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Original Article

Effects of whole-body electrostimulation and acroyoga based exercise programme on blood pressure in a group of young women

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Abstract
The major objective of this study was to investigate the blood pressure response after ten weeks of acroyoga and whole body electromyostimulation training programme. Twenty-eight young non-smokers and non-sportive women (21.5±1.9 years; 166.2±6.6 cm, 61.8±6.7 kg; BMI 22.4±2.44 kg/m^2; fat-free mass 25.4±2.56 kg; < 60 minutes regular physical activity per week) participated in the study, 10 in an whole-body electromyostimulation (WB-EMS) group, 10 in an acroyoga group and the remaining 8 in a control group. The most meaningful results to emerge from the data is that acro yoga exercise programme (AYEP) and WB-EMS group led to a postexercise decrease in BP. A clear benefit of AYEP was identified in the analysis. The results indicate statistical significant difference in AYEP group between the beginning and the end of study ($SBP_{pre\text{-}test}$: 124.50 ± 8.31 mmHg vs. $SBP_{30\ min\ post\text{-}test}$: 119.53 ± 11.27 mmHg, *p= 0.0445*; $DBP_{pre\text{-}test}$: 87.5 ± 3.02 mmHg vs. $DBP_{10\ min\ post\text{-}test}$: 81.23 ± 4.44 mmHg, *p= 0.0498*; $DBP_{pre\text{-}test}$: 87.5 ± 3.02 mmHg vs. $DBP_{30\ min\ post\text{-}test}$: 80.98 ± 3.61 mmHg, *p= 0.0311*). From the outcome of our investigation, AYEP was much more beneficial with regards to post-exercise hypotension in comparing with WB-EMS group.
Key Words: exercise; hypertension; stress test; post-exercise hypotension; physical activity

Introduction

Hypertension is one of the risk factors increasing cardiovascular disease morbidity and mortality. Physical activity has been established to provide many health benefits in both cardiovascular patients and the general population. Nevertheless, up to 31 % world population do not meet the current minimum recommendation on physical activity (Kohl et al., 2012) At the especial risk of hypertension development as a result of the sedentary lifestyle there are people with a long-term spinal cord injury (Adriaansen et al., 2017; Chase, 2004). However, novel forms of exercise provide the health benefits of recommended physical activity for people who are unable or unwilling to undertake the conventional forms of exercise. Post-exercise hypotension, caused by a persistent reduction in vascular resistance, mediated by the autonomic nervous system and vasodilator substances, has been observed in both normotensive and hypertensive individuals.

Furthermore, the post-exercise hypotension has been associated with after exercise plasma volume recovery and with long-term adaptations to exercise training (Halliwill, 2001). WB-EMS stimulates all main muscle groups simultaneously during a moderate exercise and can be considered as a time-efficient option to high-intensity resistance exercise improving the general strength (Wolfgang Kemmler et al., 2016). Furthermore, WB-EMS affects positively the body composition and fitness parameters by enhancing the energy expenditure and by improving the isometric strength (Boccia et al., 2017; Maggioni et al., 2010), and it has been observed to be an effective method for cardio-metabolic risk factors prevention in previous studies (Wolfgang Kemmler, Kohl, Freiberger, Sieber, & von Stengel, 2018; Wittmann et al., 2016).

Yoga exercise is a combination of asana (physical postures), pranayama (breathing techniques) and meditation influencing both, physiological and psychological health factors. In previous studies, yoga has been reported to have a protective effect against cardiovascular disease risk factors including blood pressure (BP) and heart rate (Innes, Bourguignon, & Taylor, 2005; Satin, Linden, & Millman, 2014). Furthermore, a regular yoga practice was observed to be as effective as a medical therapy in controlling BP in patients with hypertension (Murugesan, Govindarajulu, & Bera, 2000). Acroyoga, which is getting widespread since 2003, combines the yoga practice of asana, acrobatics, and Thai yoga massage, concentrating more on strength and balance elements than others yoga types and the connection and trust as it is partner-based ("How to Find the Right Yoga Style for You: Explore Types of Yoga - Yoga Journal," n.d.). It's socializing, and health is improving aspects are also used in lessons of Therapeutic flying, acro yoga classes for people with a spinal cord injury. Additionally, acroyoga provides benefits such as vertebral column stretching, joint mobilization or movement coordination,

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especially needed in the wheelchair population. The only requirement for the lesson is a triceps muscle functionality.

Both, traditional and resistance exercise, as well as novel methods, e.g., WB-ESM, which provide an alternative for patients unable or unwilling to undertake the conventional exercise (Banerjee, Caulfield, Crowe, & Clark, 2009), were described to have a beneficial effect as prevention of cardiovascular disease. The purpose of this study is to compare the BP response after ten weeks of acro yoga and WB-EMS training programme.

Material & methods

An experimental approach to the problem

This study aimed to investigate the effect of electromyostimulation (EMS) and acroyoga exercise programme (AYEP) in a group of healthy young untrained women. We supposed that EMS would be beneficial for lowering BP levels the same as AYEP.

Participants

Our sample consisted of 28 healthy young non-smokers and non-sportive women (< 60 minutes regular physical activity per week) (mean±S.D. for age, height, body mass, body mass index, free fat mass are 21.5±1.9 years; 166.2±6.6 cm and 61.8±6.7 kg, 22.4±2.44 kg/m^2, 25.4±2.56 kg respectively) without any signs of symptoms of high BP. Table 1 shows the physical characteristics of the participants. Inclusion criteria: 1. Women aged 18-25 years 2.

No history of pre-hypertension or hypertension in the last one year 3. No experience with the similar experimental exercise protocol 4. No history of vascular disease 5. No history of cardiovascular and metabolic diseases 6. Signed an informed consent form. A written consent form was obtained from each participant according to the guidelines of the institutional ethics committee. Participants were instructed to refrain from drinking alcohol and coffee beverages and also refrain from any kind of intense physical activity 48 hours preceding testing. Participants were asked to maintain their normal daily regimen with the same amount of physical activity and usual daily lifestyle.

Table 1. Baseline characteristics of the WB-EMS, AYEP and control group

Variable	***WB-EMS*** (n=10)	***AYEP*** (n=10)	***Control group*** (n=8)
Age (years)	22.5 ± 1.91	22.7 ± 0.85	23.4 ± 2.01
Body weight (kg)	61.64 ± 7.23	64.11 ± 5.11	62.11 ± 6.22
Body height (m)	1.67 ± 0.05	1.64 ± 0.09	1.65 ± 0.08
Body mass index (kg·m^{-2})	22.68 ± 1.11	23.8 ± 1.05	22.77 ± 1.09
Body fat (%)	23.23 ± 5.85	26.03 ± 4.12	24.94 ± 6.17
Fat free mass (kg)	26.05 ± 2.29	28.01 ± 1.89	27.17 ± 3.29

Study design

The main aim of this investigation is to assess the effect of WB-EMS and AYEP programme on BP during the experimental bicycle test and also after ten weeks the selected exercises programme.

All three precisely controlled bicycle tests were performed in an air-conditioned laboratory at a temperature of 21º C at the same time of the day and the same weekday (from 8:00 am). All participants attended testing on three occasions (one familiarization tests, and two identical experimental test before and after the ten weeks of study experiment). Firstly, the anthropometric characteristic was recorded, and also participants performed familiarization experimental test on a standard bicycle ergometer (Lode Excalibur Sport, Groningen, The Netherlands) which was not used in data analyses. Participants were instructed to maintain their cadence 60-65 rpm during all tests. Subsequently, participants performed two experimental tests (before and after the 10 weeks of study experiment), which lasted 19 min (4 min warm-up phase 1W/kg of body weight, 5 min phase 1.5W/kg of body weight, 4 min phase 2W/kg of body weight, 3 min phase 2.5W/kg of body weight, 3 min cool-down phase 0.5W/kg of body weight). All session included the measurement of systolic (SBP) and diastolic blood pressure (DBP) during the last 30 seconds of each phase of testing. During the familiarization and all subsequent tests, the pulmonary gas exchange was measured using an automated open circuit gas analysis system (Metalyzer®3B, Cortex).

Measures

BP measurements during incremental exercise testing

SBP and DBP were measured with an ausculatory BP modul for use during ergometry stress testing. For the purpose of the study, the SBP and DBP were measured 30 sec before the end of each phase of testing.

Anthropometric and body composition measurements

The body height was measured without shoes using a calibrated stadiometer (Tanita HR-001) The body weight was measured with a digital weight scale (Tanita HD-366). The measurements were allowed with only light clothing. The findings were recorded at 9:00 a.m.

Body composition measurements with the direct segmental multi-frequency bioelectrical impedance analyser (Inbody 230).

Acro-yoga exercise programme

The interventional program lasted ten weeks, and each class lasted 80 minutes. BP and heart rate (HR) were measured pre- and ten and thirty minutes after exercise. BP was taken for the first time in both arms; follow-up measurements were taken in the arm with the highest BP. The AYEP was under the supervision by a trained specialist. The exercise programme was divided into two parts. First part lasted five weeks and took place two times a week. The remained five weeks; the interventional program took place once a week. Each session started with 5 min warm-up period which was the same for each lesson. Warm-up period consisted of 3 Sun Salutation including Mountain pose (tadasana), standing forward bend (uttanasana), half standing forward bend (ardha uttanasana), plank pose, four-limbed staff pose (chaturanga dandasana), upper-facing dog (urdhva mukha svanasana) and downward-facing dog (adho mukha svanasana). At the end of each lesson, the programme was added to cool down period (20 min, stretching and relaxation exercises).

All participants tried both positions - base and flyers position (Table 2). To better understand, all positions are shown in Figure 1.

Table 2. Acroyoga workout protocol

Exercise sequence	**The main part of the lesson** (55 min)
Lesson 1	front bird, bow, whale, folded leaf
Lesson 2	throne, chair, foot to shin
Lesson 3	back bow, nataraj, crotch lever
Lesson 4	shoulderstand, shoulderstand on thighs, shin to foot, transitions: foot to shin - front bird a whale - chair - throne
Lesson 5	transition chair from handstand, hammock, panda
Lesson 6	Vishnu´s couch and transition to throne and whale
Lesson 7	multiple session (positions in 3 and more people)
Lesson 8	Creating the sequence (front bird - throne - vishnu´s couch - whale - chair - foot to shin - foot to shin - shin to foot - front bird - folded leaf - shoulderstand - front bird)
Lesson 9	straddle bat, bat
Lesson 10	the repetition of all positions and routines

Figure 1. Acro-yoga exercise programme

Whole body electromyostimulation (WB-EMS) training

The Miha Bodytec training system was used for EMS in our study. Participants were wearing an exercise west with electrodes in the areas of the (upper legs, upper arms, buttock, abdomen, chest, lower back, upper back, and latissimus dorsi muscle). Ten days before the experiment programme, the WB-EMS group underwent a whole familiarization body EMS training. The whole training was under the supervision by a trained and licensed WB-EMS trainer familiar with this field of application.

WB-EBS training lasted ten weeks, and it was divided into two parts. The first five weeks consisted of 10 WB-EBS sessions (each session lasted 22 minutes). The remaining five weeks consisted of one WB-EBS session per week. Each WB-EBS training started with warm- up which consisted of 6 minutes of electromyostimutation (5-10 Hz pulses lasting 150 µs). Stimulation frequency was set up of 100 Hz, with a pulse duration of 350 µs intermittently with 4 seconds EMS followed by 15 seconds of rest. The intensity of stimulation was identified during the familiarization session according to the pain threshold. The force during the ten weeks was at least 60% of the familiarization maximal voluntary contraction (MVC) score. Any participant did not report serious pain or discomfort throughout the WB-EBS training. The participant was instructed to perform the movement protocol (Table 3) during the impulse boost without any additional weights in a standing position. BP and heart rate (HR) were measured pre- and ten and thirty minutes after exercise. BP was taken for the first time in both arms; follow-up measurements were taken in the arm with the highest BP.

Table 3. Movement protocol

Exercise sequence	Exercise	Number of repetitions
0	Basic static position	
1	Half-squat	12
2	Trunk rotation (each side)	8
3	Lunges (left leg to the front)	8
4	Lunges (right leg to the front)	8
5	Reverse flyes – forearms up	12
6	Chest flyes – forearms up (concentric phase only)	6
7	Side lunges (left and right)	8
8	External arm rotation (each side)	6
9	Back extension	6
10	Triceps kick back	6

Statistical analyses

A comparison between 3 groups (control, yoga exercise programme and whole body electromyostimulation group) tests were analyzed. Data were tested for normal distribution by the Kolmogorov-Smirnov test. The paired 2-sample t-test was performed to check differences between means in variables. Statistical significance was set at $p \leq 0.05$, and all data are expressed as mean ± SD.

Results

The data from the incremental cycling tests are presented in Tables 4, 5, 6. Tables 4, 5, 6 show the mean and standard deviation values for the baseline (pre-test) measurements and the final measurements after 10 weeks (post-test) of regular and controlled exercise. Baseline SBP, DBP and heart rate inside WB-EMS, AYEP and control group were not statistical significant different from each other.

As can be seen from the data in Table 4, the WB-EMS group reported statistical significant difference between pre- and post-test in values of SBP (4 min, 2W/kg and 3 min, 0.5W/kg) and DBP (5 min, 1.5 W/kg).

As Table 5 shows, there is a significant difference ($p < 0.05$) in values of (5 min, 1.5 W/kg and 3 min, 0.5 W/kg) in AYEP group. Strong evidence of yoga exercise was also found in decreasing values of heart rate at the end of the cycling test (3 min, 0.5 W/kg; Heart $rate_{pre\text{-}test}$ 126.3 ± 8.1 vs.Heart $rate_{post\text{-}test}$ 119.1 ±2.4 *p= 0.0471*).

Table 4. The effect of different types of exercise training on SBP and DBP in WB-EMS group

Variable	SBP **(mmHg)**	DBP **(mmHg)**	Heart rate **(beats·min^{-1})**	Subjective effort **(0-10)**
Pre-test (0 W)	119 ± 4.3	85 ± 4.8	95 ± 7.6	0
Post-test (0 W)	119 ± 3.9	83 ± 2.3	94 ± 5.1	0
p-value	0.5511	0.6121	0.4584	
Pre-test (4 min, 1 W/kg)	126 ± 7.2	79 ± 4.8	121 ± 7.9	4

Post-test (4 min, 1 W/kg)	124 ± 3.8	81 ± 2.6	119 ± 4.5	3
p-value	0.874	0.641	0.7333	
Pre-test (5 min, 1,5 W/kg)	149 ± 5.5	86 ± 4.6	141 ± 6.4	7
Post-test (5 min, 1,5 W/kg)	147 ± 3.9	79 ± 3.3	142 ± 5.0	6
p-value	0.4523	**0.0421***	0.424	
Pre-test (4 min, 2 W/kg)	165 ± 5.3	85 ± 6.2	165 ± 8.1	8
Post-test (4 min, 2 W/kg)	156 ± 3.1	86 ± 7.6	164 ± 7.5	5
p-value	**0.0372***	0.7124	0.8827	
Pre-test (3 min, 2.5 W/kg)	171 ± 9.2	88. 2 ± 2.2	177 ± 6.2	9
Post-test (3 min, 2.5 W/kg)	168 ± 8.6	86.1 ± 4.3	175 ± 7.7	8
p-value	0.2777	0.3147	0.8333	
Pre-test (3 min, 0.5W/kg)	131 ± 8.4	81.1 ± 7.2	131.3 ± 9.2	5
Post-test (3 min, 0.5W/kg)	123 ± 7.3	80.2 ± 3.7	126.1 ± 6.7	4
p-value	**0.0428***	0.3972	0.1479	

**p < 0.05*;
Subjective effort was scaled from 0-minimal to 10-maximal;
SBP, systolic blood pressure;
DBP, diastolic blood pressure

Table 5. The effect of different types of exercise training on SBP and DBP in AYEP group

Variable	SBP **(mmHg)**	DBP **(mmHg)**	Heart rate **(beats·min^{-1})**	Subjective effort **(0-10)**
Pre-test (0 W)	116 ± 8.8	81 ± 3.2	91 ± 6.6	0
Post-test (0 W)	117 ± 6.5	79 ± 4.1	90 ± 7.1	0
p-value	0.741	0.841	0.654	
Pre-test (4 min, 1 W/kg)	128 ± 5.7	77 ± 2.4	118 ± 3.9	3
Post-test (4 min, 1 W/kg)	126 ± 4.5	75 ± 4.7	116 ± 3.2	3
p-value	0.874	0.741	0.643	
Pre-test (5 min, 1,5 W/kg)	144 ± 7.2	78 ± 1.1	138 ± 6.8	6
Post-test (5 min, 1,5 W/kg)	139 ± 6.9	74 ± 2.7	138 ± 5.5	5
p-value	**0.0491***	0.1248	0.8791	
Pre-test (4 min, 2 W/kg)	160 ± 3.2	79 ± 2.9	163 ± 4.4	7
Post-test (4 min, 2 W/kg)	159 ± 2.4	78 ± 1.6	159 ± 2.3	7
p-value	0.6877	0.7414	0.2214	
Pre-test (3 min, 2.5 W/kg)	165 ± 7.9	85. 2 ±4.3	176 ± 4.7	8
Post-test (3 min, 2.5 W/kg)	164 ± 8.4	84.1 ± 3.2	174 ± 5.1	7
p-value	0.6781	0.4541	0.5411	
Pre-test (3 min, 0.5W/kg)	128 ± 8.4	77.1 ± 1.8	126.3 ± 8.1	5
Post-test (3 min, 0.5W/kg)	122 ± 7.3	76.2 ± 2.7	119.1 ±2.4	3
p-value	**0.0388***	0.2114	**0.0471***	

**p < 0.05*;
Subjective effort was scaled from 0-minimal to 10-maximal;
SBP, systolic blood pressure;
DBP, diastolic blood pressure

Table 6. The effect of different types of exercise training on SBP and DBP in the control group

Variable	SBP **(mmHg)**	DBP **(mmHg)**	Heart rate **(beats·min^{-1})**	Subjective effort **(0-10)**
Pre-test (0 W)	121 ± 4.9	85 ± 4.3	95 ± 1.6	0
Post-test (0 W)	120 ± 6.2	86 ± 3.8	96 ± 3.1	0
p-value	0.5121	0.7232	0.4453	
Pre-test (4 min, 1 W/kg)	129 ± 3.2	79 ± 6.1	122 ± 5.3	4
Post-test (4 min, 1 W/kg)	128 ± 3.9	80 ± 2.7	123 ± 6.8	4
p-value	0.3451	0.8994	0.4402	
Pre-test (5 min, 1,5 W/kg)	139 ± 3.8	78 ± 4.1	140 ± 3.7	6
Post-test (5 min, 1,5 W/kg)	137 ± 3.3	78 ± 6.2	142 ± 4.9	6
p-value	0.4799	0.7866	0.4116	
Pre-test (4 min, 2 W/kg)	164 ± 5.7	84 ± 4.3	165 ± 7.4	7
Post-test (4 min, 2 W/kg)	162 ± 3.9	84 ± 3.6	166 ± 5.3	8
p-value	0.6888	0.2331	0.5653	
Pre-test (3 min, 2.5 W/kg)	173 ± 5.7	88.2 ± 3.0	173 ± 5.2	8
Post-test (3 min, 2.5 W/kg)	174± 6.5	87.1 ± 3.1	173 ± 5.9	8
p-value	0.3777	0.4597	0.5642	
Pre-test (3 min, 0.5W/kg)	124 ± 3.3	81.1 ± 3.2	121.3 ± 8.1	4
Post-test (3 min, 0.5W/kg)	124 ± 2.7	84.2 ± 2.9	124.8 ± 2.2	4
p-value	0.2321	0.7322	0.2390	

$p < 0.05$;
Subjective effort was scaled from 0-minimal to 10-maximal;
SBP, systolic blood pressure;
DBP, diastolic blood pressure

The most meaningful results to emerge from the data (Table 7) is that AYEP and WB-EMS led to a postexercise decrease in BP. A clear benefit of AYEP was identified in the analysis. The results, as shown in Table 7, indicate statistical significant difference in AYEP group between the beginning and the end of study ($SBP_{pre\text{-}test}$: 124.50 ± 8.31 mmHg vs. $SBP_{30\ min\ post\text{-}test}$: 119.53 ± 11.27 mmHg, *p= 0.0445*; $DBP_{pre\text{-}test}$: 87.5 ± 3.02 mmHg vs. $DBP_{10\ min\ post\text{-}test}$: 81.23 ± 4.44 mmHg, *p= 0.0498*; $DBP_{pre\text{-}test}$: 87.5 ± 3.02 mmHg vs. $DBP_{30\ min\ post\text{-}test}$: 80.98 ± 3.61 mmHg, *p= 0.0311*).

Table 7. The effect of different types of exercise training on SBP and DBP measuring after the training sessions (presented are average values of 1st and 2nd weeks training session measurements vs. 9th and 10th)

Variable		**WB-EMS group**	**AYEP group**
SBP (mmHg)	Pre-test	125.10 ± 12.20	124.50 ± 8.31
	10 min post	122.05 ± 8.81	119.80 ± 9.95
	30 min post	122.25 ± 11.20	119.53 ± 11.27
	p value pre vs. 10 min post	0.2138	0.0971
	p value pre vs. 30 min post	0.5451	**0.0445***
		WB-EMS group	**AYEP group**
DBP (mmHg)	Pre-test	82.10 ± 4.21	87.5 ± 3.02
	10 min post	83.44 ± 4.47	81.23 ± 4.44
	30 min post	79.8 ± 276.10	80.98 ± 3.61
	p value pre vs. 10 min post	0.6419	**0.0498***
	p value pre vs. 30 min post	0.7883	**0.0311***

* $p < 0.05$
SBP, systolic blood pressure; DBP, diastolic blood pressure; WB-EMS group, Whole body electromyostimulation group; AYEP group, acroyoga exercise programme group

Discussion

The present study was designed to determine the effect of EMS and acro yoga exercise programme in a group of 28 healthy young non-smokers and non-sportive women (< 60 minutes regular physical activity per week). Our study is one of the first to explore how precisely controlled programme can influence selected parameters (SBP, DBP and changes in heart rate during the computer-controlled cycle ergometer test).

Hypertension is one of the most prevalent world chronic diseases which causes the major health consequences. It is estimated by WHO experts, that raised blood pressure currently kills nine million people every year ("WHO | A global brief on hypertension," 2013). It is important to bear in mind that the risk of hypertension does not need to be so high. Keeping the blood pressure in a healthy range requires often called healthy living habits. Efforts to prevent hypertension need to focus on improving lifestyles on a population basis which include a healthy diet, maintaining a healthy weight, getting enough physical activity, not tobacco use products and also limiting alcohol use products. Barriers to prevention include besides the insufficient attention to health education or large amounts of sodium added to food also the lack of time or access to enhance the physical activity. For these reasons, we decided to examine the effect of time-saving option type of exercise (WB-EMS). EMS is fast becoming a key instrument for some group of people who can have limitations with conventional exercise programme (extremely obese patients or older adults).

For these groups, EMS can overcome the real problems to participate in regular exercise programme with regards to having a positive benefit for body composition and also for reducing stress and high blood pressure (W. Kemmler et al., 2016; Wolfgang Kemmler, Bebenek, Engelke, & von Stengel, 2014). On the other hand, it is important to mention increasing attention to EMS as a training modality for strength training in a group of highly trained athletes (Amaro-Gahete et al., 2018; Filipovic, Kleinöder, Dörmann, & Mester, 2011; N. A. Maffiuletti et al., 2000). Summing up results from the study, we have proved our primary assumption that WB-EMS can lead to reducing blood pressure. The results of this study indicate our assumption, because the WB-EMS group reported significant statistical difference between pre- and post-test in values of SBP during the experimental bicycle test (4 min, 2W/kg, 165 ± 5.3 $mmHg_{pre-test}$ vs. 156 ± 3.1 $mmHg_{post-test}$, *p= 0.0372*; 3 min, 0.5W/kg, 131 ± 8.4 $mmHg_{pre-test}$ vs. 123 ± 7.3 $mmHg_{post-test}$, *p= 0.0428*). These findings should make an important contribution to the field of practical use or prove of WB-EMS. What is interesting in this data is that the subjective effort was also changed during the experimental bicycle test. The biggest shift was recorded for the intensity of 2W/kg for 4 min (Pre-test:8, Post-test:5). These are crucial for practical use because using WB-EMS had the positive impact on the ability to tolerate activity-related discomfort. Physical activity often is connected in physiological perception that usually novices find uncomfortable or unpleasant (sweating or pain during performing activity). This personal perception often causes or urge slowing down during the exercise or may cause stopping performing physical activity. Based on the this, it can be concluded that the underestimation of the exercise intensity may lead to overexertion even in the avoidance of activity. Our view is supported by authors who (Duncan, Sydeman, Perri, Limacher, & Martin, 2001; Ekkekakis, Hall, & Petruzzello, 2004; Lind, Joens-Matre, & Ekkekakis, 2005) confirmed the relationship between exercise intensity and perceived aversiveness. If the WB-EMS contributes to better acceptance of higher exercise intensity, this is strong evidence to include much more into regular exercise programme, especially for novices. To compare the results between WB-EMS and AYEP groups, the AYEP group did not report so much better results than WB-EMS group (for example 2W/kg for 4 min Pre-test:7, Post-test:7). We can also suppose the performance improvements which is induced by EMS training. This may originate from neural factors (Colson, Martin, & Van Hoecke, 2000) which were also proved by research (Gondin, Guette, Ballay, & Martin, 2005). Besides this, EMS can have a stimulating effect on the rate of muscle protein synthesis (Wall et al., 2012). EMS is a new form of stress for motor unit recruitment at relatively low force (Gregory & Bickel, 2005). The positive effect has been observed after four weeks of regular training under the supervision (Nicola A. Maffiuletti, Pensini, & Martin, 2002; Malatesta, Cattaneo, Dugnani, & Maffiuletti, 2003). According to this, we are confirmed, that the potential use in real sports practice as a new modern way of exercise training for aftermentioned reasons.

To compare with EMS, an AYEP was used in the study. Yoga therapy has already been proved as an effective treatment in the management of hypertension (Mourya, Mahajan, Singh, & Jain, 2009; Okonta, 2012). In our study, we decided to use acro yoga which was much more interesting for our group. Acroyoga combines yoga with acrobatics in a way which is easy to do for all participants. These combinination with acrobatics had also effect on the participant´s body composition. Breathing plays an important role in the yoga therapy. The evidence presented in this study (Mourya et al., 2009) provides and evidence that yoga therapy is one of the unconventional and cheaper ways to treat hypertension. Authors point out to the evidence of controlling of breathing influence of balance between sympathetic and parasympathetic nervous system. The participants (60 participants, 60% of patients in groups B and C were taken antihypertensive therapy) were divided into three groups (A) patients without intervention, (B) group with slow-breathing exercises, and (C) group of fast-breathing exercises. All patients were under the medical control. After the three months, improvements in blood pressure was recorded in the B and C group. What was surprising from this study (Mourya et al., 2009), that blood pressure reduction was seen even among patients who were not taken antihypertensive medication. Even, the autonomic function was statistically significant for the group with slow-breathing exercises. The results of

this study can be compared to the findings of a study (Niranjan, Bhagyalakshmi, Ganaraja, Adhikari, & Bhat, 2009). Authors claimed the combination of yoga therapy with regular exercise is the most effective strategy for BP reduction. The study intervention lasted nine months, four times a week and sixty minutes for each session.
There are similarities between our results highlighted in Table 7 and those two studies (Mourya et al., 2009; Niranjan et al., 2009). Thew statistical significant difference in AYEP group was seen between the beginning and the end of study ($SBP_{pre\text{-}test}$: 124.50 ± 8.31 mmHg vs. $SBP_{30\ min\ post\text{-}test}$: 119.53 ± 11.27 mmHg, *p= 0.0445*; $DBP_{pre\text{-}test}$: 87.5 ± 3.02 mmHg vs. $DBP_{10\ min\ post\text{-}test}$: 81.23 ± 4.44 mmHg, *p= 0.0498*; $DBP_{pre\text{-}test}$: 87.5 ± 3.02 mmHg vs. $DBP_{30\ min\ post\text{-}test}$: 80.98 ± 3.61 mmHg, *p= 0.0311*). The results of WB-EMS group also show BP reduction, but no statistically significant.

Conclusions

In summary, this study set out to determine the effect of ten weeks of AYEP and WB-EMS training programme on blood pressure response. We clearly showed that both acroyoga and electromyostimulation could be an important part in the management of hypertension. The findings suggest that this approach could also be useful for the enhancing the ability to tolerate activity-related discomfort during exercise. An implication of this is not only for novices but also for athletes.

Conflict of interest - There are no conflicts of interest concerning this paper.

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