Original Article

Kettlebell Sport: endurance weight lifting. Description and analysis of the performance model.

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Abstract

The study in question aims to analyze and describe the performative model of the kettlebell sport.

The kettlebell sport is a weight lifting discipline in which the goal is to carry out as many repetitions as possible in the exercises of clean and jerk, biathlon (jerk and snatch) in the 10 minutes provided by the regulation. Four athletes of the agonist Umbria Kettlebell Training Center Team (3 men and 1 woman) were analyzed, respectively in the male biathlon (jerk 70+70 lbs and snatch 70 lbs), male biathlon under 18 (jerk 53+53 lbs and snatch 53 lbs), male clean and jerk (62+62 lbs) and female snatch (53 and 35 lbs). The investigation area is made up of three parts: anthropometric analysis, physiological analysis, electromyography analysis. The main results of the tests are the following: it is a form of weight lifting on aerobic regime (Vo2 max $40,4 \pm 5,9$ ml/kg/min, Average Heart Rate 162 ± 14 bpm, Max Ventilation $111,6 \pm 29,6$ l/min, End of test Ematic Lactate $3,3 \pm 0,29$ mmol/l) at which, in order to excel and being able to perform, effective and efficient, an optimal technique is needed to make the best use of the available energy and organic reserves avoiding any over-use injuries due to the loads lifted. The analysis of the macrocycles' training in fact, tell us the kettlebell is a sport that requires high load volumes, at which the tonnage average per training is 19K pounds circa in the elite biathlon, 17K pounds in the under 18, 12K pounds in clean and jerk and 10K pounds in the female snatch (excluding auxiliary exercises in all cases). The electromyographic analysis show that the exercise which requires the greatest muscular recruitment of both the anterior and posterior muscular kinetic chain is the clean and jerk, while the snatching exercise, being unilateral, involves the crossed muscular kinetic chains.

Further tests on a larger sample of athletes are needed to verify and eventually correct the assessments made of the study in question.

Key Words: Strength, Conditioning, Kettlebell Sport, Power Endurance, Resistance Training

Introduction

The purpose of this study is to analyse and describe the performance model of the kettlebell sport from a technical and physiological point of view. This is a sport of weightlifting, hailing from the Soviet Union, the aim of which is to perform as many repetitions as possible in the exercises of jerk, snatch and long cycle in 10 minutes as required by the regulation. There are different categories based on the kettlebell used (men series A elite 70 lbs - series B amateur 53 lbs, series C beginner 35 lbs, women series A elite 53 lbs, series B amateur 35 lbs, series C beginner 26 lbs) and inside in the same categories of body weight. After a historical description of the discipline and technique of the exercises, an extensive bibliographic review of the scientific studies on kettlebell training, has been reported, focused on the increase or not, of the consumption of oxygen, strength, power and activation of electromyography in kettlebell exercises included in the general physical preparation of athletes and amateurs.

(1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21). The only studies found in the bibliography concerning the kettlebell sport are related to the improvement of the physical efficiency of cadets of the military academy held in Ukraine in 2017, when the improvement in tests such as pull-ups, the 3 Km race and 100 m race were evaluated in subjects who performed kettlebell sports or were performing groups of classical training (22,23,24,25,26). Based on a deep research this is the first study on the subject, as at present date only a single analysis has been performed on the cardiopulmonary response during the execution of the snatch exercise in the regulation of 10 minutes, but with an amateur weight of 16 kg (27).

The investigation area is divided into three parts: anthropometric analysis, physiological analysis and electromyography analysis.

The results of tests carried out on 4 athletes of the competitive team of the Umbria Kettlebell Training Center in the competition exercises, jerk, snatch, long cycle (Fig.1-2-3), have been followed up by reports. (28)

Fig. 1 – phases of Jerk exercise

Fig. 2 – phases of Snatch exercise

Fig. 3 – phases of Long Cycle exercise

Material & Methods

Participants

All the tests are carried out on 4 athletes of the competitive team of the Umbria Kettlebell Training Center, 3 males and 1 female, Italian nationality and highly qualified (3 Master of Sports, 1 Candidate Master of Sport), with more than 15 competitions of 19, 28, 34 and 41 years, without dope.

The tests concerned all the competition exercises: Elite men's biathlon (jerk 70+70 lbs - snatch 70 lbs), male biathlon under 18 (jerk 53+53 lbs - snatch 53 lbs), male long cycle (62+62 lbs) and female snatch (53 and 35 lbs).

Procedure & Instruments

It has been submitted a retrospective analysis of the related literature and tested a protocol reaserch. The tests were carried out at the Medicenter medical office in Perugia supervised by MD Ceravolo Carmelo Antonio. Each athlete was subjected to the following assessments:

Anthropometric Analysis (Table 1)

Height, body weight, BMI (Body Mass Index), WHR (Waist-to-Hip Ratio), skin folds, resting heart rate, systolic and diastolic blood pressure

Physiological Analysis (Table 2)

Heart rate, oxygen consumption, respiratory volumes detected by FITMATE Cosmed and blood lactate in resting conditions, at the end of the test and after recovery measured by ACCUTREND PLUS Roche in a sample of blood from the ear lobe.

Electromyography Analysis (Fig. 4-5-6-7-8-9)

Electromyography analysis was carried out in all three competition exercises by FREEEMG- BTS Bio Engineering with the placement of 8 electrodes respectively on the vast medial left -right, femur biceps left and right, very long on the left - right back, left, right trapezoid.

Results

ANTHROPOMETRIC ANALYSIS

Parameter	Study 1	Study 2	Study 3	Study 4
Gender	Female	Male	Male	Male
Years	41	19	28	34
Rank	MS	CMS	MS	MS
N° match	16	16	21	42
Discipline	Snatch	Biathlon U18	Biathlon	Long Cycle

Height (cm)	173	180	178	175
Body Weight (kg)	141	80	79,5	77
BMI (kg/mq2)	21,4	24,7	25	25,1
Circumference Waist (cm)	74	85	71,5	84,3
Circumference Hips (cm)	102	94	75,5	99,4
WHR	0,73	0,90	0,95	0,85
Fat Mass (%)	22	13	10	12
Resting Heart Rate (bpm)	66	58	62	49
Resting Systolic Blood Pressure (mm Hg)	105	110	100	120
Resting Diastolic Blood Pressure (mm Hg)	70	80	70	75

Table 1 – athletes history and anthropometric analysis

PHYSIOLOGICAL ANALYSIS

Parameter	Jerk Male 24+24 kg	Snatch Male 24 kg	Jerk Male 32+32 kg	Snatch Male 32 kg	LongCycle Male 28+28 kg	Snatch Female 24 kg	Snatch Female 16 kg
Functional Capacity (MET)	8,9	10,9	12,0	12,6	13,3	8,5	9,2
VO ₂ max (ml/kg/min)	31,3	38,2	41,9	44,1	46,6	29,7	32,4
AnaerobicThreshold (ml/kg/min)	27	33,3	33,9	36,7	42,1	10,3	28,1
Average Heart Rate (bpm)	148	173	145	172	170	160	155
Max Heart Rate (bpm)	169	180	180	186	180	168	165
VO ₂ /FC Max (ml/beat)	14,8	17	18,8	18,5	19,9	11,8	13,4
Peak of Cardiac Output val. (l/min)	15,4	18,8	20,1	21,2	22,1	11,7	12,8
Peak of Volume Stroke val. (ml)	91	105	116	114	123	73	82
Max Ventilation (l/min)	70,1	93,9	117,8	135,6	140,7	76,3	79,2
Breathing Frequency (b/min)	42	44	78	77	73	39	38
Breathing Reserve (%)	56	49	35	26	12	36	34
Start test Ematic Lactate (mmol/l)	1,2	1,2	1,04	1,04	1,8	0,8	0,9
End test Ematic Lactate (mmol/l)	3,2	3,0	3,5	3,1	3,7	1,9	2,4
After Recovery Ematic Lactate (8')	1,9	1,6	2,0	1,8	2,5	1	1,1

Table 2 – report Physiological analysis

ELECTROMYOGRAPHY ANALYSIS

Fig. 4 - EMG lower district kettlebell jerk 70+70 lbs

Fig. 5 - EMG superior district kettlebell jerk 70+70 lbs

Fig. 6 - EMG lower district kettlebell snatch DX 70 lbs

Fig. 7 - EMG superior district kettlebell snatch DX 70 lbs

Fig. 8 - EMG superior district kettlebell long cycle 62+62 lbs

Fig. 9 - EMG lower district kettlebell long cycle 62+62 lbs

Dicussion

The data obtained lead us to define the Kettlebell sport as an activity of weight lifting in an aerobic regime, in opposition with its “noble brother”, the Olympic weightlifting. Making a comparison with other sports, it is very close to endurance speciality, such as the half marathon of running and swimming. The elements at the base of high performance are the efficiency of the cardiovascular and pulmonary system at central and peripheral level together with an optimal technical execution.

The electromyographic analysis show that the exercise which requires the greatest muscular recruitment of both the anterior and posterior muscular kinetic chain is the clean and jerk, while the snatching exercise, being unilateral, involves the crossed muscular kinetic chains. The analysis of the macrocycles' training in fact, tell us the kettlebell is a sport that requires high load volumes, at which the tonnage average per training is 19K pounds circa in the elite biathlon, 17K pounds in the under 18, 12K pounds in clean and jerk and 10K pounds in the female snatch (excluding auxiliary exercises in all cases).

The latter exalts the first element, since a correct technique allows an economy of the exercise that will turn into less fatigue and consequently a greater number of repetitions performed. To paraphrase Marty Gallagher in the article “New wine, old bottles” it can be said that “the system is between two worlds: strength training and cardiovascular training. It is neither pure strength training nor pure cardiovascular training. The kettlebells are between two worlds and create a compromise, taking possession of the grey area between the two disciplines.” (29)

Conclusions

This is the first study that describe the performance model of the kettlebell sport. It demonstrates that Kettlebell Sport is a form of weight lifting on aerobic regime ($\text{Vo}_2 \text{ max } 40,4 \pm 5,9 \text{ ml/kg/min}$, Average Heart Rate $162 \pm 14 \text{ bpm}$, Max Ventilation $111,6 \pm 29,6 \text{ l/min}$, end of test Ematic Lactate $3,3 \pm 0,29 \text{ mmol/l}$) at which, in order to excelle and being able to perform, effective and efficient, an optimal technique is needed to make the best use of the available energy and organic reserves avoiding any over-use injuries due to the loads lifted. To have a complete overview of the model performance of the Kettlebell Sport, a greater sample of athletes to be tested is still required.

Conflicts of interest – The authors declares that there are not conflicts of interest.

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