiety evaluated during school assessments will have similar reactions during team sports games organized at school (according to the scores obtained for the Pearson coefficient  $r$ , presented above, large effect sizes were obtained in the study).

Regarding the influence of school performance, across disciplines, on the three subscales of SAS-2, it was found that:

Table II

Results obtained in the Pearson correlation test on the subscales of the working instruments used and academic performance.

Variables	Parameters	SAS-2 Subscales		
		Somatic	Worry	Concentration
CTAS – Subscales	Thoughts	Pearson Correlation	.443**	.621**
		Sig. (2-tailed)	.000	.000
		N	63	62
	Of -Task Behaviors	Pearson Correlation	.563**	.448**
		Sig. (2-tailed)	.000	.000
		N	62	61
	Automatic Reactions	Pearson Correlation	.665**	.472**
		Sig. (2-tailed)	.000	.000
		N	63	62
Academic performances	School performances in Romanian language and literature	Pearson Correlation	-.402**	-.289*
		Sig. (2-tailed)	.001	.022
		N	63	62
	School performances in mathematics	Pearson Correlation	-.119	-.042
		Sig. (2-tailed)	.353	.742
		N	63	62
	School performances in sports	Pearson Correlation	-.435**	-.312*
		Sig. (2-tailed)	.000	.013
		N	63	62

*Somatic manifestations* experienced in team sports games are negatively influenced by school performances in Romanian language and literature,  $r(63) = -0.435$ ,  $p < 0.001$ , and school performances in sports,  $r(63) = -0.402$ ,  $p < 0.001$ , the effect size being above average for both results. Consequently, the lower the academic performances of students in the two school subjects, the more intense will be the somatic manifestations of students during sports games and vice versa. School performance in mathematics does not influence the level of somatic manifestations,  $r(63) = -0.119$ ,  $p > 0.05$ .

The level of *worry* of students in sports games is negatively influenced by school performances in the sport discipline  $r(63) = -0.312$ ,  $p < 0.05$ , with a below average effect size, and by school performances in the Romanian language and literature discipline,  $r(63) = -0.289$ ,  $p < 0.05$ , the effect size being average.

Similarly to the other two subscales of SAS-2, the level of *concentration* of students during sports games is influenced by academic performance in the Romanian language and literature discipline,  $r(63) = -0.418$ ,  $p = 0.001$ , with an over-average effect size, and by school performance in sport  $r(63) = 0.368$ ,  $p < 0.05$ , with a below average effect size.

## Discussion

The study aims to investigate aspects of anxiety during classroom assessments as well as during team sports played in school. Thus, based on the results obtained in the tools used in the research, we highlighted the level of anxiety of pupils in the school environment, in two different contexts: the tests for assessing competences in school subjects and participation in team sports during physical education classes.

Although testing appears to be a potentially useful method to enhance long-term retention, it may also induce anxiety, which can be unfavorable to learning (Mok & Chan, 2016). The experience of anxiety, as an emotional state, is normal in any situation where there may be a

danger that causes physical or psychological impairment, for example, situations that are threats to self-esteem or psychological well-being (Robu, 2011). However, above average and high levels of anxiety can lead to personal destruction and low performances (Abulghasemi, 2008; Bochi & Florescu, 2018; Hong & Karstensson, 2002; Onyeizugbo, 2010; Zeidner & Matheus, 2003).

It is worrying for parents and teachers to test youth who have test anxiety, who may experience more anxiety disorder and depression symptomatology than their non-test anxious peers (Weems et al., 2010), and that anxiety may become chronic during childhood, it may persist in adolescence and adulthood (Goodwin et al., 2004). It is necessary to have a better understanding of how students meet school requirements, given that educational systems are oriented towards achieving school performance. Therefore, it is of particular importance for the teaching staff to ensure a safe climate in teaching, but especially evaluation, and to ensure a supportive class climate. The role of the teacher has been highlighted in many studies, from postulates based on a philosophy of values that teachers teach to student generations: "Voices of teachers not only spread the new ideas among people but also facilitate the free movement of values" (Florescu, 2015) to responsibilities for developing the psychological processes necessary for students to learn. Clipa (2015) points out, "The educator, given his training and the importance of his/her activity, is a stimulating force of a people's spirit, able to generate positive chain reactions on the part of the people he educates, to increase their thirst for knowledge and to put into motion their motivation". It is important to understand the role of climate in school beyond academics. Laurian-Fitzgerald et al. (2015) write, "The climate of classroom and school should consider the other parts of the brain in addition to academic knowledge". Bochi & Andra (2018) offer some recommendations for teachers: 1. provide a favorable climate for school assessments, 2. use of positive feedback on the results obtained, and 3. focus

on the learning effort more than on the obtained result. Parnabas & Mahamood (2013) also synthesize the ways in which teachers and other speculators can use techniques to deal with stressful situations, including testing, cognitive restructuring and emotional self-control. According to the authors, cognitive techniques are positive self-talk, physical activity, goal setting, thinking on practice, thinking stopping, remember the worst case scenario, focus on what you can control, imagery and simulation, while somatic techniques are meditation, breathing techniques, progressive relaxation, autogenic training and biofeedback.

The study does not capture the level of anxiety in sports according to the interest of pupils in sport (hobby), the level of competitiveness or skills of the pupils, which need to be investigated in future studies.

## Conclusions

1. High levels of anxiety were obtained in more than a quarter of the students, both in the Children's Anxiety Scale and the Sport Anxiety Scale-2, which means that school-based assessment situations and sports games at school are perceived by students as threatening, stressful or demanding.

2. The level of anxiety in sports of primary school students is in an association relationship and is influenced positively by the level of test anxiety and negatively by the school performance of students in the disciplines Romanian language and literature, and sport. Thus, the level of anxiety that pupils experience during school appraisals and contests, often completed with a score, influences the level of anxiety in sport during team sports competitions, where the result obtained places the participating students in one of the two positions: losers or winners. At the same time, the low school performance in disciplines that seek to develop communication skills and motor skills negatively influences and leads to an increase in students' level of anxiety in sport.

## Conflicts of interests

There are no conflicts of interests.

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# The relationship between music listening and sports; a brief analysis from the PubMed publications perspective

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## Abstract

**Introduction.** Music is useful to reduce the perception of effort and to increase physical performance.

**Objectives.** The objective was to highlight the interest in the relationship between physical exertion and music listening, by studying the number of publications appearing in PubMed, which cover this subject.

**Methods.** The obtained information was from the database of the PubMed site. In order to highlight the relationship between music and sport, key words were selected: “music listening AND sport” (ML-SP). The articles were collected from the first year of PubMed publication until the end of 2018. The following filters were analyzed: “Sex”, with sub-filters: “Male” (M), “Female” (F) and “Male+Female” (M+F); “Age”, with sub-filters: 0-18 years, 19-44 years, 45-64 years, >65 years and >80 years. An analysis of the chosen keywords, in relation to the filters and the total number (N) of publications; sub-filters and the average number of publications per year (N/Y) was made.

**Results.** Differences were significant between N/Y - 45-64 ( $p=0.0008$ ); N/Y - >65 ( $p=0.0005$ ); N/Y - >80 ( $p=0.0001$ ); 19-44 - 0-18 ( $p=0.0351$ ); 19-44 - 45-64 ( $p=0.0064$ ); 19-44 - >65 ( $p=0.0028$ ); 19-44 - >80 ( $p=0.0001$ ).

**Conclusions.** 1) Studies regarding ML-SP were analyzed from the first publications posted by PubMed until the end of 2018, for a period of 69 years. 2) ML-SP studies, although not very numerous (154), have increased numerically over time, the most being registered in 2017. 3) Most studies were performed on human subjects of both genders, between the ages 19-44 years. 4) This study shows that there is a growing interest in studies related to the ML-SP relationship, but further research is required in order to extend this topic.

**Keywords:** music listening, sport, PubMed filters, PubMed sub-filters.

## Introduction

Music has positive effects on the emotional state and physical activity (Hutchinson et al., 2015). Listening to music self-selections or listening to classical music, after exposure to a stressor, significantly reduces negative emotional states, compared to listening to heavy metal music or remaining quiet (Labbé et al., 2007). Music is cheap, easy to administer, with no adverse effects (Matsota et al., 2013), and has mild anxiolytic effects (Fachner et al., 2013). Different mechanisms explain the positive effects of music during physical exercise: via rhythmic training; via the release of well-being hormones; via the excitation of the autonomic nervous system; via mood and the evocation of positive memories; by diverting our attention from the

unpleasant effects that physical exertion can cause, such as: fatigue, pain, boredom (Clark & Tamplin, 2016; Habibzadeh, 2015). Listening to music can increase performance during resistance exercise (Ballmann et al., 2018).

## Objectives

The objective was to highlight the interest in the relationship between physical exertion and music listening by studying the number of publications appearing in PubMed, which cover this subject.

## Hypothesis

Studies show great interest in the relationship between listening to music and stress, and physical exertion in general. However, the relationship between listening

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to music and physical stress remains limited given the publications found in PubMed.

## Material and methods

The information was obtained from the database of the PubMed site.

### Keywords

We mention that “music listening” was used instead of “music”, because the word music also refers to musicians. In order to highlight the relationship between music and sport, key words were selected: “music listening AND sport” (ML-SP). The articles were collected from the first year of PubMed publication until the end of 2018.

### Periods of research

The publications were grouped by 10-year periods up to 2009, for which the average number of publications per year was calculated. From 2010 until the end of 2018, the number of publications per year was recorded.

### PubMed filters

The following filters and sub-filters were analyzed:

- “Sex” filter, with sub-filters: “Male” (M), “Female” (F) and “Male + Female” (M+F)
- “Age” filter, with sub-filters: “Birth-18 years” (0-18), “Adult 19-44 years” (19-44), “Middle Aged 45-64 years” (45-64), “Aged: 65+ years” (>65) and “80 and over 80+ years” (>80).

### Study design

An analysis of the chosen keywords was made in relation to the:

- filters and the total number (N) of publications
- sub-filters and the average number of publications per year for each sub-filter (N/Y)

The number of publications presented in the results is that displayed by the PubMed site, according to the publication information.

### Statistical evaluation

- The results obtained were analyzed using SPSS 19.0 statistical package.
- For continuous data examination, Student’s t test was used.
- The differences were considered significant at a  $p < 0.05$ .

## Results

The data were collected in January 2019. For all groups, data distribution was normal, according to the

Kolmogorov-Smirnov test. The analysis was made for the chosen time periods.

a) Analysis of the total number (N) of publications (Table I, Fig. 1)

Table I		
Total number (N) of publications		
Keywords chosen	Time period for which PubMed presented studies	N
LM-SP	1949-2018	154

For the period analyzed (69 years), from the first PubMed publication on ML-SP until the end of 2018, N was 154. Overall, the most numerous publications were for H (131), and the fewest were for Year (2). Of sub-filters, the most numerous publications were for: H (131), M F (118), 19-44 years (86).

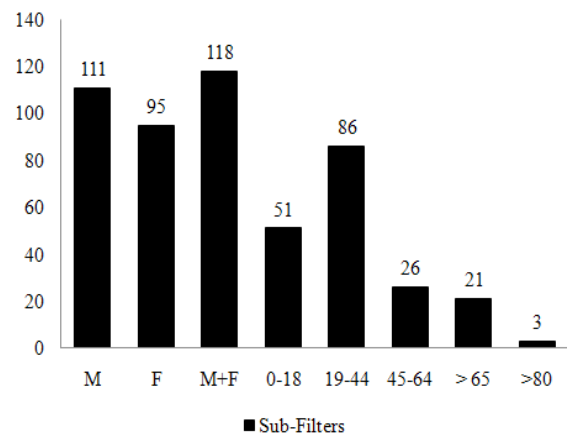


Figure 1 – Total number (N) of publications for sub-filters.

b) Analysis of the keyword “Music listening and sport”, for the filter “Sex” (Fig. 2)

N/Y was higher in 2017 (=22) and 2014 (=19). N/Y for: a) M was higher in 2016 and 2017 (each =15); b) F was higher in 2016 (=15); c) M+F was higher in 2015, 2016 and 2017 (each=15). The site published no studies for M, F and M+F between 1949-1979.

Differences (Table II) were not significant between: N/Y-M ( $p=0.1294$ ), N/Y-F ( $p=0.0693$ ), N/Y-M+F ( $p=1.748$ ); M+F-M ( $p=0.4108$ ), M+F-F ( $p=0.2524$ ).

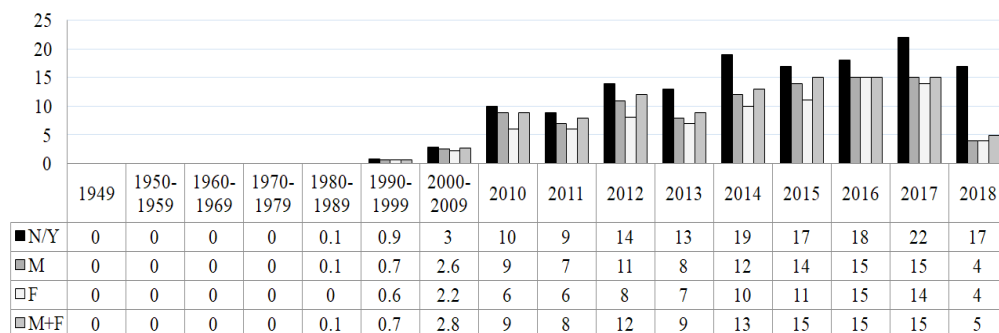


Figure 2 - Number of publications for the keyword “Music listening and sport”, for the filter “Sex”.

**Table II**

Statistical analysis for the keyword “Music listening and sport”, for the filter “Sex”

Periods 1949-2018	N/Y	M	F	M+F
Mean	8.9375	6.15	5.2375	6.5375
Standard deviation	8.0029	5.7178	5.0578	5.9346
P-value for comparison with N/Y	-	0.1294	0.0693	0.1748
P-value for comparison with M+F	-	0.4108	0.2524	-

*c) Analysis of the keyword “Music listening and sport”, for the filter “Age” (Fig. 3)*

N/Y was higher in 2017 (=22) and 2014 (=19). N/Y for: a) 0-18 was higher in 2015 (=7); b) 19-44 was higher in 2017 (=14); c) 45-64 was higher in 2017 (=7); d) > 65 was higher in 2017 (=7); e) > 80 was higher in 2011 (=2). The site published no studies: a) between 1949-1979, for all ages; b) between 1990-1999, for 45-64, >65 and >80; c) in 2010 and between 2012-2018, for >80.

The differences (Table III) were significant between: N/Y - 0-18 ( $p=0.0026$ ); N/Y - 45-64 ( $p=0.0008$ ); N/Y - >65 ( $p=0.0005$ ); N/Y - >80 ( $p=0.0001$ ); 19-44 - 0-18 ( $p=0.0351$ ); 19-44 - 45-64 ( $p=0.0064$ ); 19-44 - >65 ( $p=0.0028$ ); 19-44 - >80 ( $p=0.0001$ ). The differences were not significant between N/Y - 19-44 ( $p=0.0564$ ).

## Discussions

The present work is a continuation of our studies regarding the relationship between music and sports (Jurcu & Jurcu, 2012).

### A. Analysis of filters

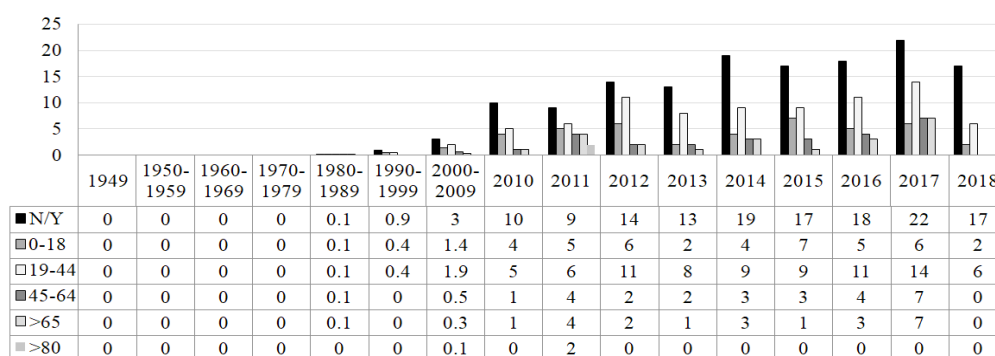
*a) Analysis of the Sex filter.* Most studies included human subjects of both genders. This proves that the interest of the publications was related to studying the reactions of both men and women regarding the connection between music listening and sports. The publications with

M subjects were more numerous than those with F, which may indicate that the interest in studies on the chosen topic was higher with respect to M. N/Y shows that the interest in this research topic increased between 1980-2010. The highest interest in studies with M+F was present in 2015, 2016, 2017, while in 2018 a lower N/Y was registered. The interest in H is also evidenced by the differences between M+F - M ( $p=0.4108$ ) and M+F - F ( $p=0.2527$ ), which, although statistically non-significant, were present.

*b) Analysis of the Age filter.* Most studies included young human subjects (19-44). This proves that the interest of the publications was related to the study of reactions in young subjects, regarding the connection between music listening and sports. N/Y for ages 44-64 and > 65 was comparable, these age groups proving to be of comparable interest for the literature. The smallest N/Y was for age > 80, which proves that this age segment, although arousing lower research interest, was still analyzed. N/Y shows that interest in this research topic increased between 1980-2011. The highest interest in studies with 19-44 was present in 2017, while in 2018, a lower N/Y was registered. The interest in 19-44 was also evidenced by the significant statistical difference compared with the other age ranges: 0-18 ( $p=0.0351$ ), 45-64 ( $p=0.0064$ ), >65 ( $p=0.0028$ ), >80 ( $p=0.0001$ ).

### B. Music listening

Studies have already shown that music has many profound social effects (Snyder & Chlan, 1999). In music therapy, for the health of a patient, the most useful is classical music (Trappe, 2010; Yoshie et al., 2009). To date, there has been progress in studying emotional responses during the performance of selected time-response tasks (Hajcak et al., 2003; Critchley et al., 2005). Studies over the last decade show that music induced physiological responses according to the different styles in most cases, in which the responses were related to “tempo” and were associated with intensification of breathing (Wilkins & Morre, 2004;



**Figure 3** - Number of publications for the keyword “Music listening and sport”, for the filter “Age”.

**Table III**

Statistical analysis for the keyword “Music listening and sport”, for the filter “Age”

Periods 1949-2018	N/Y	0-18	19-44	45-64	>65	>80
Mean	8.9375	2.6812	5.0875	1.6625	1.4	0.1312
Standard deviation	8.0029	2.4762	4.6815	2.0006	1.9160	0.4831
P-value for comparison with N/Y	-	0.0026	0.0564	0.0008	0.0005	0.0001
P-value for comparison with 19-44	-	0.0351	-	0.0064	0.0028	0.0001

Trappe, 2010). Music listening activates the brain structures involved in reward, pleasure and emotional compensation, such as the insula, the medial ventral prefrontal cortex, the amygdala, the hippocampus (Koelsch, 2009).

### C. Music listening and sport

There are 4 different ways of using music during sports or physical exercise: a) distraction of athletes, making the environment more pleasant; b) regulation of movements; c) relaxing or regulating the mood of an athlete or a team; d) recovery music (Karageorghis & Priest, 2012; Karageorghis & Priest, 2008; Chiat & Ying, 2012).

Listening to music reduces the perception of effort, improves physical performance, oxygen consumption and physiological efficiency (Hutchinson et al., 2015). Moreover, listening to self-selected music accelerates heart rate recovery following anaerobic testing (Ballmann et al., 2018). Music is useful for diminishing negative bodily sensations and the perceived effort (Karageorghis & Terry, 1997; Karageorghis et al., 2012), especially in low to moderate intensity physical efforts (Potteiger et al., 2000; Razon et al., 2009), as a dissociative strategy for distracting attention from bodily and internal sensations (exertion, fatigue) (Hutchinson & Tenenbaum, 2007). Thus, during exercise, different types of music can act effectively as a passive distractor, leading to a reduced perception of effort (Potteiger et al., 2000). Listening to one's favorite music increases physical performance and reduces the perceived effort, more so than watching videos (Lin & Lu, 2013).

## Conclusions

1. Studies regarding ML-SP were analyzed from the first publications posted by PubMed until the end of 2018, for a period of 69 years.

2. ML-SP studies, although not very numerous (154), have increased numerically over time, the most being registered in 2017.

3. Most studies were performed on human subjects, of both genders, between the ages 19-44 years.

4. This study shows that there is a growing interest in studies related to the ML-SP relationship, but further studies are required to extend this topic.

## Conflicts of interest

Nothing to declare.

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## A PubMed evaluation of the *Rhodiola rosea* adaptogen

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### Abstract

**Introduction.** *Rhodiola rosea* (RR) has been used as an adaptogen to increase an organism's resistance to stress.

**Objectives.** The objective was to highlight the interest in RR as an adaptogen, from the perspective of the age of participants, in a PubMed evaluation.

**Methods.** Keywords were selected: “*Rhodiola rosea* adaptogen” (RRAD); “*Rhodiola rosea* and stress” (RRS); “*Rhodiola rosea* and cortisol” (RRC); “*Rhodiola rosea* and anxiety” (RRA). The PubMed filter chosen was gender (Sex), with sub-filters: human male (HM), human female (HF) and human male and female (HM+HF). Chosen time periods: 1963-1969, 1970-1979, 1980-1989, 1990-1999, 2000-2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018. Analysis criteria: total number of publications (N); average number of publications per year (N/Y).

**Results.** a) RRAD: differences were significant between: N-HM ( $p=0.00002$ ); N-HF ( $p<0.00001$ ) and N-HM+HF ( $p=0.00004$ ). b) RRS. Differences were significant between: N-HM ( $p=0.0004$ ); N-HF ( $p=0.0002$ ) and N-HM+HF ( $p=0.0007$ ). c) RRC. Differences were significant between: N-HM ( $p=0.0406$ ) and N-HF ( $p=0.0191$ ). d) RRA. Differences were significant between: N-HM ( $p=0.0012$ ); N-HF ( $p=0.0007$ ) and N-HM+HF ( $p=0.0012$ ).

**Conclusions.** 1) The studies regarding *Rhodiola rosea* as an adaptogen were analyzed from the first publications posted by PubMed, regarding RRAD, RRS, RRC and RRA, until the end of 2018, for a total period of 32 years. 2) The studies regarding RRAD, RRS, RRC and RRA, although reduced numerically (154), show an increase in time, the highest interest being in RRS, and the lowest one, in RRC. 3) Most studies on RRAD, RRS, RRC and RRA were performed on human subjects, of both genders. 4) This study shows that, although there is still modest interest in publications on RR as an adaptogen, it is still increasing.

**Keywords:** *Rhodiola rosea*, adaptogen, stress, cortisol, anxiety, PubMed filters, PubMed sub-filters.

## Introduction

### A. Adaptogens

Adaptogens are extracts or compounds from natural plants (Kaur et al., 2017) that increase adaptability and survival, in stressed organisms (Panossian et al., 2018). For adaptogenic plants, the criteria include a high level of safety, no adverse effects on normal physiological functions, and normalization of body functions, regardless of the nature of the stressors (Panossian et al., 2012; Xia et al., 2016; Panossian, 2017).

Adaptogens are stress response modifiers that increase non-specific stress resistance of an organism by augmenting its ability to adapt and survive (Kaur et al., 2017; Panossian, 2017). In a context of fatigue and stress,

their stimulatory effect is more pronounced (Panossian & Wikman, 2010).

The main adaptogens, the most studied and effective ones, are represented by: *Rhodiola rosea*, *Schisandra chinensis* and *Eleutherococcus senticosus* (Panossian et al., 2012; Panossian, 2017; Bleakney, 2008; Panossian & Wikman, 2008; Panossian, 2013).

### B. *Rhodiola rosea*

For a long time in traditional medical systems in Asia and Europe, the root of *Rhodiola rosea* (RR) has been used as an adaptogen to increase an organism's resistance to physical stress (Schriner et al., 2009).

*Rhodiola rosea* L., belonging to the Crassulaceae family, is a type of herbaceous perennial (Panossian et al., 2010; Nabavi et al., 2016). Nearly 200 species are included

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in the genus *Rhodiola*, but *R. rosea* is the most studied and known species (Kosakowska et al., 2018). For centuries, RR has belonged to traditional medicine in parts of Russia, Asia and Europe (Ishaque et al., 2012).

#### *C. Rhodiola rosea adaptogen*

Many in vitro and in vivo as well as pharmacological studies have been carried out, and traditional medicinal RR uses have been established: for fatigue, stress, age-related conditions, cognitive decline, depression, and behavioral disorders (Ishaque et al., 2012; Hung et al., 2011; Booker et al., 2016; Chiang et al., 2015). RR also inhibits painful behavior, mechanical hyperalgesia and thermal pain (Doncheva et al., 2013), has antioxidant capacity (Shen et al., 2013), and significantly improves long-term memory (Petkov et al., 1986) and mental performance (Timpmann et al., 2018).

Thus, RR attenuates responses to stress (Timpmann et al., 2018) and can also play an important role in the modulation of anxiety (Jurcu et al., 2012), physical stress (Jurcu et al., 2012), fatigue (Jurcu et al., 2019; Jurcu & Jurcu, 2018; Panossian et al., 2010), cognition and mood (Panossian et al., 2010).

RR decreases cortisol (Zhang et al., 2009; Panossian et al., 2010), by interacting with the HPA system (Panossian et al., 2010). For example, repeated administration of RR increases the ability to concentrate and decreases the cortisol response in patients with fatigue syndrome (Olsson et al., 2009).

RR is effective in mild to moderate depression and generalized anxiety (Panossian et al., 2010), extenuating anxiety (Ma et al., 2018). For example, administration of RR in subjects with moderate anxiety resulted in a significant reduction of stress, anxiety, anger, confusion and depression, and a significant improvement in mood (Copley et al., 2015). The anxiolytic effects of RR can be mediated through pathways other than GABAA (Cayer et al., 2013).

## Objectives

The objective was to highlight the interest in RR as an adaptogen, from the perspective of the age of participants, in a PubMed evaluation.

## Hypothesis

So far, studies have shown interest in RR in general. On the other hand, RR as an adaptogen remains relatively little analyzed, given the number of publications found on the PubMed site.

## Material and methods

The information was obtained from the database of the PubMed site.

#### *Keywords*

To highlight the importance of RR as an adaptogen, we selected for the analysis a few keywords related to the uses of RR and the stress domain: cortisol, one of the most important stress markers; and anxiety, one of the most important reactions to stress. Therefore, the keywords chosen were:

- “*Rhodiola rosea* adaptogen” (RRAD)
- “*Rhodiola rosea* and stress” (RRS)

- “*Rhodiola rosea* and cortisol” (RRC)
- “*Rhodiola rosea* and anxiety” (RRA)

#### *PubMed filters*

The PubMed filter that we chose for the analysis was gender (Sex), with the sub-filters: human male (HM), human female (HF) and human male and female (HM+HF).

#### *Periods of research*

We chose the time periods from the year of the first publication posted by the site, until the end of 2018: 1963-1969, 1970-1979, 1980-1989, 1990-1999, 2000-2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018.

#### *Study design*

The study was carried out based on the following criteria:

- Analysis of the chosen keywords in relation to the total number of publications (N).
- Analysis of the chosen keywords in relation to the sub-filters and the average number of publications per year (N/Y).

#### *Statistical evaluation*

- The results obtained were analyzed using SPSS 19.0. statistical package.
- For continuous data examination, Student's t test was used.
- The differences were considered significant at a  $p < 0.05$ .

## Results

The data were collected in January 2019. For all groups, data distribution was normal, according to the Kolmogorov-Smirnov test (1). The analysis was made for the chosen time periods.

#### *A. Analysis of the total number (N) of publications (Table I).*

Of the chosen keyword combinations, those with the longest period for which PubMed presented publications were RRS (32 years), and those with the shortest period for which PubMed presented publications were RRA (18 years). Most publications were for RRS (194), and the fewest were for RRC (11). For all the word combinations chosen, the most numerous publications were for HM+HF.

**Table I**

Total number (N) of publications for the chosen keywords

Key-words	Time period for which PubMed presented studies	N	Sex Filter		
			HM	HF	HM+HF
RRAD	1991-2018	54	7	3	8
RRS	1986-2018	194	21	16	26
RRC	1987-2018	11	3	2	4
RRA	2000-2018	18	3	2	3

#### *B. Analysis of keyword combinations*

##### *a. Analysis of the keyword “Rhodiola rosea adaptogen”*

It was found that (Fig. 1): N/Y for HM was higher than for HF, for all periods; HM and HF had the same N/Y between 2000-2009 ( $=0.1$ ), 2010 ( $=1$ ), 2013 ( $=1$ ) and 2014 ( $=1$ ); N/Y for HM+HF was higher than for HM and HF and was the highest in 2010 and 2018 (each= $2$ ); the site published no studies for: HF in 2012, 2016 and 2017; HM, HF and HM+HF between 1991-1999, in 2011 and 2015.

The differences were significant (in *italics*) between (Table II): N-HM ( $p=0.00002$ ); N-HF ( $p<0.00001$ ) and N-HM+HF ( $p=0.00004$ ). The differences were not significant between: HM+HF-HM ( $p=0.382$ ) and HM+HF-HF ( $p=0.0582$ ).

**Table II**

The mean, standard deviation and p-value for the keyword "Rhodiola rosea adaptogen"

Period 1991-2018	N	HM	HF	HM+HF
Mean	3.6909	0.7364	0.3727	0.8273
Standard Deviation	1.8218	0.6064	0.475	0.7059
p for comparison with N	-	0.00002	< 0.00001	0.00004
p for comparison with HM+HF	-	0.382	0.0582	-

*b. Analysis of the keyword "Rhodiola rosea and stress"*

It was found that (Fig. 2): N/Y for HM was higher than for HF for all periods, excepting the years where N/Y was equal, 2010 (each=1), 2014 (each=2), 2015 (each=4) and 2016 (each=2); N/Y for HM+HF was the highest in 2015 (=4); the site published no studies for: HM in 2010; HM, HF and HM+HF between 1986-1999, in 2011.

**Table III**

The mean, standard deviation and p-value for the keywords "Rhodiola rosea and stress"

Period 1991-2018	N	HM	HF	HM+HF
Mean	13.175	1.1583	1.125	1.7417
Standard Deviation	8.2185	1.0688	1.0825	1.3041
p for comparison with N	-	0.0004	0.0002	0.0007
p for comparison with HM+HF	-	0.2909	0.1522	-

The differences were significant between (Table III): N-HM ( $p=0.0004$ ); N-HF ( $p=0.0002$ ) and N-HM+HF ( $p=0.0007$ ). There were no significant differences between: HM+HF-HM ( $p=0.2909$ ) and HM+HF-HF ( $p=0.1522$ ).

*c. Analysis of the keywords "Rhodiola rosea and cortisol"*

It was found that (Fig. 3): N/Y for HM was higher than for HF between 2000-2009; HM and HF had the same number of studies in 2013 (=1); N/Y for HM+HF was the highest in 2013 (=2); the site published no studies for: HM, HF and HM+HF between 1987-1999, between 2010-2012 and 2014-2018.

The differences were significant between (Table IV): N-HM ( $p=0.0406$ ) and N-HF ( $p=0.0191$ ). The differences were not significant between: N-HM+HF ( $p=0.0725$ ); HM+HF-HM ( $p=0.3876$ ) and HM+HF-HF ( $p=0.2576$ ).

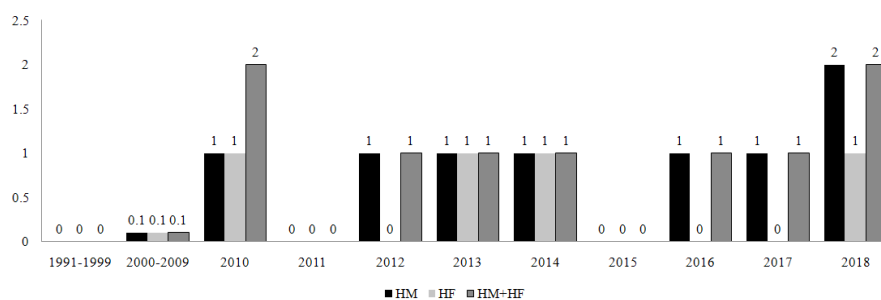
**Table IV**

The mean, standard deviation and p-value for the keywords "Rhodiola rosea and cortisol"

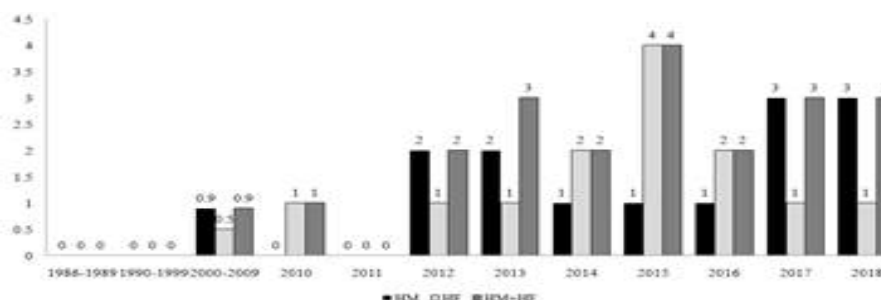
Period 1991-2018	N	HM	HF	HM+HF
Mean	0.625	0.1	0.0917	0.1833
Standard Deviation	0.6112	0.2769	0.2752	0.5505
p for comparison with N	-	0.0406	0.0191	0.0725
p for comparison with HM+HF	-	0.3876	0.2576	-

*d. Analysis of the keyword "Rhodiola rosea and anxiety"*

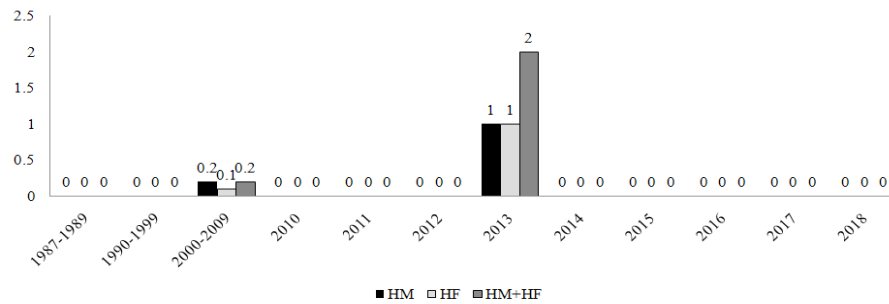
It was found that (Fig. 4): N/Y for HM was higher than for HF in 2013; HM and HF had the same number of studies between 2000-2009 and in 2015 (=1); N/Y for HM+HF was the highest in 2013 and 2015 (each=1); the



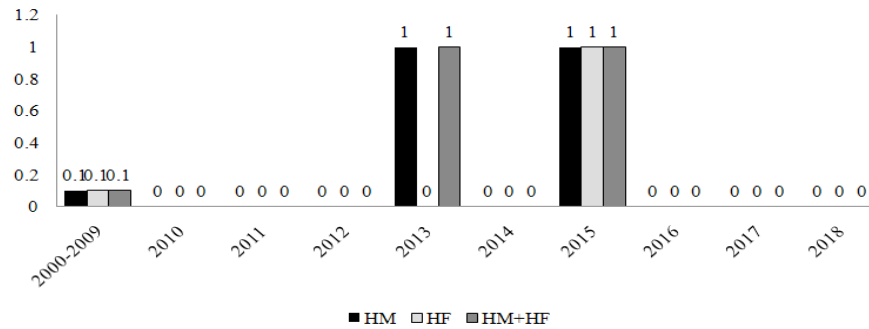
**Figure 1** - N/Y for the keyword "Rhodiola rosea adaptogen".



**Figure 2** - N/Y for the keywords "Rhodiola rosea and stress".



**Figure 3** - N/Y for the keywords "Rhodiola rosea and cortisol".



**Figure 4** - N/Y for the keywords "Rhodiola rosea and anxiety".

site published no studies for: HF in 2013; HM, HF and HM + HF between 2010-2012, 2014 and 2016-2018.

The differences were significant between (Table V): N-HM ( $p=0.0012$ ); N-HF ( $p=0.0007$ ) and N-HM+HF ( $p=0.0012$ ). There were no significant differences between: HM+HF-HM ( $p=0.5$ ) and HM+HF-HF ( $p=0.3154$ ).

**Table V**  
The mean, standard deviation and p-value for the keywords "Rhodiola rosea and anxiety"

Period 1991-2018	NM	HM	HF	HM+HF
Mean	1.64	0.21	0.11	0.21
Standard Deviation	1.151	0.3961	0.2982	0.3961
p for comparison with N	-	0.0012	0.0007	0.0012
p for comparison with HM+HF	-	0.5	0.3154	-

## Discussions

### A. Analysis of the total number (N) of publications

The main interest of studies regarding the selected keyword combinations was in RRS, followed numerically by RRAD. It can be observed that although RR is an adaptogen, the studies in which the word adaptogen was found were much fewer compared to those referring to RR and stress, even though the quality of adaptogen refers to stress. The increased interest in the relationship between RR and stress is also evidenced by the much longer time period during which the studies were conducted, compared to the periods for RRAD, RRC and RRA.

### B. Analysis of keywords

"*Rhodiola rosea* adaptogen". The number of studies on HM was consistently higher than that of studies on HF,

showing that interest in male subjects was higher.

"*Rhodiola rosea* and stress". There was interest in both HM and HF studies, which were more numerous in 2014, 2015, 2016.

"*Rhodiola rosea* and cortisol". Gender references were completely absent, except for the period 2000-2009 and the year 2013, when there was similar interest in studies with subjects of both genders.

"*Rhodiola rosea* and anxiety". Gender mentions were very few, only in the period 2000-2009 and over the years 2013 and 2015, when there was similar interest in studies with subjects of both genders.

Regarding the Gender filter, studies for all the chosen keyword combinations were reduced numerically, but there was an almost constant increase in interest starting with 2012. For the entire period of publications, the greatest research interest was in subjects of both genders.

## Conclusions

1. The studies regarding *Rhodiola rosea* as an adaptogen were analyzed from the first publications posted by PubMed, regarding RRAD, RRS, RRC and RRA, until the end of 2018, for a total period of 32 years.

2. The studies regarding RRAD, RRS, RRC and RRA, although reduced numerically (154), show an increase in time, the highest interest being in RRS, and the lowest interest, in RRC.

3. Most studies on RRAD, RRS, RRC and RRA were performed in human subjects, of both genders.

4. This study shows that, although there is still modest interest in publications on RR as an adaptogen, it is still increasing.

## Conflicts of interest

Nothing to declare.

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## Websites

- (1) <https://dictionary.apa.org/kolmogorov-smirnov-two-sample-test>

## REVIEWS

# Evaluation methods in idiopathic scoliosis

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### Abstract

Idiopathic scoliosis evaluation remains a challenge for both the clinician and the patient for the entire period of morphological changes related to pubertal growth. Traditionally, idiopathic scoliosis evaluation and monitoring involves repeated exposure to X-rays, which can increase the risk of cancer in children. To reduce the consequences on human health, modern computer technology has developed non-invasive methods to monitor the evolution of scoliosis, such as raster-stereography, computerized photogrammetry and ultrasonography.

The aim of the study is to identify, on the one hand, the methods of diagnosis and evaluation of scoliosis and, on the other hand, to present the advantages and disadvantages of each method, so that the clinician can establish an accurate diagnosis and risk-free monitoring over time.

**Keywords:** evaluation, raster-stereography, computerized photogrammetry, ultrasonography.

## Introduction

Idiopathic scoliosis is an evolutive disease, characterized by a three-dimensional torsional deformation of the spine and trunk (Grivas et al., 2006), of multifactorial etiology, which has not yet been elucidated. The main diagnostic criterion is the deviation of the spine in the frontal plane with a minimum of 10° (Cobb, 1948 cited by Weiss, 2015), accompanied by the vertebral rotation (Lam et al., 2008), observable on the X-ray, of the spine. Due to its evolutive nature, scoliosis requires careful monitoring, especially during the period of maximum vulnerability of the spine to deformation, more precisely during the period of pubertal growth spurt. Both the diagnosis and the follow-up of scoliosis are based on clinical and radiological examination.

The aim of the study was to identify, on the one hand, the methods of diagnosis and evaluation of scoliosis and, on the other hand, to present the advantages and disadvantages of each method, so that the clinician can establish an accurate diagnosis and risk-free monitoring over time.

We classified the methods of diagnosis and evaluation of scoliosis as irradiating radiological options and non-irradiating non-radiological options.

### Irradiating radiological methods

#### a) Spine X-ray

Cobb angle measurement on spine radiographs, performed in orthostatism, is currently presented as the

gold standard in the diagnosis of scoliosis (Cobb, 1948).

The Cobb angle is determined manually by means of a goniometer and represents the angle formed at the intersection of the parallel lines drawn at the edge of the upper and lower plateau of the most inclined vertebrae of the scoliotic curvature (Katz et al., 1998).

Radiological evaluation usually involves two planes: posteroanterior (PA) and lateral, allowing assessment of both the Cobb scoliosis angle and the sagittal profile expressed by the kyphosis angle, the lordosis angle respectively, also with relevance in assessing the evolution of spinal deformity (Carreiro, 2009a).

Another essential parameter in the prognosis of the curvature and the monitoring of scoliotic evolution is vertebral rotation (Pinheiro et al., 2010), measured on the posteroanterior radiograph by various methods - Nash & Moe scale (Lam et al., 2008), Perdriolle method (Lam et al., 2008), or with the Raimondi “rule” (Weiss, 1995).

The rib-vertebra angle on frontal plane radiographs is a very important measurement as a prognostic factor allowing the examiner to distinguish between evolving and resolving scoliosis (Mehta, 1972).

The Risser sign constitutes a further parameter for radiographic evaluation and is useful in indicating the patient's growth status (Shuren et al., 1992).

The method, however, has significant risks. In order to obtain a “full spine” image, two (digital) radiographs are assembled together, in fact a double exposure.

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In addition, in order to monitor the progression of scoliosis, patients undergo periodic radiographic examination (Kim et al., 2010), sometimes requiring approximately 25 X-ray exposures during the growth period (Coelho et al., 2013), which increases the risk of cancer in children by 2.4/1000 (Levy et al., 1996).

Cancer rates are higher for breast, lung, and ovarian cancers (Nash et al., 1979).

The age of the patient at the time of exposure is also critical (Levy et al., 1996).

Due to these factors, the radiographic irradiation technique is important.

Posteroanterior radiography and the use of a protective shield have been recommended to avoid direct exposure of the breasts and genitals (Gray et al., 1983).

Breast cancer rates are only 1/3 in patients who undergo PA radiography compared to those who have been exposed to anteroposterior radiography (Ronckers et al., 2010).

#### *b) Low radiation EOS imaging system*

A solution with a reduction of radiation to at least half up to one third of the radiation dose used for general computerized X-ray imaging is the low radiation EOS imaging system which performs a “scan of the child standing, showing the actual anthropometric parameters of the child, who supports his weight - which allows to visualize the interaction between the joints and the rest of the musculoskeletal system, especially the spine, hips and lower limbs” (Mahboub-Ahari et al., 2016).

This scanning technology can simultaneously take anterior and posterior radiographs and lateral radiographs of the spine, allowing the entire body to be viewed in a single image, without the need to assemble multiple images together. This gives an accurate picture of the musculoskeletal system, which is essential for planning diagnosis and treatment.

Scanning is performed in about 15-20 seconds, and the scanned images are immediately displayed in both two-dimensional and three-dimensional form (1).

The system also has the option of reducing the dose from low-dose to ultra-low-dose radiation, resulting in a reduction of radiation of up to 1/6 - 1/9 of the standard X-ray dose (Deschenes et al., 2010).

However, it remains an exposure to radiation, the effects of which have already been stated.

It should also be considered that the cost of a scan is much higher than the cost of a traditional X-ray film, as well as that, being an AP exposure, the radiation dose varies considerably in comparison with posteroanterior exposure.

To these disadvantages, the high cost of acquisition is added, which makes the application of EOS technology inaccessible in the vast majority of countries, including Romania. X-ray imaging in the form of classical radiography remains the routine practice (Mahboub-Ahari et al., 2016).

### **Non-irradiating non-radiological methods**

#### *a) Instrumental: the clinical-scoliometric method*

Starting from the bend forward test, called Adam's test, used to detect back asymmetry or the presence of a gibbosity, the rotation angle of the trunk could be measured using a scoliometer or an inclinometer (Carreiro, 2009b).

The scoliometer is an evaluation tool that has proven highly useful.

Scoliometer measurements showed a good correlation with radiographic measurements (Coelho et al., 2013).

As the first non-invasive and non-irradiating method, the method is used primarily in screening, justifying the execution of posteroanterior and lateral radiography in standing position for a more accurate assessment of the curvature, when the scoliometer indicates an angle of 7 degrees or more (Grosso et al., 2002; De Wilde et al., 1998).

This method has the advantage that it can be used by general practitioners, and Adam's test is widely used in the school community and among all people that are engaged in the health of children (including parents).

#### *b) MRI imaging*

Examination of the scoliotic spine by magnetic resonance imaging provides valuable information because it includes the spinal cord, soft paravertebral tissue, and allows visualization of the intervertebral discs.

Recently, studies have shown that the intervertebral disc is more involved in scoliotic deformation than the morphological alteration of the vertebra (Schlösser et al., 2014).

The disadvantages of this method are given, on the one hand, by the position in which this technique is performed, with the patient in dorsal decubitus, the deformation attenuating with the loss of gravitational forces (Knott et al., 2010), an axial loading being required to recreate this force and to provide similar images to standing radiographs, and, on the other hand, by the significantly higher cost and routine issues.

### **Computerized methods**

Non-irradiating computerized methods have been developed as a result of algorithms used to automatically extract useful information from images. The most widespread method of investigating the anatomy of the surface body is surface topography (Komeili et al., 2015). This type of analysis came from photographic images in combination with the technique of marking anatomical landmarks. Specific software programs extract information obtained from 2D image sequences, which are subjected to qualitative and quantitative analysis leading to the collection of 3D information.

As forms of controlled energy projected on the surface of interest, both light and ultrasound were used. Thus, on the one hand, stereography was born and, on the other hand, ultrasonography, as a result of echo detection (Aroeira et al., 2016).

#### *a) Raster-stereography*

Raster-stereography is a non-invasive, non-irradiating method that performs a three-dimensional reconstruction of the surface of the back and of the vertebral spine based on optical-topographic measurements of the back, based on the “photogrammetric” concept and the “triangulation method” (Drerup, 2014), with automatic detection of anatomical landmarks.

The surface of the human body reflects to a certain extent the “spatial arrangement of the skeletal structures” that are the basis, and the sensitive changes of the body

surface reflect changes in the skeletal system.

Raster-stereography has been proven to be a valid and reliable technique (Betsch et al., 2011), of high accuracy for analyzing the shape of surfaces (Knott et al., 2016).

However, it is less accurate than X-ray, because the spinal deformity is evaluated indirectly, from measurements of the surface of the back.

Raster-stereography as a non-invasive method can be a complementary and intermittent alternative method for X-ray examination - without replacing it, but only making its use less frequent. It allows to monitor scoliotic evolution and aesthetic appearance, in fact a priority for the patient (Zaharia et al., 2017).

#### *b) Computerized photogrammetry*

The computerized photogrammetric method, with wide applicability in fields such as cartography, architecture, engineering, has also been used for the control of quality and three-dimensional evaluation (Lillesand & Kiefer, 2000), as a new method for non-radiological evaluation of scoliosis (Aroeira et al., 2011).

Predominantly used in clinical practice for postural evaluation, photogrammetry also performs the assessment of the spine curvature by calculating the angle between two points on the spine (Carman et al., 1990). Thus, the angle of scoliosis is determined by joining the spinous processes in the patient in orthostatic position and subsequently measuring the amplitude of the curve formed, with the possibility of making measurements in both the frontal and sagittal plane.

The angle of scoliosis calculated by photogrammetry is not the same as the Cobb angle, the latter being measured according to the vertebral body and not according to the spinous process (D'Ossualdo et al., 2002).

Studies have shown the "reliability" (Saad et al., 2009) of the method, and it has been "validated" (Letafatkar et al., 2011; Leroux et al., 2000) as an intermittent alternative method for radiation exposure, allowing non-invasive postural evaluation.

Nevertheless, "the real applicability of this method is questionable, as it remains unclear how this technique is used to monitor postural treatment" (Furlanetto et al., 2012).

#### *c) Ultrasonographic evaluation*

With the identification of vertebral bone structures such as the spinous and transverse processes, ultrasonography has opened the possibility of using ultrasound for non-invasive evaluation of the spine (Suzuki et al., 1989; Wang et al., 2015; Nguyen et al., 2015).

Using this method, the spine is scanned between T1-S1 with a linear ultrasound probe (frequency 7.5-12 MHz), equipped with a sensor to detect the position and orientation of the probe (Brink et al., 2018). The scan is performed in maximum 30 seconds, and the software allows both manual measurement of scoliotic parameters and automatic measurement, both methods being "intra- and inter-evaluator reliable, where intra-evaluator has to do with the image acquired/analyzed by the same evaluator and inter-evaluator with the image acquired/analyzed by different evaluators" (Zhou et al., 2017).

Based on the precisely identified landmarks (the spinous process and the transverse process), the scoliosis angle

was calculated, which was found to have "strong linear correlations with the Cobb angle" (Zhou et al., 2017).

The data obtained by scanning, together with information on the position and orientation of the probe, are used by the analysis software to reconstruct the 3D model of the spine to measure axial rotation and deformation in the coronal and sagittal planes (Zhou et al., 2017).

The method has multiple applications:

- the possibility of evaluating the spine from different bending positions, right-left (He et al., 2017), from the seated or bent position (Jiang et al., 2018);
- evaluation of the flexibility of the spine from different positions (a) upright position (b) dorsal decubitus (c) ventral decubitus (d) sitting position (e) ventral bending (He et al., 2017);
- allows multiple scans as well as widening of the examined field, including the paravertebral musculature and ribs (Zheng et al., 2016);
- used in pre- and post-surgery monitoring (Zheng et al., 2016);
- therapeutic evaluation of the corset by examination before and after applying the corset (Zheng et al., 2016);
- used in screening and monitoring of scoliosis (Brink et al., 2018).

From the point of view of non-irradiating and non-invasive performances, of repeatability and multiple applicability in the evaluation of the spine, of information about spinal rotation, of muscles and of three-dimensional information, but also from the point of view of the lower operating costs, the method prevails over the other complementary methods (2).

The method is "feasible", although it tends to underestimate the scoliotic curve (Cheung et al., 2015).

## **Conclusions**

1. School screening programs are recommended for the early diagnosis of idiopathic scoliosis; Adam's test should be performed for scoliosis screening purposes, using a scoliometer.
2. It is necessary to obtain an initial radiographic image that can show the vertebral morphology and the parameters to evaluate.
3. Radiological exposure should be posteroanterior rather than anteroposterior in order to reduce irradiation of breast tissue.
4. It can be considered a complementary monitoring method that can be used in the long term.
5. The patient should be evaluated by the complementary method at the same visit when the initial radiograph is also recommended, so that a comparison of the two methods can be made.
6. Follow-up can be first performed with a non-radiographic or a low-dose radiographic method, using a traditional radiograph only in the presence of a considerable change in deformity.
7. Attention will be given to imaging examination, especially when using an indirect method, such as surface topography.
8. Monitoring at shorter time intervals is recommended in order to capture changes in vertebral deformity over time.

# Conflicts of interest

No conflict of interest and nothing to declare.

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# Teaching strategies with the purpose of abstracting the scientific language, specific to the sports domain

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## Abstract

Abstracting through symbols represents the last stage within the process of cognitive processing of a notion. Taking the form of a *specific language*, graphic representations have the role, on the one hand, to reunite in Venn diagrams the information abstracted via symbols, and on the other hand, to facilitate visualizing the connections between data and revealing some new possibilities to connect and to intertwine them. Dividing into components the entire studied matter/issue (for example, the structural units of sports training, the periodization of sports training, etc.) will lead to a more thorough acquisition of theoretical-practical knowledge, to an understanding of the relationships between two or more teaching concepts, to a comparison and critical analysis of their components, to a reduction of the learning time (emphasis being placed on learning and thorough studying of the links between the studied contents) and, not least, to the development of critical thinking. In this manner, the subjects are determined, within a formal framework, to correctly use in various teaching contexts (in writing/orally) the already known or even new lexical elements, specific to sports training. The cognitive skills formed by using these teaching strategies are the fruit of critical thinking, of cognitive acquisitions obtained through disciplined, self-corrective thinking, whose evaluation criteria are: clarity, accuracy, validity, logic and appropriateness to purpose.

**Keywords:** graphic symbol method, mathematical operation method, critical thinking.

## Introduction

Depending on the experience and the level of previous knowledge, on the motivational system and the psychological mechanisms associated with the knowledge process, teaching contents should be structured, simplified and presented in a manner susceptible to stimulate interest and facilitate understanding. Didactic logic should rely on the logic of the discipline taught, while “knowledge should be grouped around the fundamental logical structure of the science concerned, with emphasis on the most significant theses and principles for the understanding of all the other phenomena” (Nicola, 1994). In this way, decontextualization and loss of the meaning of a knowledge component within that science are avoided.

The literature classifies and details a wide variety of methods, which lead to the achievement of different types of objectives, but the graphic symbol method and the mathematical operation method have been less studied and methodologically grounded, their application spectrum being rather limited.

In essence, the pedagogical quality of a method involves its transformation from a way of knowledge proposed by the teaching staff into a way of learning in order to find the

shortest path to the exit, to knowledge, to truth: “However, there is an exit, because there are signs everywhere; their decryption creates alternatives and man must choose”, Mircea Eliade showed in his writings (Ruti, 1997).

## Abstracting of scientific terminology by using the graphic symbol method

Scientific language is composed of definitions and specific operation terms, which have the role to ensure accuracy, concision and rigor in the logical succession of ideas, allowing elimination of ambiguities and mixing of cognitive information with subject’s activity. A special category of scientific language is represented by formalized languages, in which the terms and the relationships established between them are replaced by symbols that permit information encoding and processing.

Human culture started by symbols. Regarded during evolution and in a differentiated manner, symbols have mediated the cultural-scientific dimensions of knowledge over time. Human thinking is symbolic in nature, its natural tendency being, as Descartes showed, to “imaginatively express abstract things and to abstractly express concrete things” (Cassirer, 2008). Having its own logic in relation

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to individual or collective representations, human actions possess imaginary dimensions, which span a very wide scale, from simpler or more complex hypotheses that can be verified to elements with an occult meaning that are less obvious, abstract or impossible to perceive. Being neutral in relation to truth values, a symbol carries the meaning of memorized and processed notions, because there are no mnemonic mechanisms specific to imaging representations (Miclea, 2003).

Anything can be or can become a symbol, under conditions of which in addition to the *signifier* (the visible part), the image, the sign, the abbreviation, etc., there is also a *signified* (the invisible part). Despite the polemic generated by semiology studies regarding the relationships established between the terms *sign-signified-signifier/symbol-symbolized-symbolizer*, in the majority of the specialized studies, a synonymy between the terms *sign* and *symbol* is found when defining or explaining them (Apostol, 2013). Thus, a *sign* is a symbol, an emblem, an image, etc. which indirectly represents (conventionally or by virtue of an analogical correspondence) a notion, an idea, a quality, an indicator, all that expresses, indicates or symbolizes something different from itself. If a *sign* represents the unity between the meaning and a graphic indication, a *symbol* represents an image, a conventional sign, a group of conventional signs or a conventional abbreviation used in science and technique to note certain concepts, operations, dimensions, and representing quantities, operations, processes, formulas, etc. (Cirlot, 2002; Eliade, 2013; Adkinson, 2018; Jacobi, 2018).

According to the idea that a *sign* denominates and a *symbol* expresses, the latter maintains an optimal balance between content and expression, between intellect and activity – with the mention that *signs* stand for ideas, but the ideas represented by *symbols* are their own direct significance (Butiurc , 2007; Evseev, 2007). Thus, the abstracting process of the essential and non-essential characteristics of an object, process/class of objects or class of processes confers the symbol/sign a particular structure: in a single image the subject consciously links (associates) the image (sign, symbol) with the corresponding concepts. The symbol thus becomes the sensory support of the concepts (carrier of the concepts) and is reproduced during the process of their application (Kendel & Squire, 2000; Li & James, 2006).

Being full of content and having a great force of suggestion, today symbols are accepted mainly for practical reasons, becoming carriers of the meaning of memorized and processed notions.

### Theoretical conceptualizations regarding the efficacy of using mathematical operations in the teaching process

In the process of teaching contents specific to sports training, subjects frequently do not really and timely perceive the correlations between newly taught and previously acquired notions. Not being able to easily establish quantitative content relationships between the data of a problem situation, they predominantly focus their

attention on the direct concrete final answer – mistaken or not (Chiriacescu, 2012; Fotescu, 2014; Pera, 2017). By means of the graphic symbol and the mathematical operation methods, subjects can be placed in a new learning situation, to discover truth and to associate the information obtained with practical aspects.

Venn diagrams have the role of organizing information logically, helping to eliminate terminological ambiguities and mental discomfort created by the too high or the too complex influx of information, leading to a logical organization of information. This cognitive organizer, graphically represented by the intersection of two or more circles, evidences the similarities that occur in overlapping spaces and the differences between non-overlapping sections, respectively, highlighting in this way the particular and common characteristics of the classes of objects, processes or concepts specific to sports training (Dan & Chiosa, 2008).

Using Venn diagrams will allow operating with properties of mathematical groups at all teaching stages. The criterion chosen to form a group must not generate any doubt regarding the fact that a certain element belongs or does not belong to the group. For example, if A is the group of students at a Faculty of Physical Education and Sport and B is the group of 1<sup>st</sup> year students, it can be said that B is a *part* or a *subgroup* of A or that group B is *strictly included* in group A; this will be written as  $B \subset A$ . Using *Venn diagrams*, the relationship of inclusion will be represented (Figure 1).

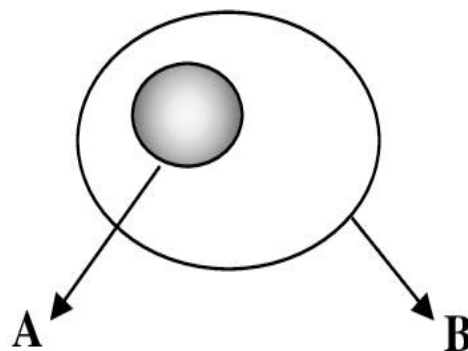
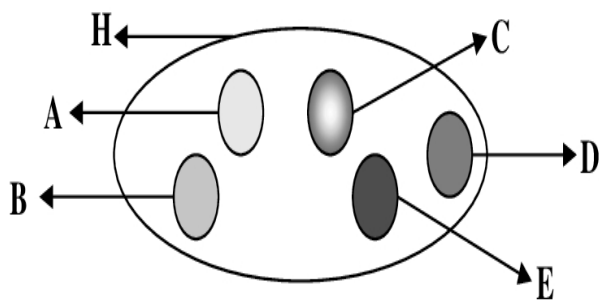


Figure 1 – Relationship of inclusion between two groups.

Similar inclusion relationships can be established for various teaching contents specific to the discipline *Theory and methodology of sports training*, such as those involving the structural elements of sports training, the periodization of sports training, sports selection, the stages of training, the components of sports training, etc.

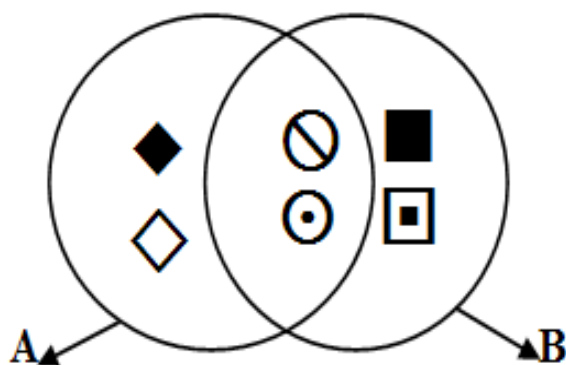
For example, by noting the training macrocycle with H, it can be found that the five types of mesocycles: A – adjustment mesocycle, B – basic mesocycle, C – preparation and control mesocycle, D – pre-competition mesocycle, E – competition and recovery mesocycle are *subgroups* of H; so  $A \subset H$ ,  $B \subset H$ ,  $C \subset H$ ,  $D \subset H$ ,  $E \subset H$  (Figure 2).



**Figure 2** – Relationship of inclusion between the training mesocycles and macrocycle.

Establishing graphic symbols for the type of exercise characteristic of each training microcycle (Dragnea, 2006):

low exercise (restoration and recovery), moderate exercise (without high-intensity exercise), moderate exercise (one lesson with high-intensity exercise), submaximal exercise (4 lessons with high-intensity exercise), exhaustive exercise (5 lessons with maximal exercise) based on *mathematical group operations*: union ( $A \cup B$ ), intersection ( $A \cap B$ ) and difference ( $A \setminus B$  and  $B \setminus A$ ) allows analyzing the typology of microcycles in terms of characteristics of the exercise composing the adjustment mesocycle – group A, and the basic mesocycle – group B (Figure 3).



**Figure 3** – Relationships between the adjustment mesocycle and the basic mesocycle.

A *union* of groups A and B, noted with  $A \cup B$ , is the group of all elements belonging to at least one of them. This will be written  $A \cup B = \{x \mid x \in A \text{ or } x \in B\}$  or  $\{ \cdot, \cdot, \cdot \} \cup \{ \cdot, \cdot, \cdot \} = \{ \cdot, \cdot, \cdot, \cdot, \cdot \}$ . It follows that the structure of the two types of mesocycles includes the types of exercise associated with the symbols.

An *intersection* of groups A and B, noted with  $A \cap B$ , is represented by the elements common to the two subgroups. This will be written  $A \cap B = \{x \mid x \in A \text{ and } x \in B\}$  or  $\{ \cdot, \cdot \}$ . This means that in the two training mesocycles subjected to analysis, two microcycles have the same exercise values: a microcycle is characterized by low exercise (restoration and recovery), while the other is characterized by submaximal exercise (3 lessons with

high-intensity exercise).

The *difference* between groups A and B, noted with  $A \setminus B$ , will contain only those elements that are included in group A and are not found in group B. This will be written  $A \setminus B = \{x \mid x \in A \text{ and } x \notin B\}$  or  $\{ \cdot, \cdot \}$  and  $B \setminus A = \{x \mid x \in B \text{ and } x \notin A\}$  or  $\{ \cdot, \cdot \}$ . From the analysis of the elements (symbols) that differentiate the two groups, it results that group A or the adjustment mesocycle is differentiated from group B or the basic mesocycle by the design and the presence of two types of microcycles: one characterized by moderate exercise (without high-intensity exercise), and the other characterized by the same type of exercise, but which includes a lesson with high-intensity exercise. Regarding the elements that differentiate group B from group A, these refer to the presence in the basic mesocycle of a submaximal exercise microcycle (4 lessons with high-intensity exercise), as well as an exhaustive exercise microcycle, in which 5 lessons with high-intensity exercise are scheduled.

If mathematical group operations allow evidencing the common elements and the particular characteristics of different sports-related classes of objects or processes, mathematical operations with brackets have the role of facilitating the deep understanding of a process, provided that this is approached in its integrality. For example, in the language specific to sports, it can be said that achievement of operational objectives will lead to fulfillment of current objectives, and these will ensure meeting of intermediate objectives, and subsequently, of final objectives. The same statement, in mathematical language, will translate as:  $\{[(x + x + \dots + x) + y + y + \dots + y] + z + z + \dots + z\} = t$ ; the first language, specific to the field of sports, involves great generalization, determined by multiple human and methodological variables; the second, mathematical, language, from which ambiguity is absent, is dominated by explainability.

A transdisciplinary teaching approach, open to mathematical logic, which aims to reconcile the contradictions between affectivity and reason, will lead to a more objective evaluation of the plausibility and relevance of the connections between the studied processes and to a deeper understanding of the problem subjected to analysis.

### Development of critical thinking by using the graphic symbol and the mathematical operation methods in the teaching process

The most important contribution of critical thinking is that it gives rise to action (any understanding is followed by action). Thinking critically means to continuously evaluate the plausibility and relevance of available data, to ask questions, to look for answers, to find alternatives to already established attitudes, to logically analyze the arguments of the others, etc. Being an efficient learning tool, it helps the subjects to choose among the available alternatives and to understand the mechanisms of their own thinking; this type of thinking “is a higher-order cognitive ability which involves intellectual autonomy, flexibility and a certain degree of constructive skepticism” (Nicu, 2007).

Because critical thinking allows the learning subjects

to keep control of information, their stimulation is required for the development of their critical reflection and self-reflection ability regarding their learning experiences (Bielitz, 2012). The development of the level of critical thinking is aimed at orienting the learning and assessment actions towards higher-order cognitive and affective behaviors leading to the understanding of one's own thinking mechanisms.

Adjusting the teaching strategies to the personality and interest of each subject will lead to the elimination or reduction of the conflicting nature of the relationships with the disciplines of motricity which, in terms of terminology and contents to be acquired, are not always harmonious (Santi, 2018). Certainly, these relationships should not be irreconcilable, because the contradicting terms are found in the learning subject, but the contradiction is also solved within the subject. The irrefutable proof is that each subject succeeds in acquiring, better or worse, in a longer or shorter time period, the contents requested by the evaluator. This aspect guarantees an intelligence that must be systematically exploited in the teaching process whenever the contents of the discipline, through the nature of the problems addressed, offers this opportunity. It is important to intelligently design acting strategies, to create teaching situations able to cognitively challenge, incite the subjects, so that their intelligence as well as that of the teaching staff manifests not only by advancing their own hypotheses at a given moment, but also by considering the arguments opposing them.

It is important that the teacher should possess careful listening techniques, that he or she should try to think with the subject, i.e. to temporarily adopt the subject's conceptual scheme, and even provide additional arguments for possible hypotheses. The teacher should receive the subject's "reply" not to discourage it, but to bring it to discussion. If the logic requires it, he or she must admit the validity of the arguments, instead of vainly persisting in defending an idea whose inconsistency or exaggeration has been proved. Only in this way is his or her own point of view reformulated, either more comprehensively or more restrictively, and the subject has the chance to develop and use flexible logical thinking, the ability to synthesize, argue and interpret the teaching contents objectively. In fact, this is also feedback, the effort to reach an agreement (be it partial) through mutual position clarifications, through an attempt to reduce divergences, through the common construction of a possible convergence or a differentiation without incompatibility, but without renouncing one's own point of view and without urging the other to do so. This is why teaching strategies should be attractive, efficient and capable of significant cognitive transformations (Creu, 2019).

Forming the bridge that links the contents taught with the new contents to be acquired, these methods create the binder between the teacher's communication needs, spanning a very wide scale, and the relatively reduced expression means available to the subject (at least during the first stages of learning). Facilitating learning and representing a useful tool for both the teaching-learning process and evaluation, these methods will lead to intellectual autonomy, to the formation of an ability to

critically analyze the teaching contents and to transfer solutions to similar situations.

## Conclusions

1. Using the graphic symbol and the mathematical operation methods at all teaching stages is not a panacea for all the theoretical and methodological contents of sports training. However, these can be successfully used whenever aiming to assess the plausibility and relevance of concepts, data, classes of objects and processes specific to sports training.

2. Practice and repeated examination by various well-organized tests, with a broad spectrum of items and different complexities, in order to stimulate curiosity and motivation create the premises for the development of subjects' cognitive abilities.

3. Using the graphic symbol and the mathematical operation methods should be considered as an alternative or a complement to the teaching methods grounded in the literature, on the one hand, and, on the other hand, as an opportunity for teachers to improve, regulate and self-regulate their didactic approach.

## Conflicts of interest

There are no conflicts of interest in this study.

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## RECENT PUBLICATIONS

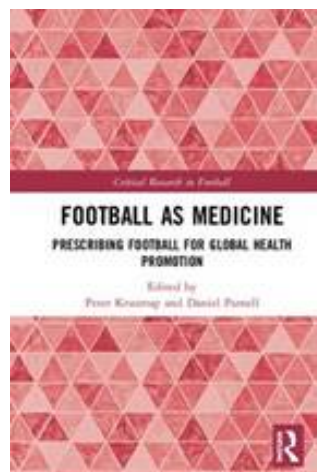
### Book reviews

#### **Football as Medicine. Prescribing Football for Global Health Promotion**

Editors: Peter Krustup, Daniel Parnell

Publisher: Routledge, London, December 2019

266 pages; price: £96.00 (paper) /from £18.50 (eBook)



The fact that sport, generally speaking physical activity, is good for human beings has been a truism for a long time. However, the fact that football itself may represent a really active and potent health promoting instrument is something that has not been frequently claimed, studied and proved. This is why the very recent book from Routledge, - *“Football as Medicine. Prescribing Football for Global Health Promotion”* – rightly draws attention, not only but especially to those interested and involved in sport, as evidently the most affordable factor of individual and public health. A book that has been designed and launched within *The Critical Research in Football* collection, a quite recent - just from 2017 - book series, which defines “football” as broader than association football and also takes into consideration research on rugby, Gaelic and gridiron codes.

No less than 75 authors from 5 continents (including here the two editors) have contributed to this 266-page text, which within its 17 chapters demonstrates that and explains how football training positively influences the three main types of fitness: cardiovascular, metabolic and musculoskeletal, in different target populations: from children to type 2 diabetes patients, from patients suffering from cancer to people with mental health conditions, from socially deprived to older persons, etc. Moreover,

as football cannot be played individually, it has the particularity of simultaneously involving more people, a particularity which in this case represents an advantage because it makes possible to plan, organize, support and supervise low-cost multi-person interventions both through community and club sport development programs.

It is worth mentioning that the concept of football as medicine is new, and somehow proposed for the first time by the two editors. More concretely, it originates in their initially separate initiatives decades ago: in Copenhagen, where Peter Krustup started to organize “family football for the parents and grandparents of his under 14 girls team”, and in Liverpool, where in 2006, within his PhD studies, Daniel Parnell started “to examine the effectiveness of football-based community interventions at Everton FC”. Later, over the years, the two researchers closely coordinated their scientific interests and efforts, so that in January 2017 the so-called “*Football is Medicine*” platform could be established. Having about 300 members in 22 countries and UEFA as the most important partner, this platform has already organized three international meetings to date. ([https://www.researchgate.net/publication/325855468\\_The\\_Football\\_is\\_Medicine\\_platform-scientific\\_evidence\\_large-scale\\_implementation\\_of\\_evidence-based\\_concepts\\_and\\_future\\_perspectives](https://www.researchgate.net/publication/325855468_The_Football_is_Medicine_platform-scientific_evidence_large-scale_implementation_of_evidence-based_concepts_and_future_perspectives)).

The great idea of the “football as medicine” concept and certainly of this work is that taking into consideration the world’s appetite for it, it is high time the game of football became the force that it could be for health and wellness. And in making readers adopt this conviction, the authors collected an impressive body of evidence coming from many fields of expertise, and provided a comprehensive up-to-date overview of both individual and population health effects that football training generates.

To shortly describe the scientific contribution of the book, we will delineate the title and/or content of each of its chapters. So, why and how football is medicine for cardiovascular disease, type 2 diabetes mellitus plus metabolic syndrome, as well as for promotion of bone health across the lifespan is documented by the first three chapters of the volume. The next chapter provides arguments that the game may be useful even for the rehabilitation of cancer patients, while chapter 5 teaches us that football could also represent broad-spectrum prevention for children and youth. A social perspective is brought to us by the next two chapters, which demonstrate the beneficial effects both in homeless and socially deprived (chapter 6) and old people (chapter 7).

Chapters 8 and 9 are dedicated to motivational aspects,

while the fundamentals of football at the workplace are presented within chapter 10. How to effectively implement “football fitness” (chapter 11), injury prevention in football (chapter 12), watching Football as Medicine, i.e. promoting health at the football stadium (chapter 13), and smartphone fitness apps and football fans: a case study of Fan Fit – Fan Fit (<http://fanfit.co.uk>) being an app designed by Salford Business School staff and students to help sports clubs and fans to communicate and think more about active, healthy lifestyles (chapter 14) – also provide essential information for understanding and implementing the concept of football as medicine. Football and mental health and the benefits coming from the policy of tobacco-free stadia – as was the case of the experiment at the 2016 UEFA European Championships in France – are the subjects

developed within chapters 15 and 16, the book ending with a comment on the policy and politics of implementing football as medicine within the English context.

Taking into consideration the actual stage of research, as well as the body of evidence and experience accumulated to date in the field, it must be concluded that the game of football is really a priceless medicine and that football training can be used as a vehicle for improving world health; in other words that “it is already time for patients to play”. This makes the present book a valuable resource not only for those involved in physical activity and health, public health, health promotion and medicine, but also for football and sport business managers.

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## EVENTS



INSPECTORATUL ȘCOLAR  
JUDEȚEAN CLUJ



### This year also the rural autumn cross country races were a success (Bor a – 4<sup>th</sup> ed., Rchi ele-Mrg u – 9<sup>th</sup> ed. and Frata – 5<sup>th</sup> ed.)

This year, all autumn cross country races took place in October, the organizers taking advantage of the extremely favorable weather for such outdoor competitions. Thus, the races were held in Bor a on 7 October, in Rchi ele on 20 October, and in Frata on 29 October. The novelty this year was that the number of participating centers and consequently the number of participants was higher than last year.

As usual, the educational health prevention project in rural areas *Sport - an alternative for a healthy life 2019-2020* started with the autumn cross country running races and will continue with cross country ski races as part of the winter competitions scheduled for January-February 2020 and with the 2020 spring cross country running races. We mention that all these are rural competitions.

#### Results

##### a) Bor a (4)

*Participating centers:* Bor a (Middle School), D bâca

(*Gelu Românul* Middle School), Rscruci (Professional School), Achiulel Mare (Middle School), Chinteni (Middle School), Apahida (tefan Pascu Middle School), Panticeu (*Iuliu Haieganu* Middle School); Mera (*Tamás Gyula* Middle School), Sânpaul (*Ioan Alexandru* Middle School), Aghire u Fabrici (Middle School), Bonida (Middle School), Cojocna (Middle School).

*General ranking:* I - Achiulel Mare Middle School; II – Chinteni Middle School; III – Rscruci Professional School.

*First place in all age categories:* 11-12-year-old boys, 5<sup>th</sup>-6<sup>th</sup> grades - Ianis Sabo - Panticeu (*Iuliu Haieganu* Middle School); 11-12-year-old girls, 5<sup>th</sup>-6<sup>th</sup> grades - Aura Lucreia Uu - Chinteni (Middle School); 13-14-year-old boys, 7<sup>th</sup>-8<sup>th</sup> grades – Raul Murean - Panticeu (*Iuliu Haieganu* Middle School); 13-14-year-old girls, 7<sup>th</sup>-8<sup>th</sup> grades - Petru a Frgu - Chinteni (Middle School). Tug of war: I - Aghire u Fabrici Middle School.

*Local officials:* Paul Ciprian Varga - director of Bor a Middle School; Maria Secar - mayor of Bor a commune.



Start to one of the girls' running races



Start to one of the boys' running races



Tug of war



Award ceremony



Award ceremony for 11-12-year-old boys, conducted by school inspector Laura Ionescu



Award ceremony for 13-14-year-old boys, conducted by school inspector Cristian Potor

**b) R chi ele-M rg u (9)**

*Participating centers:* R chi ele, Sâncraiu (Ady Endre School), S cuieu Middle School, M guri Bogd ne ti Middle School, Râ ca Middle School, Beli (Avram Iancu Middle School), M ri el (Pelaghia Ro u Middle School), C l ele Middle School.

*General ranking:* I - R chi ele-M rg u Middle School; II - Ady Endre Middle School, Sâncraiu; III - S cuieu Middle School.

*First place in all age categories:* 9-10-year-old boys, 3<sup>rd</sup>-4<sup>th</sup> grades - Darius Alexandru B la - R chi ele; 9-10-year-old girls, 3<sup>rd</sup>-4<sup>th</sup> grades - Alexandra Abrudan - R chi ele; 11-12-year-old boys, 5<sup>th</sup>-6<sup>th</sup> grades - Radu Potra - R chi ele; 11-12-year-old girls, 5<sup>th</sup>-6<sup>th</sup> grades - Kolcsar Boroka; 13-14-year-old boys, 7<sup>th</sup>-8<sup>th</sup> grades - Paul Todoru - R chi ele; 13-14-year-old girls, 7<sup>th</sup>-8<sup>th</sup> grades - Ioana B la - R chi ele.

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



The opening ceremony



View of the 11-12-year-old girls' race



Arrival of the 11-12-year-old boys' race



Preparation for the award ceremony



Award ceremony for 11-12-year-old girls



Award ceremony for 13-14-year-old girls, conducted by school director Alexandra Ro u

**c) Frata (5)**

*Participating centers:* Frata Middle School, C m ra u Middle School, Sopor de Câmpie Middle School, Luna Middle School, C ianu Middle School, Trittenii de Jos (Pavel Dan Middle School).

*General ranking:* I - C m ra u Middle School; II – Frata Middle School; III - Sopor de Câmpie Middle School.

*First place in all age categories:* 11-12-year-old boys, 5<sup>th</sup>-6<sup>th</sup> grades - Vasile Molnar - C m ra u; 11-12-year-old girls, 5<sup>th</sup>-6<sup>th</sup> grades - Raluca Juchi - C m ra u; 13-14-year-old boys, 7<sup>th</sup>-8<sup>th</sup> grades - Daniel Filip - Sopor de Câmpie; 13-14-year-old girls, 7<sup>th</sup>-8<sup>th</sup> grades - Tamara Francisc - Sopor de Câmpie.

*Local of cials:* Teodor Bara – director of Frata Middle School; Vasile Trif – mayor.



View of the 11-12-year-old girls' race.



View of the 11-12-year-old boys' race.



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



Opening ceremony conducted by the director of Frata School, Teodor Bara



Award ceremony for 13-14-year-old boys, conducted by school inspector Cristian Potor



Award ceremony for team leaders, conducted by mayor – Vasile Trif

**Cristian Potora, Laura Ionescu**  
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## FOR THE ATTENTION OF CONTRIBUTORS

### The subject of the journal

The journal has a multidisciplinary nature oriented toward biomedical, health, exercise, social sciences fields, applicable in activities of physical training and sport, so that the dealt subjects and the authors belong to several disciplines in these fields. The main 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.

Another merit of the journal is the obligatory publication of the table of contents and a summary in English for all articles. Frequently, articles are published in extenso in a language of international circulation (English, French).

The journal is published quarterly and papers are accepted for publication in Romanian and English. The journal is sent by e-mail or on a floppy disk (or CD-ROM) and printed, by mail to the address of the editorial staff. The works of contributors that are resident abroad and of Romanian authors must be mailed to the editorial staff to the following address:

### **Health, Sports & Rehabilitation Medicine**

Chief Editor: Prof. Dr. Traian Bocu

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### Objectives

Our intention is that the journal continues to be a route to highlight the research results of its contributors, especially by stimulating their participation in project competitions. Articles that are published in this journal are considered as part of the process of promotion in one's university career (accreditation that is obtained after consultation with the National Council for Attestation of University Titles and Diplomas).

We also intend to encourage the publication of studies and research that include relevant original elements, especially by young people. All articles must bring a minimum of personal contribution (theoretical or practical), that will be highlighted in the article.

In the future, we propose to fulfill criteria that would allow the promotion of the journal to superior levels according international recognition.

## THE STRUCTURE AND SUBMISSION OF ARTICLES

The manuscript must be prepared according to the stipulations of the International Committee of Medical Journal Editors (<http://www.icmjee.org>).

The number of words for the electronic format:

– 4000 words for original articles;

- 2000 words for case studies;
- 5000-6000 words for review articles.

**Format of the page:** edited in WORD format, A4. Printed pages of the article will be numbered successively from 1 to the final page.

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

**1. Title page:** Includes the title of the article (maximum 45 characters), the first name of the authors followed by their surname, workplace, postal address of the institute and postal address and e-mail of the first author. It will follow the name of the article in English.

**2. Abstract:** Original articles require a summary structured in: (Background, Aims, Methods, Results, Conclusions), of maximum 250 words, followed by 3-8 key words (if possible from the list of established terms). All articles will have a summary in English. Within the summary (abstract), abbreviations, footnotes or bibliographic references should not be used.

*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.

## 4. References

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).

## Conflict of interest

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

## Acknowledgements

The specifications must concern only people outside the study who have had a substantial contribution, such as statistical processing or review of the text in English. The authors have the responsibility to obtain the written permission from

the persons mentioned within the respective chapter, in case readers refer to the interpretation of results and conclusions of these persons. Also it should be mentioned if the article uses partial results from certain projects or if these are based on master or doctoral theses defended by the author.

#### **Peer-review process**

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

#### **Ethical criteria**

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

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

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

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.

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

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#### **INDEXING**

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