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PERCEPTUAL RESPONSES OF PEOPLE WITH METABOLIC SYNDROME TO BLOOD FLOW RESTRICTION STRENGTH EXERCISE

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Annotation. Low-intensity resistance exercises with blood flow restriction have been shown to improve neuromuscular parameters in several clinical groups, but their tolerance and effect on people with metabolic syndrome remains unknown. This study assessed perceived exertion on the Borg scale and muscle pain response on a visual analogue scale after exercises with blood flow restriction and without restriction compared to high-intensity strength training in people with metabolic syndrome. Our results showed that both high-intensity and low-intensity strength exercises performed until the concentric failure elicit a higher level of perceived exertion compared to strength exercises with the blood flow restriction, but that blood flow restriction exercises may cause a more pronounced muscle pain response.

Introduction. Absence of physical activity and a sedentary lifestyle are considered as socially significant issues around the world. Decrease of motor activity and high-calorie diet are the main factors of metabolic syndrome (MS) [1]. Cardiorespiratory training [2] and muscle strength [3] are inversely related to the MS development. Although high-intensity training can potentially contribute to the more effective improvement of tolerance to glucose, to the decrease of the dyslipidemia and waist measures in people with MS [4], performance of these exercises requires significant physical efforts. People with MS components often face problems when performing high-intensity exercise programs. Moreover, high-intensity exercises lead to the increase in the level of perceived exertion, to the decrease of satisfaction after performing physical exercises [5], which can be considered as the factor of decrease in commitment to perform exercises regularly. Therefore, introduction of new exercise modes with low and moderate intensity, which would lead to the significant improvement of metabolic components, preserve useful effects of high-intensity exercises, but at the same time possess low perceptual

responses, can be useful for a long-term compliance with the exercise regimen by people with MS.

Low-intensity weight training sessions when combined with the blood flow restriction (BFR) raise doubts about the idea that in order to increase size and strength of muscles, heavy loads, which exceed 65% of the maximum of one repeat (the repetition maximum - RM), are required [6]. Despite this fact, other studies showed that low-intensity weight exercises with BFR are able to cause the muscle hypertrophy and the improvement of muscle strength in various population groups [7, 8].

Although it was confirmed that these exercises, performed until the concentric failure is reached, also could cause muscle hypertrophy and increase muscle strength [9], the necessity of increasing amount of exercises makes this training method unpractical. It was shown that the use of low-intensity strength exercises with the local BFR is able to increase the area of muscle cross section, as well as high-intensity strength training, while decreasing the amount of training and time until the concentric failure [10].

Main mechanisms responsible for muscle adaptation after strength training with BFR are unknown. However, it is suggested that it can be related to an increased activation of type II muscle fiber [11], accumulation of metabolites in the intramuscular environment [17], secretion of anabolic hormones [12], myoedema caused by this regimen of physical loads [14] and the activation of various molecular mechanisms [15].

Some studies showed that strength and aerobic exercises with BFR lead to increased responses of parameters in the load perception [16, 17]. For example, increase in perceptional responses caused by low-intensity weight exercises, such as an assessment of perceived exertion and discomfort in the legs, was higher when using exercises with BFR, but these responses are not higher than those, which were received when performing low-intensity strength exercises until the concentric failure [18]. Moreover, it was revealed that the mood state was decreasing after low-intensity weight exercises of with BFR, when at the same time it was not registered after low-intensity weight exercises without BFR [19]. The other study with elderly women with hypertonia showed that strength exercises with BFR revealed a lower rating of perceived exertion in comparison with traditional high-intensity strength exercises [20]. The mood improved after high-intensity aerobic training and aerobic training with BFR, similar in comparison with anaerobic training without BFR [21].

Therefore, literature data indicate an ambiguous response of perceived exertion in various population groups.

The purpose of the study is to evaluate the level of perceived exertion and pain response according to the visual analog scale (VAS) after low-intensity strength training with BFR in comparison with traditional strength training in people with the metabolic syndrome.

Methods and organization. Fifteen people (9 men, age - 34,2±4,7 years, 9 women, age - 35,4±3,5 years), who meet the MS presence criteria according to the definition given by the International Diabetes Federation, participated in this study. Each participant performed three different protocols of strength exercises, divided by the 7-day recovery period.

The first protocol corresponded with high intensity (HI) and consisted of 3 sets 10 repeats each from 80% of 1 RM with the recovery interval of 2 minutes between sets. The second protocol included low-intensity exercises with BFR (LIBFR) with the weight 30-40% of 1 RM, performed in 3 sets until the concentric failure with the 1-minute pause between sets.

In order to create the blood flow restriction in extremities, we used an elastic tape, wrapped around the proximal part with a exertion 7 according to the scale of perceived exertion (0 to 10) [22]. The elastic tape was applied before the first set and removed after the last set of the exercise.

The third protocol of low intensity without BFR (LI) corresponded 30-40% of 1 RM, performed in 3 sets until the concentric failure with the 1-minute pause. Each protocol included two exercises: leg press and standing barbell curl. After every set, the level of perceived exertion according to the Borg scale (6-20) and the level of local muscle pain when performing exercises according to the visual analogue scale of pain (VAS: 1-10) were evaluated.

Results and discussion. The results presented in the table below show that the level of perceived exertion and local muscle pain was increasing during all sets in exercises for all protocols. The perceived exertion level was significantly higher in the HI group in comparison with LIBFR and LI groups ($p<0,05$). The perceived exertion level was also higher in the LI group in comparison with the LIFBR group ($p<0,05$). LI and LIBFR protocols demonstrated similar increase in levels of the local muscle pain according to the VAS without any significant differences ($p>0,05$), however, both protocols showed a higher pain response compared to the HI group ($p<0,05$).

Interrupted BFR, which showed the same acute physiological response as the continuous BFR, can be used to decrease the local muscle pain [14]. It is also important to note that perceptional responses do not last long after BFR exercises. It was also shown before, that these responses pass after several training sessions [23].

Table

Evaluation of exertion tolerance according to the Borg scale and the VAS after various training modes (points)

Indicator	Group		
	HI	LIBFR	LI
The Borg scale	16,5±1,41	13,87±1,55	15,46±1,41
The VAS	5,92±1,46	7,28±1,45	7,57±1,19

Conclusion. The data obtained show, that both high-intensity strength exercises and low-intensity exercises performed until the concentric failure, cause the higher level of perceived exertion compared with strength exercises with BFR. Exercises with BFR can cause a more pronounced muscle pain response.

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