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Correlation between Anthropometric, Physical Fitness Traits and Lung Capacities with Success of Iranian Elite Greco-Roman Wrestlers

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Abstract

The aim of present study was to evaluate the relation of anthropometric, physical fitness traits and lung capacities with success of Iranian elite Greco-Roman wrestlers. Twenty five Iranian elite Greco-Roman wrestlers (22 ± 4 years old) (both of light and heavy weights) participated in present study. Anthropometric characteristics, physical fitness traits and lung capacities were tested in the exercise physiology laboratory. Our results showed a significant and positive correlation between arm spam, as only anthropometric trait, and success of Iranian elite Greco-Roman wrestlers. Also, maximal oxygen consumption, dead lift, squat, bench press, agility, shoulder and-wrist elevation, sit and reach, reaction time-eye/left hand, reaction time-eye/foot, reaction time-ear/left hand, reaction time-ear/foot have positive correlation with their success. Furthermore, there were a significant and positive correlations between inspiratory reserve volume, tidal volume, forced vital capacity, forced expiratory volume (second), maximal voluntary ventilation and success. In contrast, we observed a negative and significant correlation between body fat (%) and success of Iranian elite Greco-Roman wrestlers. Physical fitness traits and lung capacities have greater potential than anthropometric characteristics in the prediction of Greco-Roman wrestler's success in championship levels.

Keywords: Anthropometric characteristics, Physical fitness traits, Lung capacities, Wrestler's success, Greco-Roman wrestling.

Introduction

Greco-Roman wrestling is one of the more popular events of the modern Olympic Games (Mirzaei et al., 2009; Mirzaei et al., 2011). It is an aerobic and anaerobic exercise that allows only upper body moves and last a bout duration of 6 min (2*3-min bouts) (Mirzaei et al., 2011; Demirkan et al., 2014).

Knowing of physiological and physical factors contributing to successful Greco-Roman wrestling is a challenge confronting sport scientists (Mirzaei et al., 2009). A significant portion of the studies have been used physiological/anthropometrical profiles (Mirzaei et al., 2011; Demirkan et al., 2014) and physical fitness tests to reveals wrestler's current physiologic capability to competition (Horswill et al., 1988; Mirzaei et al., 2009). It has been shown that elite Iranian (Mirzaei and Ghafouri, 2007) and Canadian wrestlers (Sharratt et al., 1986) have an anthropometric and physiological profile similar to elite wrestlers from other countries. Also, elite junior wrestlers compared to elite senior wrestlers have a lower and higher aerobic and anaerobic power, respectively (Horswill et al., 1988). Furthermore, top-level wrestlers had significantly more aerobic and anaerobic power, muscle strength, muscle endurance (Roemmich and Frappier, 2002) and flexibility (Yoon, 2002) compared to lower level wrestlers. In addition, physiological profile of elite wrestlers has been used as training targets for developing athletes (Callan et al., 2000). Also, wrestlers showed higher level of muscular strength, aerobic and anaerobic power 7 months before a major event (Utter et al., 2002).

For progress in wrestling, it is necessary that all of physiological, anthropometric aspects and bio-motor abilities are evaluated. So far, there are insufficient studies that have investigated the relationship between anthropometric, physical fitness traits and lung capacities with success of wrestlers. In one studies, it has been shown that motor ability (Cvetkovic et al., 2005) contributed to success and technical efficiency in wrestling competition. Since the information regarding top level wrestlers in Greco-Roman wrestling is limited, there is not a distinct criterion for coaches and athletes in this style of wrestling to establish a necessary foundation for competitive success. The results of present study will provide useful information to identify important factors involved in talent process for Greco-Roman wrestling. Hence, the aim of the present study was to evaluate the relation of anthropometric, physical fitness traits and lung capacities with success of Iranian elite Greco-Roman wrestlers.

Material and Methods

Twenty five Iranian elite Greco-Roman wrestlers (22 ± 4 years old) (both of light and heavy weights) participated in this study and signed an informed consent statement in adherence with the human subject's guidelines of Iran's National Olympic Committee research center. Wrestlers were tested in the exercise physiology laboratory of Shahid Chamran University of Ahvaz (Iran).

Anthropometric measurements including wrist circumference, shin circumference, height from hip joint to the top of the head, height from iliac crest to the top of the head, and arm span to height ratio were determined by tape measure. The subject's height was also recorded by wall-mounted stadiometer (YG-200; Yagami, Nagoya, Japan). Body weight was measured using a digital scale with light clothing and without shoes (TBF-551; Tanita, Tokyo, Japan). Body mass index (BMI) is calculated as weight in kilograms divided by the square of height

in meters. Also, body fat percentage, fat and muscle weight were measured by body composition analyzer (Olympia 3.3: Jawon Medical Co., Gyeongsangbuk-do, Korea). Length and circumference of limbs were determined by tape measure.

Also, grip strength and dead lift were determined by biodex dynamometer (Yagami Co, Japan). Flexibility of muscles and reaction time were determined by digital biodex flexible gauge and reaction timer (Yagami Co, Japan), respectively. Squat and bench press were determined by free weights based on one repetition maximum. Evaluation of the maximal oxygen consumption (VO_2max) was determined by the Astrand test on treadmill (h/p/cosmos, mercury® med, Germany). Agility in the present study was determined by a 4 × 9-m shuttle run test. Lung capacities were measured by a digital spirometer (HI-601, Japan).

The wrestler's success was rated based on their success in provincial and national competitions, official tournament and Asian games during three years ago. For first to third positions in official tournament and Asian games, points of 100, 90 and 85 were allocated, respectively. Also, for the first to third positions in national competitions, points of 80, 70 and 65 were assigned, respectively. In addition, points of 60, 50 and 45 were allocated for first to third positions gained during provincial competitions, respectively. Finally, in order to control the number of attendance in competitions by each athlete in the last 3 years, their scores were multiplied in numbers of attendance and divided on sum of number's attendance.

Data were analyzed in SPSS software (version 16.0) and presented in terms of means ± SD. Initially, Shapiro-Wilk's test was performed to test normality. Then, Pearson's correlation coefficient was calculated to determine the relationship between variables. The significance level was set at $P < 0.05$.

Results

Means and standard deviations of anthropometric measurements and physical fitness traits are presented in table 1 and 2, respectively. The wrestler's success based on their success in competitions was 68.94 ± 15.14. Results showed, among anthropometrics characteristics, arm spam (Positive) and body fat (%) (Negative) significantly correlated with success of elite Greco-Roman wrestlers, respectively (Table 1). Also, dead lift, squat, bench press, VO_2max, agility, shoulder and-wrist elevation, sit and reach, reaction time-eye/left hand, reaction time-eye/foot, reaction time-ear/left hand, reaction time-ear/foot and success of elite Greco-Roman wrestlers have positive correlation (Table 2). Furthermore, there are significant and positive correlations between inspiratory reserve volume (IRV), tidal volume (VT), forced vital capacity (FVC), forced expiratory volume (second) (FEV1), maximal voluntary ventilation (MVV) and success of elite Greco-Roman wrestlers (Table 3).

Table 1. Correlation of anthropometric traits with elite Greco-Roman wrestler's success

Anthropometric characteristics	Mean ± SD	Correlation coefficient	Significant
Height (cm)	175 ± 9	0.30	0.13
Weight (kg)	78 ± 15	0.07	0.72
Body mass index (m/kg^2)	25 ± 3	0.24	0.23
Body fat (%)	14 ± 3	-0.42	0.03*
Fat weight (kg)	11 ± 4	-0.22	0.27
Body muscle (%)	79 ± 3	0.35	0.07
Muscle weight (Kg)	62 ± 11	0.18	0.36
Humeral length (cm)	33 ± 3	0.19	0.35
Forearm length (cm)	30 ± 1	0.26	0.19
Femoral length (cm)	42 ± 4	-0.33	0.10
Calf length (cm)	41 ± 4	0.01	0.99
Wrist circumference (cm)	19 ± 1	0.38	0.06
Waist circumference (cm)	82 ± 8	-0.04	0.84
Hip circumference (cm)	98 ± 6	-0.07	0.72
Femoral circumference (cm)	57 ± 5	0.02	0.89
Calf circumference (cm)	38 ± 3	0.14	0.47
Ankle circumference (cm)	24 ± 3	-0.03	0.86
Sitting height (cm)	74 ± 4	-0.08	0.68
Arm span (cm)	181 ± 10	0.61	0.01*

The asterisk (*) indicates a significant correlation between two corresponding variables

Table 2. Correlation of physical fitness traits with elite Greco-Roman wrestler's success

Sport performance tests	Mean ± SD	Coefficient correlation	Significant
Grip strength-right hand (N)	49 ± 9	0.36	0.07
Grip strength-left hand (N)	48 ± 9	0.36	0.07
Dead lift (kg)	168 ± 23	0.86	0. 01*
Squat (kg)	148 ± 45	0.42	0.03*
Bench press (kg)	110 ± 28	0.42	0.03*
Maximal oxygen consumption ($ml.kg^{-1}.min^{-1}$)	50 ± 7	0.78	0. 01*
Agility (second)	7.4 ± 0.46	0.37	0.04*
Shoulder and-wrist elevation (cm)	24 ± 9	0.74	0. 01*
Sit and reach (cm)	33 ± 11	0.74	0.01*
Reaction time-eye/left hand (S)	0.51 ± 0.22	-0.53	0.01*
Reaction time-eye/right hand (S)	0.47 ± 0.07	-0.12	0.09
Reaction time-eye/ foot (S)	0.40 ± 0.12	-0.43	0.03*
Reaction time-ear/left hand (S)	0.54 ± 0.12	-0.41	0.04*
Reaction time-ear/right hand (S)	0.59 ± 0.10	0.37	0.06
Reaction time-ear/ foot (S)	0.47 ± 0.17	-.046	0.01*

The asterisk (*) indicates a significant correlation between two corresponding variables

Table 3. Correlation of lung capacities with elite Greco-Roman wrestler's success

Lung capacity characteristics	Mean ± SD	Coefficient correlation	Significant
Inspiratory vital capacity (IVC)	3.4 ± 0.64	0.001	0.99
Inspiratory reserve volume (IRV)	2.3 ± 0.66	0.58	0.01*
Expiratory reserve volume (ERV)	1.04 ± 0.48	-0.23	0.26
Tidal volume (VT)	0.98 ± 0.52	0.43	0.02*
Forced vital capacity (FVC)	4.40 ± 0.67	0.55	0.01*
Forced expiratory volume (second) (FEV1)	4.04 ± 0.62	0.88	0.01*
Peak expiratory flow (PEF)	7.42 ± 1.79	0.36	0.07
Forced inspiratory flow (FIF)	5.38 ± 1.72	-0.07	0.73
Maximal voluntary ventilation (MVV)	163 ± 23	0.87	0.01*

The asterisk (*) indicates a significant correlation between two corresponding variables

Discussion and Conclusions

Knowing of anthropometric and physical fitness traits in each sport is an important and decisive factor that determinate athletic performance. Elite athletes have special anthropometric and physiological characteristics in their sports that determined their successes (Bourgois et al., 2000). In present study, we showed relationship between anthropometric and physiological traits with success of Iranian elite Greco-Roman wrestlers. Collectively, it does not seem that anthropometric traits to be determining factor in the success of Greco-Roman wrestling, but it seems that physical fitness traits to be definitive factors influencing on success of wrestlers.

Arm spam, as anthropometrics characteristics, positively correlated with success of Iranian elite Greco-Roman wrestlers. Also, measurements of arm-span were 6 cm more than his height (175 cm versus 181 cm). Because having long arms is a mechanical advantage in Greco-Roman wrestling, this trait is probably one of the reasons for successful performance of the subject in techniques such as the reverse lift, back arch and gut-wrench (Mirzaei et al., 2011). The subject's body fat (%) was higher than subjects of other study (Mirzaei et al., 2011) that investigated 55 kg weight class Greco-Roman wrestling (14 % versus 8.4 %). However, body fat (%) in present study determined in both of light and heavy weights Greco-Roman wrestling. In contrast of Roemmich and Frappier's (1993) study, our finding showed a negative correlation between body fat (%) and success of our subjects. This contradiction may be due to difference in the method of measuring body fat.

In line with other researchers (Roemmich and Frappier, 1993; Yoon, 2002; Mirzaei et al., 2011), results showed that higher levels of strength (dead lift, squat, and bench press), endurance (VO_2max), flexibility (shoulder and-wrist elevation, sit and reach) and reaction time are associated with higher levels of success in companions. Also, it is suggested that

changes in body composition induced by strength training have positive effect on muscle performance (Roemmich and Sinning, 1997). In addition, senior successful wrestlers had significantly more relative grip strength, pull-ups, oxygen consumption, and peak anaerobic power of upper and lower limbs (Nikooie et al., 2015). Furthermore, having high levels of agility and reaction time can dramatically help wrestlers to use rapidly their techniques against faster opponents' movements. Finally, a wrestler can earn better results due to high endurance and muscle strength that provides more stability in defense and attack positions (Yoon, 2002).

For the first time, we showed significant and positive correlations between lung capacities and success of elite Greco-Roman wrestlers. Collectively, these correlations may be due to high levels of strength and endurance of the respiratory muscles and low levels of airway resistance (Rong et al., 2008).

Collectively, according to our findings, physical fitness traits and lung capacities have greater potential than anthropometric characteristics in the prediction of Greco-Roman wrestler's success in championship levels. Thus, Greco-Roman wrestler's talent identification programs should place greater emphasis on the physical fitness traits and lung capacities than anthropometric measurements.

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Conflict of Interest

The authors have not declared any conflicts of interest.

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