CORRELATION BETWEEN ANTHROPOMETRIC PARAMETERS AND ENDURANCE INDICATORS IN KETTLEBELL SNATCH

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Abstract

Kettlebell lifting is characterized by a work, with a constant hold of kettlebell in the hands. Most of this load gets in kettlebell juggling and kettlebell snatch pull. Therefore, taking into account this fact, the forearm and palm size might be just as important as strength indicators. Aim of our study was to analyses correlation indicators between anthropometrical parameters of arm and forearm and aerobic, anaerobic performance indicators and results in kettlebell snatch.

In study voluntarily participated, 20 kettlebell lifters, 11 of them were first sport class athletes and nine athletes were SMK (sports master's candidates), SM (sport masters). Kettlebell snatch results were determined in competitions and registered in protocol. To determine aerobic and anaerobic work capacity, kettlebell lifters executed complex load test with expiratory gas analysis. Testing was executed on cardiopulmonary diagnostic device "MasterSreen CPX". In forearm and hand size determination we used anthropometry. A palm and finger longitudinal dimension of the circumference of the forearm and finger strength was measured.

In assessing the results of correlation between kettlebell snatch and the hand anthropometry has shown that the tight correlation is just between finger and hand joint longitudinal dimensions. At aerobic threshold we observed medium correlation in all cases, but at anaerobic threshold all correlation results were tight.

Such a correlation confirms the fact in the literature, that the anaerobic threshold is essential for high results cyclical kind of sports where one of the prerequisites is high rate of work capacity. Longitudinal size of hand is significant and can be useful to take into account when realizing selection of new coming athletes in this kind of sport.

Keywords *Kettlebell snatch, load test with expiratory gas analysis, anthropometry of palms and forearms, handgrip strength, correlation.*

Introduction

The kettlebell lifting is cyclic kind of sport. For the beginners the main physical ability is strength. Fort the beginners achieving 15 repetitions in kettlebell lifting the main physical ability becomes strength endurance (Ромашин, 1998), then one of the most important aims in training process is to increase strength endurance level, so it is easy to lift kettlebell for 30–40 reps, but nowadays it is not enough to successfully compare in competitions, where takes place average of 100 reps.

Italian authors (Impellizzeri, 2005) have determined that the anaerobic threshold load capacity is a good cyclist work capacity indicator: between the cycling track time and the aerobic capacity of the indicators is reliable correlation (correlation coefficient ranges from – 0.68 to – 0.94, $p < 0,05$). No doubt, high endurance indicators is one of main factors in kettlebell sport, so one of the conditions for success in competitions are athlete's high aerobic and anaerobic capacity. It is therefore possible to win by another factor - their movement economy, ability to lift kettlebell at high speed with less oxygen consumption (Franch, 1998, Ingham, 2002).

Despite the kettlebell lifting is characterized by a work, with a constant hold of kettlebell in the hands. Most of this load gets in kettlebell juggling and kettlebell snatch pull. Therefore, taking into account this fact, the forearm and palm size might be just as important as strength indicators. Aim of our study was to analyses correlation indicators between anthropometrical parameters of arm and forearm and aerobic, anaerobic performance indicators and results in kettlebell snatch.

Material and methods

In study voluntarily participated, 20 kettlebell lifters, 11 of them were first sport class athletes and nine athletes were SMK (sports master's candidates), SM (sport masters). All the subjects involved

in the experiment average age was 23 ± 1.2 years, mean height 181.4 ± 2 cm, mean weight 76.9 ± 3 kg.

Correlation analysis was conducted among kettlebell competition results, complex load testing indicators (veloergometry with expiratory gas analysis) and fingers /palms /forearms anthropometric measurements.

Kettlebell snatch results were determined in competitions and registered in protocol. The results presented by the left and right hand were summarized.

To determine aerobic and anaerobic work capacity, kettlebell lifters executed complex load test (Галашко, 2008) with expiratory gas analysis. This method combines veloergometry and expiratory gas analysis techniques. Testing was executed on cardiopulmonary diagnostic device "MasterSreen CPX" (figure 1) (Lescinskis, 2010).

Figure 1. Cardiopulmonary diagnostic device „MasterSreen CPX”

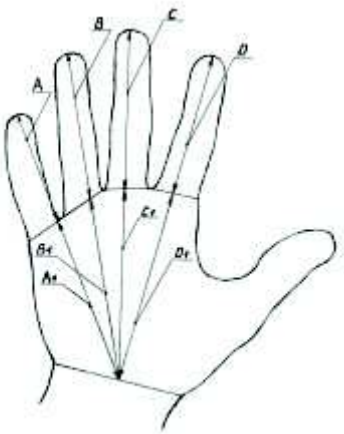

Figure 2. The measurement of specific anthropometric parameters of hand

The load test was carried out in sports physicians’ supervision and is composed of several parts; duration of them has been established by sports physician, taking into account the state of health and fitness levels (Санося, 1999). Test consisted of four stages: 1. stillness; 2. warm-up; 3. load – progressively increasing physical load; 4. recreation. Each kettlebell lifter gradually increased the load on veloergometer to starvation. Load intensity starting load phase was 50W, then it was increased by 10W each minute. Carrying out a load, cardiopulmonary diagnostic device "MasterSreen CPX recorded parameters of aerobic and anaerobic threshold, which were used for correlation: heart rate (beats/min), oxygen consumption (l/min), relative work capacity (W/kg) (Lescinskis, 2010).

In forearm and hand size determination we used anthropometry. A palm and finger longitudinal dimension of the circumference of the forearm and finger strength was measured (Jurimae, 2009, Visnapuu, 2009). During the long arm and finger size measurement we used a specific method of measurement. We used anthropometry for forearm and hand size determination. We determined longitudinal dimensions of palm and fingers, forearm circumference and finger strength (Jurimae, 2009, Visnapuu, 2009). During the palm and finger longitudinal measurement, we used very specific method. Long arm and finger size measurement we used a specific measurement method. For the measurement of finger and palm lengths we used specific measurement methods (Visnapuu, 2009). The test subject place his palm with freely extended fingers on a sheet of paper, then outline of the hand was drawn on the paper. The outlines where drawn with a thin marker that was placed perpendicularly onto the paper. The contour of the hand was drawn with maximal active voluntary adduction of thumb and other fingers. After drawing palm contour, the measurement of longitudinal dimensions with precision of 0.1cm takes place. (Visnapuu, 2009). The specific parameters of the forearm and palm were measured by the following

formula: palms lengths (A_1+B_1+C_1+D_1), overall length of fingers (A+B+C+D) and these measurements were summed ((A_1+B_1+C_1+D_1) + (A+B+C+D)), so we determined overall length of palm and fingers (figure 2). Parameters of both hands were summed together.

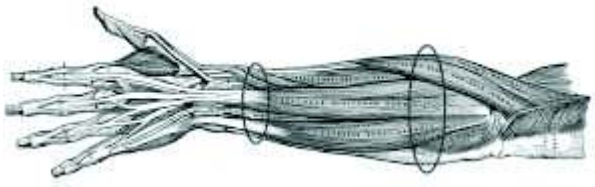

Figure 3. The measurement of forearm anthropometric parameters

Figure 4. Dynamometer of handgrip strength

Circumference of forearm was measurement in most slender and largest part of forearm (figure 3). Measurements were made by measure tape with 0.1cm precision, and measurements of both hands forearms were summed together.

For determination of finger and palm flexors maximal strength dynamometer was used (figure 4). Best results of each hand were summed together. To process various data and results, we used descriptive statistics, Pearson [r] and Spearman [r_s] correlation coefficient. The difference was considered to be reliable when $p<0.05$ (Dravnieks, 2004).

Results

Correlation analysis between all hands, forearm anthropometric measurements and physical training tests with complex load and kettlebell snatch results were carried out. In kettlebell snatch result correlation with palm's longitudinal size we observed significant ($p>0.95$), but weak correlation - $r = 0.486$, between the finger longitudinal size $r = 0.553$ (medium correlation), with the fingers and palms overall longitudinal dimensions $r_s = 0.889$ (tight correlation), with the relative work capacity at the aerobic threshold $r = 0.644$ (medium correlation), with relative work capacity at anaerobic threshold $r = 0.942$ (tight correlation), with the aerobic threshold heart rate $r_s = 0.652$ (medium correlation), with the anaerobic threshold heart rate $r = 0.742$ (tight correlation), with the respiratory capacity at aerobic threshold $r = 0.670$ (medium correlation), with the volume of the respiratory at anaerobic threshold $r = 0.786$ (correlation) (table 1, Figure 5, Figure 6).

The correlation results of kettlebell snatch is not significant ($p <0.95$) with arm circumference $r = 0.075$, with a palm handgrip strength parameters $r = - 0.346$ (table 1, Figure 5).

Table 1.

Correlation results of kettlebell snatch with anthropometric parameters of hands and forearms and load test indicators at aerobic (AeT) and anaerobic (AnT) threshold

	Measurement	module of correlation coefficient [r]	Correlation description	Significance of correlation [p]
Anthropometric parameters	palm longitudinal size (cm) (A_1+B_1+C_1+D_1)	r=0.486	weak correlation	Correlation significant (p>0.95)
	finger longitudinal size (cm) (A+B+C+D)	r=0.553	medium correlation	
	finger and palm summed longitudinal size (cm) ((A_1+B_1+C_1+D_1)+(A+B+C+D))	r_s=0.889	tight correlation	
	forearm circumference (cm)	r=0.075	weak correlation	Correlation insignificant (p<0.95)
	handgrip strength (kg)	r= - 0.346		
AeT	relative work capacity (W/kg)	r=0.644	medium correlation	Correlation significant (p>0.95)
	heart rate (beats/min)	r_s=0.652		
	oxygen consumption (l/min)	r=0.670		
AnT	relative work capacity (W/kg)	r=0.942	tight correlation	Correlation significant (p>0.95)
	heart rate (beats/min)	r=0.742		
	oxygen consumption (l/min)	r=0.786		

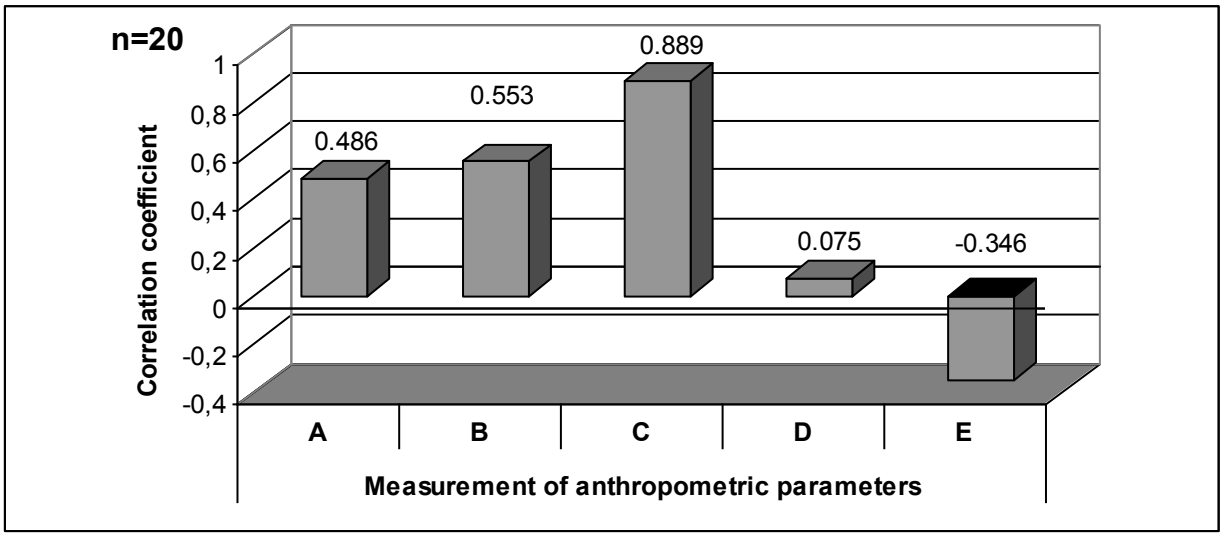

Figure 5. Correlation results of kettlebell snatch results with anthropometric parameters of hands and forearms

In figure 5 we see correlation results between kettlebell snatch and palm and forearm anthropometrical measurements, where: A – palm longitudinal size; B – fingers longitudinal size; C – fingers and palms summed longitudinal size; D – forearm circumference; E – handgrip strength.

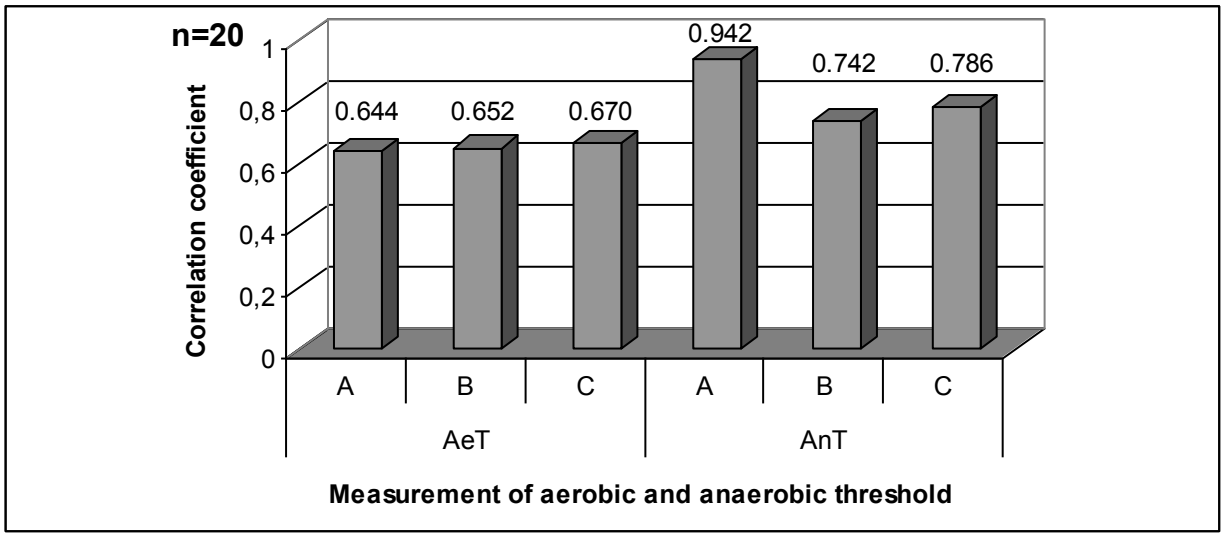

Figure 6. Kettlebell snatch results correlation with
load test indicators at aerobic (AeT) and anaerobic (AnT) threshold

In figure 6 can be seen correlation results of kettlebell snatch with the results of complex load test at aerobic (AeT) and anaerobic (AnT) threshold: A – relative work capacity (W/kg), B – heart rate (beats/min), C – oxygen consumption (l/min). At aerobic threshold we observed medium correlation in all cases, but at anaerobic threshold all correlation results were tight.

Discussion

Adult amateur level athletes have observed a close correlation between their aerobic capacity and the result in resistance loads.

A close correlation has been observed between kettlebell snatch and the anaerobic threshold parameters. Such a correlation confirms the fact in the literature, that the anaerobic threshold is essential for high results cyclical kind of sports where one of the prerequisites is high rate of work capacity.

In other endurance sports like marathon, there is a close correlation between the run results and workload of anaerobic exchange threshold, where the correlation coefficient between these parameters is from – 0.88 to – 0.99.

In assessing the results of correlation between kettlebell snatch and the hand anthropometry has shown that the tight correlation is just between finger and hand joint longitudinal dimensions, which means that the longitudinal size is significant and can be useful to take into account when realizing selection of new coming athletes in this kind of sport.

The study showed that the correlation is not reliable with the circumference of the forearm and handgrip strength, which means that athletes, reaching a certain maximum force level of handgrip and forearm circumference, should pay greater attention to the forearm muscle specific strength development.

Conclusions

Correlation analysis of the data showed that correlation of all parameters is not statistically significant. All the correlation coefficient of the modules is not greater than the critical value.

A close correlation has been observed between kettlebell snatch and the anaerobic threshold parameters. Therefore, to achieve an adequate evolution of heart, circulatory and respiratory systems, resistance training should start right from young age.

In assessing the results of correlation between kettlebell snatch and the hand anthropometry has shown that the tight correlation is just between finger and hand joint longitudinal dimensions.

The study showed that the correlation is not reliable with the circumference of the forearm and handgrip strength.

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