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Anthropometric and Physiological Profiles of Elite Iranian Junior Rowers

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Abstract: The purpose of the present study was to determine anthropometric and physiological profiles of elite junior male and female Iranian rowers. The anthropometric and physiological profiles of 33 male and 23 female Iranian elite rowers who were invited to the national training camps were measured. The major results were as follows (male and female respectively): body height (181.1±4.9, 170.3±4.1 cm), body weight (80.6±3.9, 70.1±4.4 kg), length of upper extremity (49.4±3.7, 44.3±4.4 cm), length of lower extremity (104.5±4.7, 93.2±5.7 cm), shoulder width (55.85±3.9, 40.1±3.5 cm), elbow width (30.1±3.2, 24.5±2.3 cm), knee width (39.16±2.7, 36.5±2.5 cm), ankle width (27.1±2.5, 23.5±1.8 cm), body fat percent (10.6±3.6, 15.7±3.8), pull up (29.1±14.1, 19.3±9.5 rep), sit-ups (66±8.5, 59±9.7 rep), bench press (99.3±20.2, 64±14 kg), back squat (109.2±30.3, 62.5±5.52 kg) grip force (58.7±6.8, 34.3±8.1 kg), agility [shuttle run test 25 yard (9.9±0.4, 11.4±0.8 sec), aerobic power (50±3.5, 45.9±5 ml kg^{-1} min^{-1}), anaerobic power (84.3±8.9, 59.3±4.1 rep) and Sargent jump (31.2±3.4, 24.6±5.5 cm). This data provides specific anthropometric and physiological information from elite Iranian rowers that are important to the sport scientific, coaches and these athletes.

Key words: Talent selection · Physiological characteristics · Fitness profile · Elite rowers

INTRODUCTION

Physical and physiological characteristics of elite athletes are different among sports. In selection of athletes for a particular sport, the focus should be on those traits and abilities which have the most significant influence on sport performance, such as physiological and anthropometric characteristics [1].

Physical structure is an important factor that contributes to success in rowing [2] and evidences indicates that anthropometric characteristics have influence on rowing performance [3]. Indeed rowing is a type of strength-endurance sport demanding high levels of both aerobic and anaerobic capacities for successful performance. Rowing is estimated to be 70-80% aerobic and 20-30% anaerobic [4]. The rowing stroke is supported by the sliding seat so that the drive phase is sequentially performed by extension of the legs and extension of the trunk with simultaneous flexion of the arms [5, 6]. The rower has to attain a combination of high stroke force and optimal stroke length to produce an effective stroke [5]. Strength enhancement not only has an influence on speed and power, but also provides the basis for strength endurance [7]. Having good anaerobic and aerobic capacity, body strength, power and agility are the most important factors needed to achieve good results in rowing competitions [6, 7]. The profile of male and/or female junior rowers can be used in evaluating for talent identification [8], thus results of the studies that investigate and evaluate this traits can be important for coaches at all levels.

Few studies have been reported in the literature about some anthropometric characteristics such as height, lean body weight and limb lengths from rowers' athletes [9-12]. These studies showed that elite rowers are usually taller and heavier than athletes of other sports. However, if rowers' anthropometric profiles are to be used as talent identification at all levels, previous data are only limited information and more knowledge is required about the anthropometric characteristics of the elite rowers either male or female. Moreover, the increasing level of professionalism in the sport and the exacting competition schedule emphasis the need for quantitative research on general physiological variables [13]. Therefore, the aim of the present study was to determine anthropometric and physiological profiles of elite junior male and female Iranian rowers.

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MATERIALS AND METHODS

Subjects: The sample consisted of 33 male and 23 female rowers, all of whom were members of the Iranian National Rower Team between 2006 and 2011. All the rowers were competed in the International (Asian) champions (Kayak and Dragon bout). The subjects had at least 2 years' training experience. Measurements took place during the competition phase of the season. Each rower read and signed a written informed consent prior to participation and also was familiarized with the procedures and possible risks. The Institutional Review Board of the University approved the research protocol.

Testing Procedures: The following anthropometric variables were measured: shoulder width, length of upper extremity, length of lower extremity, elbow width, knee width, wrist width, ankle width and body fat percent. Body fat percent was derived from the Jackson–Pollock method for both male (chest, waist and thigh fold) and female (triceps, waist and Hip) [14] athletes. Skinfolds were obtained using the Lafayette (USA) skinfold caliper. All bilateral measurements were obtained from the left side of the body [8]. After the anthropometric measurements were taken, the rowers completed the experimental tests. Muscular endurance was estimated using the maximal number of pull up (with palms facing the subject) and maximal number of sit-ups in 60 seconds. Agility was assessed with the shuttle run test (25 yard) which will be in short described here. Two lines 25 yards apart were traced and two woods behind one of the lines were placed. The participant were instructed to run from start line to the other line, picks up a block and returns to place it behind the starting line, then returns to pick up the second wood, then runs with it back across the line. Anaerobic power was determined with a 30-second vertical jumping test. Aerobic power was assessed with the Astrand-rhyming step test [15]. For perform of this test, the subjects did step up and down on a bench (men: 40cm, women: 33cm) for 5 minutes at the rate of 90 steps per minute. Heart rate was measured from exactly 15 to 30 seconds following completion of the test. Testing room temperature was controlled between 22 and 26°C. Sergeant jump test were employed for estimate the explosive power of the leg extensor muscles. A 40-yd sprint test was used to assess speed. Grip strength was assessed [16] using a standard hand-grip dynamometer (Lafayette Co, USA). The maximal strength testing consisted of a 1RM bench press and squats (back squat – thighs parallel to the floor) performed with the standard Olympic style bar and weights. Since all the athletes had participated in the resistance training for at least two years, they were qualified for execution of bench press and back squat. Each athlete was asked to squeeze as hard as possible. All participants completed the study protocol. Participants were advised not to engage in strenuous activities one week before an exercise test and not to exercise on the day of the test. Verbal encouragement was provided during the testing procedure. All measurements were taken by the same experienced investigator who was assisted by two recorders.

Statistical Analysis: The Statistical Package for Social Sciences (SPSS v. 14, Inc. Chicago, IL) was used for all descriptive statistics. The results are reported as means and standard deviations (SD). Student's *t*-test for independent samples was used to determine the differences in variables between the two groups. The use of p<05 was considered to be statistically significant.

RESULTS

Anthropometric characteristics of the Iranian rowers are presented in Table 1. The female athletes have significantly less shoulder width and wrist width (p<0.05). Physiological characteristics of the athletes are presented in Table 2. The two groups significantly (p<0.05) differed in the bench press, squat, anaerobic power, 40-yd sprint and agility. Although the male subjects had also higher in other fitness factors, these differences were not statistically significant.

DISCUSSION

Anthropometric characteristics are undoubtedly performance related factors, especially for rowing sport [10, 17]. Indeed finalists can be distinguished from non-finalists during by anthropometric characteristics such as height, weight and circumferences [12, 17].

Table 1: Subject descriptive data and anthropometric parameters

Variable	Male (N=33)	Female (N=23)
Age (y)	19.06±3.8	17.8±4.9
Weight (kg)	80.6±3.9	70.1±4.4
Height (cm)	181.1±4.9	170.3±4.1
Upper length extremity (cm)	49.4±3.7	44.3±4.4
Lower length extremity (cm)	104.5±4.7	93.2±5.7
Shoulder width (cm)	55.85±3.9	40.1±3.5*
Elbow width (cm)	30.1±3.2	24.5±2.3
Knee width (cm)	39.16±2.7	36.5±2.5
Wrist width (cm)	19.7±0.6	16.7±1.2*
Ankle width (cm)	27.1±2.5	23.5±1.8
Body fat (%)	10.6±3.6	15.7±3.8

* Significant difference between the two group (male and female) of rowers (p<0.05)

Table 2: Physiological scores of rowers

Variable	Male (N=33)	Female (N=23)
Bench press (kg)	99.3±20.2	64±14*
Squat (kg)	109.2±30.3	62.5±5.52*
Anaerobic power (rep)	84.3±8.9	59.3±4.1*
Aerobic power (ml kg^{-1} min^{-1})	50±3.5	45.9±5
Sit-ups (rep)	66±8.5	59±9.7
Pull ups (rep)	29.1±14.1	19.3±9.5
Sargent (cm)	31.2±3.4	24.6±5.5
40-yd sprint (sec)	5.7±0.4	7.5±0.8*
Agility (sec)	9.9±0.4	11.4±0.8*
Grip force (kg)	58.7±6.8	34.3±8.1

*Significant difference between the group (male and female) of rowers ($p<0.05$)

In addition rowing is a strength endurance type of sport, therefore the anthropometric elevation and physical fitness tests can provide either the rowers or coaches with information relative to the rower's current physiologic capability and can allow them to compare that capacity with reference values for appropriate peer sexes. The estimation of current status related to strengths or weaknesses, can become the basis for the development of an optimal training program. Thus, in current study we assessed anthropometric and fitness characteristics of elite rowers at both male and female.

Compared with elite rowers both male and female from various countries who have won international tournaments and world championships [10, 12, 17-19], the elite rowers in this study have been found to have similar height and weight values. In rowing, body weight is typically supported by a sliding seat in the boat therefore they can afford to carry a greater mass and possess an advantage [6, 20, 21] found that rowing performance is significantly related to height. Tall rowers are able to make long rowing strokes [22] and long stroke lengths are closely identified with high-level rowing performance [4]. It is suggested that there is no effect of regular training for rowing on statural growth and rowers are already taller than average during childhood, maintaining their position relative to reference data during childhood and adolescence [23], this point may be important to used for talent identification in rowing.

Upper length and lower length extremity values are shown in Table 1. Upper length and lower length are factors related to the stroke rate [3]. Long legs increase the drive phase of the rowing stroke, thus providing the rowers with long legs with a biomechanical advantage [24]. These values are closely in line with the values that were generally observed for the World Junior Rowing Championship finalists [17]. Longer limbs are an advantage due to the catch and drive action involving all four extremities, resulting in a longer stroke [20]. In fact long legs increase the drive phase of the rowing stroke [17], thus providing the rowers with long legs with a biomechanical advantage [24]. Thus, these factors might affect rowing performance and the selection of competitive rowers might well focus upon these genetically- determined factors [3].

The widths and breadths of subjects' limbs are present in Table 1. Sklad *et al*. [25] found that rowing training for at least one year can increase some limb widths and girths (arm and chest) in junior rowers. Although these values are supported by the previous data [19], junior male rowers had significantly greater shoulder and wrest widths than the female group. However, these results are in line with previous data [6] and indicated that elite rowers male have higher values for upper limbs than female elite athletes.

The calculated fat percent values are shown in Table 1. Studies have reported that a high body fat content has been found to affect adversely the 2000 m rowing ergometer performance [4, 19]. Therefore, low body fat percentage can be a vantage for success in rowing competitions [26]. Manore *et al*. [27] showed that percentage of body fat varies depending on the athlete's sex and the sport itself. Studies of male and female international rowers [28] have noted that the range of percentage of body fat values was from 6% to 10% and 11 to 15% for male and female, respectively. The mean fat percentage for the rowers in this study is among these cited ranges. It is interesting to note that the percentage of body fat seems to have been decreasing in recent years in elite rowers [9]. However, percentages of body fat values were lower than are reported in other studies [9, 29]. Body fat content varies, depending on the period of the season for joiner rowers [30], thus difference in time of measurements related to phase of the season may play a role in these differences.

Successful elite rowers produce about 75–80% of their power with their legs and 20–25% with their arms during the rowing stroke [31]. Strength improvement has an influence on speed and power, also provides the basis for strength endurance [7]. In fact, the higher levels of maximal strength and muscular endurance and power in the elite rowers provide an advantage to sustain a more powerful stroke during the oar cycle [5, 7, 32]. The sit-ups, pull ups, agility, grip force 40-yd sprint, bench press, squat and sargeant values are shown in Table 2.

Although these results are lower than the values reported by previous studies [18, 33-35]. This difference may partially be explained by comparing the subjects characteristic employed in these studies. On the other hand, the participations in present study included junior rowers, whereas the subjects of previous study were senior rowers.

Aerobic power is one of the main criteria used by scientists to assist in identifying and selecting rowers [6, 33]. To a high aerobic capacity, elite rowers are required to have the ability to sustain very high oxygen consumption, based on the fact that during a race most oarsmen usually perform near their maximal aerobic capacity for the entire duration of the race [33]. We measured the aerobic power in rowers by recording heart rate via Astrand-rhyming step test [15]. It was a simple method and accessible to measure the aerobic capacity for our purpose. By this, mean aerobic power for male and female subjects were 50±3.5 and 45.9±5 VO_2max, respectively. These values were close to that reported by some pervious researches [36, 37] but were higher [33] or lower [9] than other studies. However, this difference may partially be explained by comparing the different testing protocols employed in these studies. Age difference and experience (junior vs. senior) also can be considered as other factors.

CONCLUSIONS

The anthropometric and fitness profile charts in elite rowers can contribute to talent selection and identification also could be of great importance for optimal construction of strength/power and endurance training programs to improve rowing performance by the coaches [12, 32]. The results of present study and related studies can become the guide for sport scientific, coaches and athletes alike as they progress through the hierarchy of competition. The present study provides baseline anthropometric and physiological data that can be used in the prescription of individual training programs for rowers' athletes. However, this study is the first to be published on the Iranian National Junior Rowers and we hope continue with these topics to achieve good results in international rower competitions.

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