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Influence of experimental training with external resistance in a form of "kettlebell" on selected components of women's physical fitness

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abstract

Background An aim of this work was to determine the influence of women's experimental training using kettlebells on selected components of physical fitness.

Material/Methods Two groups of women, experimental (N = 20) and control (N = 20), took part in this study. In order to determine the influence of the training program developed by the present authors, participants were subjected to examinations aimed to assess the level of selected components of physical fitness (speed of hand movements, flexibility, explosive strength of lower limbs muscles, strength endurance of abdominal muscles and hip flexors, strength endurance of upper limbs muscles and the shoulder girdle, agility, the maximum oxygen uptake, the maximum and average power).

Results Women who participated in kettlebells training showed statistically significant changes in all the examined components of physical fitness. In this group the greatest increase (84.25%) occurred in the endurance strength of upper limbs and the shoulder girdle. However, standard fitness training was more beneficial for shaping flexibility.

Conclusions A key element to the benefit of circuit training with kettlebells use (and additional exercises carried out in this training) is a possibility to improve comprehensive physical fitness.

Key words kettlebell, women, physical fitness, experimental training

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INTRODUCTION

Kettlebell weight enables performing many multi-articular functional exercises at a different pace. It may have a positive effect on different components of a person’s physical fitness, such as strength, power, muscle endurance and oxygen function [14, 16]. In view of the beneficial influence on listed areas, it is also applied in sport, e.g. in weightlifting [17]. Amongst advantages of such training, it is also necessary to emphasize the possibility of its use in the rehabilitation of athletes with muscular dysfunctions within the back [5]. Jay et al. [14] presented that training with kettlebells can reduce pain of the neck, shoulders or lumbar area of the back by improvement in the efficiency of movement apparatus within those body parts.

In fitness training for women, there is still a need to develop different variants of methodological functional training with external resistance, aimed to shape strength, endurance or power [8, 12]. Intensive endurance-strength training with a use of kettlebell weight can effectively meet those needs. However, the influence of such training on the body composition and level of strength or endurance abilities in women is not sufficiently known yet [20]. Much more information comes from studies in which men were diagnosed. Lake and Lauder [16] stated that the group using kettlebell weight in training obtained bigger increases in maximum power and explosive strength compared to the group exercising with own body weight. Schnettler et al. [24] noticed that thanks to exercises with kettlebells he subjects have shown beneficial changes in the maximum oxygen uptake.

The aim of this study was to determine the influence of experimental training with kettlebells use, carried out by women, on selected components of physical fitness.

MATERIAL AND METHODS

The study involved 40 physically active women, aged 27–32 years, who regularly (for not less than 2 year and not more than 3 years) attended one of Cracow’s fitness clubs in which examinations were carried out. These women participated in physical activities from 3 to 4 times a week. They were selected from a group of participants in the Club’s programming activities with a use of special selection, based on a survey that was aimed to determine the test group of people of similar age, physical activity level and basic performance characteristics (heart rate at rest). Chosen candidates were divided randomly into two groups: experimental (N = 20) and control (N = 20). All participants voluntarily took part in the research project.

In order to determine the influence of the training program developed by the authors of this work, participants were subjected to examinations aimed to assess the level of selected components of physical fitness. Examinations were carried out on two days with an interval of one week, before starting and after completion of an eight-week training cycle carried out by the experimental and control group. On the first day of examinations, based on the Eurofit test [9], the following variables were diagnosed (the order of the applied tests was kept):

1. Speed of hand movements– plate tapping.
2. Flexibility – Sit-and-Reach.
3. Explosive strength of lower limbs muscles – Standing Broad Jump.
4. Strength endurance of abdominal muscles and hip flexors – Sit-Ups in 30 seconds.
5. Strength endurance of upper limbs muscles and shoulder girdle –Bent Arm Hang.
6. Agility – 10 x 5m Shuttle Test.
7. On the second day the following were examined:
8. Maximum oxygen uptake – Astrand-Rhyming test. In order to determine VO_{2max} (ml x min^{-1} x kg^{-1}), Astrand's nomogram was used [2].
9. Ability to develop maximum power – Wingate test (10-secondmodification) with the body weight on at the level of 10% [3, 10]. Additionally, during this test the participants' average performance power was examined.

CHARACTERISTICS OF TRAINING CARRIED OUT BY THE EXPERIMENTAL GROUP (E)

An aim of the experimental training with kettlebells was to shape circulatory-respiratory endurance, strength, power, speed, agility and flexibility. Methodological guidelines of the experimental training are presented in Table 1.

Table 1. Experimental training program – methodological establishments

Training program	
Number of circuits	3
Exercises in a circuit	from 3 to 5
Repetitions	from 15 to 20
Pace of performed exercises	moderate and fast
Time of breaks between circuits	2 min.

Subjects participated in experimental training 3 times a week, for 8 weeks. Each training session lasted 60 minutes and was composed of five basic stages:

1. Functional warm-up with own bodyweight.
2. Circuit weight training with kettlebells at rapid pace.
3. Circuit weight training with kettlebells at moderate pace.
4. Circuit exercises on abdominal muscles.
5. Stretching and "rest" of the body after physical training.

Ethics Commission's consent was obtained for this research at the Regional Medical Council No. 42/KBL/OIL/2015 from 15.04.2015.

CHARACTERISTICS OF TRAINING CARRIED OUT BY THE CONTROL GROUP (C)

Subjects participated in standard schedule activities at the same club as the woman from the experimental group. Each week, two aerobic and choreography trainings were carried out and one reinforcing training. Each training session lasted 60 minutes. Choreographic training consisted of warm-up and then a more extensive choreographic part. Relaxation and stretching exercises were performed at the end. Strengthening training consisted of a simple choreographic warm-up, circuit exercises with own body weight or with 2 dumbbells of a maximum weight of 1 kg, exercises on abdominal muscles, as well as relaxation and stretching exercises.

METHODS OF STATISTICAL ANALYSIS

After receiving results, the normality of the analyzed schedules of variables was examined with Shapiro-Wilk test.

For both groups the basic measures of descriptive statistics were calculated: arithmetic mean and standard deviation. The difference between the obtained results before and after 8-week training cycle for both groups was also presented in percentage values.

In order to verify whether between the two measurements of the variable ratio (whose resolution does not significantly deviate from the normal) a statistically significant difference occurs in the same group, the t-Student test was used for dependent groups.

In order to verify whether between the two measurements of the variable ratio (whose resolution significantly deviates from the normal – at least in the case of one of the measurements) a statistically significant difference occurs in the same group, the Wilcoxon rank test was used.

RESULTS

Table 2 presents results of individual tests, diagnosing selected components of physical fitness before and after an eight-week training cycle carried out by women included in the experimental and the control group. Women who participated in the training with kettlebells use showed statistically significant changes in all the examined components of physical fitness. In each case this group achieved good results in examinations conducted after eight weeks of experimental training. In turn, in the control group, statistically significant changes in a level of explosive strength of lower limbs, agility, maximum and average power were not observed.

Figure 1 presents changes in the level of individual components of physical fitness which were expressed with percentage values for both examined groups. The greatest increase (84.25%) occurred in the endurance strength of upper limbs and the shoulder girdle in the experimental group, whereas women participating in fitness activities improved this component by 4.18%. The developed training program with kettlebells improved flexibility by 28.40%, speed of hand movements by -17.30% and maximum oxygen uptake by 5.97%. The remaining components of the experimental group increased below 10.00%. The control group was characterized by the greatest increases in flexibility (45.48%), and then maximum oxygen uptake (13.37%) and speed of hand movements (11.71%).

Table 2. Results of individual tests before and after eight-week training cycle

Variable (measuring unit)	Group	Examinations before training cycle (I)		Examinations after training cycle (II)		Difference of arithmetic mean (M_{II} – M_I)	Direction of changes	t-Student test for dependent groups/ Wilcoxon test	
		M_I	SD	M_{II}	SD			t/Z	p
Speed of hand movements (s)	E	12.54	1.44	10.37	1.22	-2.17	↑	t = 11.733	0.000**
	C	12.72	1.07	11.23	1.13	-1.49	↑	t = 10.125	0.000**
Flexibility (cm)	E	12.96	8.9	16.64	8.31	3.68	↑	t = -7.757	0.000**
	C	10.07	4.71	14.65	5.8	4.58	↑	t = -8.301	0.000**
Explosive strength of lower limbs muscles (cm)	E	241.46	10.98	243.40	10.95	1.94	↑	t = -5.849	0.000**
	C	242.69	9.07	242.66	9.27	-0.03	↓	t = 0.148	0.883
Strength endurance of abdominal muscles and hip flexors (rep)	E	21.57	3.38	23.53	3.03	1.96	↑	t = -5.662	0.000**
	C	21.67	3.22	23.6	3.09	1.93	↑	t = -6.381	0.000**
Strength endurance of upper limbs muscles and shoulder girdle (s)	E	15.43	9.87	28.43	11.93	13.00	↑	t = 12.441	0.000**
	C	15.07	9.29	15.70	9.37	0.63	↑	t = -2.670	0.012*
Agility (s)	E	14.47	1.73	13.40	1.28	-1.07	↑	t = 7.911	0.000**
	C	14.18	1.34	14.26	1.34	0.08	↓	t = -1.782	0.085
Maximum oxygen uptake (ml x min^{-1}x kg^{-1})	E	39.50	6.36	45.81	6.57	6.31	↑	t = -8.646	0.000**
	C	42.11	7.22	47.74	7.24	5.63	↑	Z = -4.618	0.000**
Maximum power (W)	E	408.40	77.45	428.93	69.26	20.53	↑	t = -3.475	0.002**
	C	420.97	84.61	420.80	81.89	-0.17	↓	t = 0.053	0.958
Average power (W)	E	231.17	41.16	239.47	45.52	8.30	↑	-3.336	0.002**
	C	232.07	43.3	232.80	43.88	0.73	↑	-0.989	0.331

↑ improvement in the level of physical fitness component (result to the benefit of examinations after 8-week of cycle training)
↓ decrease in the level of physical fitness component (result to the benefit of examinations before 8-week with training cycle)

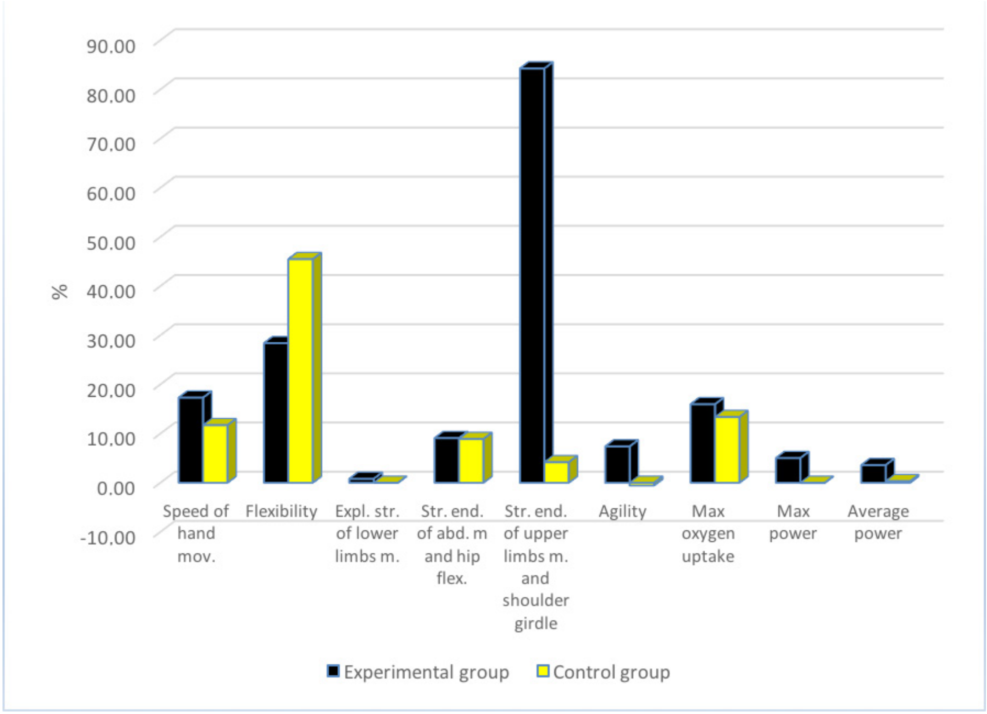

Fig. 1. Scope of changes in the level of physical fitness components for the experimental and the control group

DISCUSSION

Taking into account needs of comprehensively shaping women's physical fitness, the authors of this work decided to carry out experimental training with kettlebell weight, taking advantage of this training rise. Training was based on assumptions of circuit training with high intensity, which was supposed to enable the influence on different components of physical fitness. As results of this study indicate, women performing experimental training have statistically significantly improved all of the diagnosed components of physical fitness. In the control group, performing standard training in a fitness club, a statistically significant improvement was recorded in results of five of the conducted tests.

The conducted 8-week training in the control and experimental group had a different influence on individual components of physical fitness. Women performing exercises with kettlebells showed great changes (based on percentage values) in endurance of upper limbs and the shoulder girdle, considerably exceeding the result achieved by women included in the control group. A significant improvement in endurance of these muscle groups in the experimental group probably resulted from exercise selection. The developed training with kettlebells included such exercises as: press and its different variants as well as stabilization exercises, which clearly contribute to an increase in muscle strength of upper limbs and to stability of the shoulder girdle [28].

However, standard fitness training was more beneficial for shaping flexibility. A smaller increase in results of bending torso forward in the experimental group can result from the influence of motor tasks with external resistance carried out with significant volume. Moreover, in the developed training a dynamic exercise dominated that the subjects had not undertaken earlier and were not accustomed to them. Therefore, muscle tiredness in this group was significant, and hence, there could be a temporarily increased mobility limitation (muscle stiffness) after a conducted training cycle. It is possible that the result for this group would be more beneficial if regeneration time was extended between finishing the training cycle and examinations. According to many authors, flexibility as the anatomical-functional feature seems exceptionally dependent on the level of post-workout regeneration [23]. However, it is possible to find the confirmation that the very training with kettlebell has a significant influence on the improvement in flexibility through exercises that require workout in full-joint mobility [7].

A similar level of changes was observed in the level of VO_{2max}. This result confirmed other authors' observations [4, 26] that apart from aerobic training (carried out by the control group) also in high intensity efforts using kettlebell weight, a significant improvement in VO_{2max} is possible. This kind of activity uses oxygen and anaerobic stress metabolic pathways, which may indicate a rate of heart contractions that during endurance training with kettlebells increases disproportionately in relation to oxygen uptake in effort [11, 25]. Probably better result changes in VO_{2max} would be noted after a longer period of training, which would also be explicit with progressively applying greater external resistance.

In the experimental training, the obtained results in the maximum Wingate power test showed a statistically significant increase in the maximum and medium power. In the control group, the value of these physiological features almost did not change. This data proves that by meeting training guidelines adopted in this work with kettlebells, it is possible to shape the anaerobic power. It is possible also to draw a conclusion that aerobic training with restrained intensity does not cause substantial changes in this physiological feature. The experimental group was able to carry out definitely more workout in the time, which positively indicates a growth in global stress capabilities [15]. Simultaneously, a lack of changes in the scope of the developed power in aerobic training, according to many authors, is an adverse phenomenon for shaping comprehensive physical fitness [6, 22]. Exercises with use of external resistance performed at fast pace contribute to an increase in the power. However, the power co-decides about the general level of efficiency, indicating fitness to perform workout in the time, according to the assumptions of physics.

Very similar changes in both groups were presented in the examination test of endurance strength of abdominal muscles and hip flexors, as well as the speed of hand movements, which indicates a similar effect of both types of training on these components of physical fitness.

However, in relation to agility, identified as a combination of various coordination abilities, only training with kettlebells use has contributed to its improvement. Among others, Markowic et al. [18], Nowak and Ambroży [19], Voelzke et al. [27] wrote about the influence of circuit training with weight training at fast pace on the improvement in motor skills, such as jumping, speed and agility in the training of athletes.

Explosive muscles strength of lower limbs in the control group remained at a stable level, while in turn it slightly (although with statistical significance) improved in women performing the experimental training. Due to the nature of applied exercises with kettlebells it seems that changes should be greater. Perhaps, a different evaluation method of explosive strength of lower limbs should be applied, because in the long jump test other factors may play a role, and first of all the technique of performing this motor task may affect the result of the long jump test. This, in turn, may affect the result that describes a real level of explosive strength of lower limbs. Omorczyk et al. [21], based on their studies, also came to a conclusion that it would be more favorably to apply a different test (related to motor tasks shaping special efficiency) in examining female gymnasts. The mentioned authors did not notice any relationships between long jump performance and the quality of performed exercises by female athletes.

CONCLUSIONS

Standard – aerobic fitness training in which women participated in the experimental group in its assumptions includes mainly the development of the oxygen function. The authors of this work want to emphasize that thanks to the training proposed by them it is possible to shape other important components of physical fitness more widely.

A key element to the benefit of circuit training with kettlebells use (and additional exercises carried out in this training) is a possibility to improve comprehensive physical fitness, devoting as much time to aerobic or strengthening training.

For persons who prefer recreational training it may bean important motivator to undertake physical activity.

Author's training with kettlebells is high-intensity training, which increases metabolic rate and oxygen change also after its finishing, due to increased oxygen consumption after training (EPOC – excess post-exercise oxygen consumption).

REFERENCES

[1] Abel MG, Mortara AJ, Pettitt RW. Evaluation of circuit training intensity for firefighters. J Strength Cond Res. 2011;25(10):2895-2901.

[2] Astrand I, Guahary A, Wahren J. Circulatory responses to arm exercise with different arms positions. J Appl Physiol. 1968;25:528-32.

[3] Bar-Or O. The Wingate anaerobic test: An update on methodology, reliability, and validity. Sports Med. 1987;4:381-394.

[4] Brentano MA, Cadore EL, Da Silva EM, et al. Physiological adaptations to strength and circuit training in postmenopausal women with bone loss. J Strength Cond Res. 2008;22(6):1816-1825.

[5] Brumitt J, En Gilpin H, Brunette M, Meira EP. Incorporating kettlebells into a lower extremity sports rehabilitation program. N Am J Sports Phys Ther. 2010;5(4):257-265.

[6] Chtara M, Chaouachi A, Levin GT, et al. Effect of concurrent endurance and circuit resistance training sequence on muscular strength and power development. J Strength Cond Res. 2008;22(4):1037-1045.

[7] Cotter S. A performance-based comparison of kettlebell methods. Cross Fit J. 2007 July;59.

[8] Cormie P, McGuigan MR, Newton RU. Adaptations in athletic performance after ballistic power versus strength training. Med Sci Sports Exerc. 2010;42(8):1582-1598.

[9] Council of Europe. Eurofit: handbook for the EUROFIT tests of physical fitness. Rome: Secretariat of the Committee for the Development of Sport within the Council of Europe, 1988.

[10] Dotan R, Bar-Or O. Load optimization for Wingate Anaerobic Test. Eur J Appl Physiol. 1983;51:409-417.

[11] Farrar RE, Mayhew JL, Koch AJ. Oxygen cost of kettlebell swings. J Strength Cond Res. 2010;24(4):1034-1036.

[12] Focht BC. Perceived exertion and training load during self-selected and imposed-intensity resistance exercise in untrained women. J Strength Cond Res. 2007;21(1):183-187.

[13] Gibala MJ, Little JP, Essen MV, et al. Short-term sprint interval versus traditional endurance training: Similar initial adaptations in human skeletal muscle and exercise performance. J Physiol. 2006;575:901-911.

[14] Jay K, Frish D, Hansen K, et al. Kettlebell training for musculoskeletal and cardiovascular health: A randomized controlled trial. Scand J Work Environ Health. 2011;37(3):196-203.

[15] Jonen W, Netterville JT. Kettlebell safety: A periodized program using the Clean and Jerk and the Snatch. Strength Cond J. 2014;36(2):1-10.

[16] Lake JP, Lauder MA. Kettlebell swing training improves maximal and explosive strength. J Strength Cond Res. 2012;26(8):2228-2233.

[17] Manocchia P, Spierer DK, Minichiello J, Braut S, Castro J, Markowitz R. Transference of kettlebell training to traditional olympic weight lifting and muscular endurance. J Strength Cond Res. 2010;24:1.

[18] Markovic G, Jukic I, Milanovic D, Metikos D. Effects of sprint and plyometric training on muscle function and athletic performance. J Strength Cond Res. 2007;21(2):543-549.

[19] Nowak M, Ambroży T. Współczesny trening obwodowy w teorii i praktyce [Contemporary circuit training in theory and practice]. Kraków, FALL, 2015. Polish.

[20] O'Hara RB, Serres J, Traver KL, Wright B, Vojta C, Eveland E. The influence of nontraditional training modalities on physical performance: review of the literature. Aviat Space Environ Med. 2012;83(10):985-990.

[21] Omorczyk J, Ambroży T, Bujas P, Puszczałowska-Lizis E. The level of technical and specific skill efficiency in youth class female artistic gymnasts. JKES. 2014;66(24):33-40.

[22] Pienaar C, Coetzee B. Changes in selected physical, motor performance and anthropometric components of university-level rugby players after one microcycle of a combined rugby conditioning and plyometric training program. J Strength Cond Res. 2013;27(2):398-415.

[23] Rico-Sanz J, Mendez Marco MT. Creatine enhances oxygen uptake and performance during alternating intensity exercise. Med Sci Sports Exerc. 2000;32:379-385.

[24] Schnettler C, Porcari J, Foster C. Kettlebells: Twice the results in half the time? ACE Fitness Matters. 2010;1-2:6-11.

[25] Serpiello FR, McKenna MJ, Stepto NK, Bishop DJ, Aughey RJ. Performance and physiological responses to repeated-sprint exercise: A novel multiple-set approach. Eur J Appl Physiol. 2011;11(4):669-678.

[26] Taipale RS, Mikkola J, Nummela A, et al. Strength training in endurance runners. Int J Sports Med. 2010;31(7):468-476.

[27] Voelzke M, Stutzig N, Thorhauer HA, Granacher U. Promoting lower extremity strength in elite volleyball players: effects of two combined training methods. J Sci Med Sport. 2012;15(5):457-462.

[28] Waller M, Piper T, Miller J. Overhead pressing power/strength movements. Strength Cond J. 2009;31(5):39-49.

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