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# Anthropometric and physical fitness traits of four-time World Greco-Roman wrestling champion in relation to national norms: A case study

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## ABSTRACT

Mirzaei B, Curby DG, Barbas I, Lotfi N. Anthropometric and physical fitness traits of four-time World Greco-Roman wrestling champion in relation to national norms: A case study. *J. Hum. Sport Exerc.* Vol. 6, No. 2, pp. 406-413, 2011. The purpose of the present investigation was to describe the anthropometric and physical fitness traits of a four-time World senior Greco-Roman wrestling champion (age: 24 years, height: 167 cm, weight: 61 kg) in relation to national norms. The anthropometric traits included body weight, height, sitting height, arm-span, and the physical fitness traits included flexibility (sit-and-reach, trunk-and-neck extension and shoulder-and-wrist elevation tests), maximal oxygen uptake (Gas analysis method), muscular endurance (pull-ups and bent-knee sit-ups), muscular strength (bench press, squat), agility (4×9 m shuttle run), speed (40-yd sprint), bilateral visual reaction time and body composition. The major results are as follows: body fat (%): 8.4; body weight (kg): 61; height (cm): 167; sitting height (cm): 89; arm-span (cm): 174; sit-and-reach (cm): 45; trunk-and-neck extension (cm/cm): 0.64; shoulder-and-wrist elevation (cm/cm): 0.54; maximal oxygen uptake ( $\text{ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ ): 56; pull-ups (reps): 50; bent-knee sit-ups (reps/min): 77; agility (s): 7.6; speed (s): 4.57; bilateral visual reaction time (ms): 229; 1RM weight lifted in the bench press relative to body weight ( $\text{kg} \cdot \text{kg}^{-1}$ ): 1.39 and 1 RM weight lifted in the squat relative to body weight ( $\text{kg} \cdot \text{kg}^{-1}$ ): 1.83. The present study indicated that measures of the squat, speed and agility tests of the subject were higher than Iranian national norms for 55 kg senior Greco-Roman style wrestling. The measures of bench press and trunk and shoulder flexibility tests were lower than the national norms. In other tests, no major difference was observed between the results of the subject's tests and national norms. **Key words:** ANTHROPOMETRIC CHARACTERISTICS, FITNESS, GRECO-ROMAN WRESTLING, NATIONAL NORMS.



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## INTRODUCTION

Greco-Roman wrestling is a style of wrestling that is practiced worldwide. It was contested at the first modern Olympic Games in 1896 and has been included in every edition of the summer Olympics held since 1908. Two wrestlers are scored for their performance in three two-minute periods, which can be terminated early by a pinfall. This style of wrestling forbids holds below the waist which is the major difference between itself and freestyle wrestling, the other form of wrestling at the Olympics (<http://en.wikipedia.org>).

One of the challenges confronting the coaches and sport scientists is to understand the physical and physiological factors contributing to successful wrestling (Mirzaei et al., 2009). The use of physical fitness tests for the measurement of the current status of the wrestler can provide both the wrestler and coach with information relative to the wrestler's current physiologic capability and can allow them to compare that capacity with reference values from appropriate peer groups. Also, the assessment of current status reveals strengths and relative weaknesses and can become the basis for the development of an optimal training program (Mirzaei et al., 2009). Due to the importance of this topic, a significant portion of the studies performed on wrestlers are descriptive in nature, presenting the physiological and anthropometric profiles for a wrestling team (Horswill et al., 1988; Sharratt et al., 1986; Mirzaei et al., 2009), or a group of successful or less successful wrestlers (Roemmich & Frappier, 1997) and in some cases, only one wrestler (Utter et al., 2002; Wideman & Hagan, 1982).

Sharratt et al. (1986) described the physiological profile of elite Canadian freestyle wrestlers and indicated that the Canadian wrestlers have a physiological profile similar to elite wrestlers from other countries. Horswill et al. (1988) studied the physiological profile of elite junior wrestlers. They reported values of body fat (%):  $7.2 \pm 2.4$ ; aerobic power  $51.2 \pm 9.3$  ( $\text{ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ ); arm power (W):  $390.7 \pm 92$  and leg power (W):  $390.7 \pm 92$ . They concluded that elite junior wrestlers appear to have a similar percentage of body fat, lower maximum aerobic power and higher relative anaerobic power compared to elite collegiate and senior wrestlers. Roemmich & Frappier (1993) compared successful and less successful varsity wrestlers matched for age, weight, height, and wrestling experience on physiological variables important for wrestling success using field tests available to high school wrestlers. They showed that successful wrestlers had significantly more muscular strength, muscular endurance, flexibility of the low back and hamstrings, aerobic fitness, and relative anaerobic power than less successful wrestlers. However, regarding body fat (BF) %, no significant difference was indicated between the two groups. Callan et al. (2000) investigated the physiological profile of elite U. S. freestyle wrestlers and indicated that a profile of elite wrestlers can be used as training targets for developing athletes. Utter et al. (2002) studied the physiological changes of a nationally ranked older elite freestyle wrestler during a 7-month observation period as he prepared for the 2000 Olympic freestyle wrestling trials. The results showed that in the 7 months before a major event, the subject displayed a high level of wrestling-specific fitness for muscular strength, anaerobic and aerobic power. Yoon (2002) reported that the maximal oxygen uptake of national and international wrestlers taking part in international competition has been shown to be about 53 to 56 ( $\text{ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ ). He also indicated that the flexibility of top-level wrestlers was higher than that of lower level wrestlers. The result of anthropometric, bioenergetic, and biomechanical traits of Iranian wrestlers participating in the World Cup in Baku and 2004 Asian championships in Tehran indicated that there are no significant relationships between bioenergetic traits and the results from these competitions (Mirzaei & Mansour-Sadeghi, 2007). It has been noted that the bioenergetic and biomechanical indices in this study could not be the only contributors to success in wrestling competition, but that a series of factors were effective in achieving desired outcomes. Schmidt et al. (2005) investigated the effects of a competitive wrestling season on body composition, muscular strength, and muscular power in National Collegiate Athletic Association (NCAA) Division III

college wrestlers, and reported percent body fat (%):  $11.6 \pm 3.9$ ; LBM (kg):  $68.5 \pm 8.7$ ; back squat (kg):  $150.8 \pm 25.2$  and bench press (kg):  $98.3 \pm 25.4$ . Cvetković et al. (2005) studied the technical efficiency of wrestlers in relation to some anthropometric and motor variables and reported that technical efficiency in young top-level wrestlers depends on a large number of motor ability variables as well as some morphological characteristics like body weight. Vardar et al. (2007) investigated the relationship between body composition and anaerobic performance of elite young wrestlers from the Turkish national team. The results are as follows: body mass (kg):  $65.4 \pm 12.3$ ; body fat (%):  $9.7 \pm 6.3$ ; peak power ( $W \cdot kg^{-1}$ ):  $8.5 \pm 1.0$  and indicated that there is a significant relationship between mean power and lean body mass ( $r=0.90$ ), however, no significant relationship was found between anaerobic parameters and percent body fat. Mirzaei & Ghafouri (2007) studied the physiological profile of Iranian senior Greco-Roman wrestlers. They concluded that with the increase of weight in weight classes, the pull-up records are reduced, while no significant differences were found in the results of the flexibility tests. Rahmani-Nia et al. (2007) determined the physiological profile of Iranian junior Greco-Roman wrestlers. They measured muscular endurance and strength, maximal oxygen uptake, agility and speed. Mirzaei et al. (2009) studied physiological profile of Iranian junior freestyle wrestlers. They reported means and standard deviations of body weight (kg):  $77.5 \pm 19.8$ ; flexibility (cm):  $38.2 \pm 3.94$ ;  $VO_2\max$  ( $ml \cdot kg^{-1} \cdot min^{-1}$ ):  $50.5 \pm 4.7$ ; maximal anaerobic power (W):  $455.5 \pm 87.6$ ; push-ups (reps):  $66.9 \pm 7.6$ ; pull-ups (reps):  $31.6 \pm 9.7$ ; bent-knee sit-ups (reps):  $66.5 \pm 8$ ; speed (s):  $5.07 \pm 0.17$ ; agility (s):  $8.7 \pm 0.25$  and body fat (%):  $10.6 \pm 3.8$ . In another study, Mirzaei et al. (2010) investigated the relationship between body composition, aerobic power, anaerobic power and strength of Iranian freestyle and Greco-Roman wrestlers participating in the Beijing Olympic Games 2008 and reported a significant relationship between the values of upper and lower body Wingate tests and lean body mass. They also reported that the results of anthropometric and physiological measures of Iranian wrestling team are similar to the wrestlers in other countries. 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. Therefore, the purpose of this study was to investigate the anthropometric and physical fitness profile of a 4-time World senior Greco-Roman wrestling champion in the 55 kg weight class and compare it to the Iranian national norms to provide new criteria for the wrestlers and coaches. The results may provide useful information for training and tactical emphasis.

## MATERIAL AND METHODS

### *Subject*

The Iranian four-time (2005, 2006, 2007 and 2009) World senior Greco-Roman wrestling champion in the 55 kg weight class was the subject of this study. The subject was tested in the physical fitness assessment center of Iran's NOA (National Olympic Academy) six weeks prior to the World championships. Before participating, the subject read and signed an informed consent statement in adherence with the human subject's guidelines of Iran's NOC (National Olympic Committee) Research Center.

### *Procedures*

Subcutaneous body fat was measured at 7 sites (subscapular, triceps, chest, pectoral, suprailiac, abdominal, and thigh) with a Lafayette caliper (Lafayette Instrument Company, Lafayette, IN, USA). Body fat percent was computed through the formula developed by Brozek et al. (1963). Height and weight were also recorded. The subject performed a graded treadmill exercise test to estimate  $VO_2\max$ .

In the sit-and-reach test, the subject sits in front of a sit-and-reach testing box, where the feet meet the testing box at the 23 cm mark of the measuring scale. The subject was instructed to reach forward, with palms down and one hand on top of the other along the measuring scale of the testing box. The reach was repeated three times with a maximum reach on the third repetition held for 1 second. The distance of the fourth reach was used as the absolute measure for the sit-and-reach test. For the shoulder-and-wrist elevation test, the subject was instructed to lie prone with arms extended overhead while holding a yardstick with a shoulder-width grip the hands. The subject was instructed to raise the stick upward as high as possible while keeping the chin on the floor and elbows extended. The yardstick's highest point above the floor was divided on subject's arm length. In the trunk-and-neck elevation test, the subject lies prone with both hands on the lower back. The subject was instructed to raise his trunk upward as high as possible from the floor. The height of the nose above the floor when the trunk was raised to its maximum position was used as the value of trunk-and-neck extension (Evans et al., 1993).

Reaction time was measured with the subject standing on an instrumented jumping pad in front of a reaction time apparatus (Satrap Company, Iran) and was instructed to react to either a left or right visual stimulus by moving his foot from the pad. The test was repeated three times and the best of three was recorded in milliseconds (ms) as the subject's bilateral visual choice reaction time.

A 40-yd sprint test was used to assess speed. A pull-ups test (with palms facing the subject) was employed to assess muscular endurance and a 1-minute bent-knee sit-ups test was utilized to assess abdominal muscular endurance. The bent-knee sit-ups test required the subject to lock his hands behind his head and touch his elbows to the thigh with a partner holding his ankles. A 4 × 9-m shuttle run test was used to assess agility. The subject touched a sensor with his hand at each 9-m line (Mirzaei et al., 2009). Muscular strength was assessed by bench press and back squat tests. Bench press and back squat 1 repetition maximum (1 RM) were estimated from a 1-3 RM effort using the equation described by Wathan. Subject was given three to six attempts with progressively increasing weight to achieve a 1-3 RM with 3-5 minutes' rest between attempts (Anderson et al., 2008).

## RESULTS

Subject data and body composition are shown in Table 1. The performance measures of wrestling champion are presented in Table 2 and 3. Table 2 contains testing results for maximal oxygen uptake, anaerobic power, and muscular endurance and strength. Bilateral visual reaction time, flexibility, agility, and speed are listed in Table 3.

**Table 1.** Subject descriptive data and body composition.

Variable	Weight (kg)	Height (cm)	Sitting height (cm)	Arm-span (cm)	Body fat (%)
Result	61	167	89	174	8.4

**Table 2.** Muscular endurance and strength,  $VO_2\text{max}$ .

Test	Sit-ups (rep/min)	Pull-ups (rep)	$VO_2\text{max}$ ( $\text{ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ )	Bench press ( $\text{kg}\cdot\text{kg}^{-1}$ )	Squat ( $\text{kg}\cdot\text{kg}^{-1}$ )
Result	77	50	56	85	112

**Table 3.** Bilateral visual reaction time, flexibility, agility and speed.

Test	Sit-and-reach (cm)	Trunk-and- neck extension	Shoulder- and-wrist elevation	Visual reaction time (ms)	4×9-m shuttle (s)	40-yd sprint (s)
Result	45	0.64	0.54	229	7.6	4.57

## DISCUSSION AND CONCLUSIONS

The results of anthropometric measurements indicated that the arm-span of the subject was 7 cm more than his height (174 cm versus 167 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. Also, the subject's BF% was lower than the Iranian national norm in the 55 kg weight class (8.4% versus 10%). The BF% for the subject in this study is similar to that reported in other studies (Horswill et al., 1988; Schmidt et al., 2005; Vardar et al., 2007; Mirzaei et al., 2009). Ideal fat percent justified the better performance of athletes that must compete in a specific weight class.

The subject was taller than the national norm for his weight division (167 cm versus 161.1 cm). According to the FILA database, the subject was also taller than the average elite Greco-Roman wrestlers in Russia, Azerbaijan and USA (162 cm, 160 cm and 160 cm, respectively). This height difference might have given him the mechanical advantage that led to his successes.

The results of the pull-ups and sit-ups tests were higher than the national norms (50 versus 37 repetitions and 77 versus 71 repetitions, respectively). The level of muscular endurance (Table 2) is very close to that reported by Mirzaei et al. (2007). They reported a mean of 70 repetitions for the bent-knee sit-ups test and mean of 35 repetitions for the pull-ups test. High muscular endurance allows for good stability in attack and defense positions.



Two different protocols were used in the assessment of  $\text{VO}_2\text{max}$  (Gas analysis method for the subject and Bruce test for the national norm. However, the  $\text{VO}_2\text{max}$  of the subject was higher than the national norm (56 versus  $51.6 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ ). This result is in agreement with Horswill (1992), who revealed that the range of  $\text{VO}_2\text{max}$  for successful wrestlers was  $52\text{-}63 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ . In another study, Horswill et al. (1988) reported the mean  $\text{VO}_2\text{max}$  of elite junior wrestlers to be  $52.6\pm 2 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ .

The  $\text{VO}_2\text{max}$  value calculated in this study was higher than the results of Mirzaei & Ghafouri (2007) for the 55 kg weight class (56 versus  $45 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ ) and was lower than the values reported by Yoon (2002) ( $60 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ ). This difference may partially be explained by comparing the testing protocol employed in this study. On the other hand, changes in wrestling rules decreased the contribution of the aerobic system (compared to the anaerobic system) for energy production during wrestling. Yoon (2002) proposed aerobic capacity as one of the most important physical factors to achieve good results in wrestling competitions. Perhaps the greatest benefit of aerobic training is the wrestler's ability to operate at a high percent of their individual aerobic capacity (Mirzaei et al., 2009).

The result of the visual reaction time test was better than the national norm (229 ms versus 391 ms). This characteristic supports the fast reactions of the subject to perform techniques quickly in competition. The results of the speed and agility tests were better than the national norm (4.57 versus 5.14 s and 7.6 versus 8.78 s, respectively). This advantage contributed to the speed with which the subject performed his techniques. His results are also better than the values reported by Mirzaei et al. (2009) for junior freestyle wrestlers (5.07 in the speed test and 8.7 in the agility test and senior freestyle wrestlers (5.1 s in speed test and 8.43 s in agility test).

In the flexibility tests, the results of the trunk-and-neck extension and shoulder-and-wrist elevation tests were lower than the national norms (0.64 versus 0.72 and 0.54 versus 0.59, respectively). However, it was higher than the national norm in the sit-and-reach test (45 cm versus 41 cm). A slight weakness was indicated in the subject's trunk-and-neck extension and shoulder and wrist elevation tests in relation to the national norms in 55 kg weight class of Greco- Roman wrestling. Therefore, it is recommended that special attention should be paid to flexibility exercises of the subject. Because of differences in testing methods, a direct comparison of the results with other studies is not always possible. However, Yoon (2002) reported that the flexibility of elite wrestlers is higher than lower-level wrestlers.

Hip and leg strength is a prerequisite for the successful performance of techniques such as the high-dive and lifting of the opponent as in the reverse-lift. Therefore, this subject's success in the skillful implementation of such techniques against international competitors is made possible through his lower body strength. The value recorded in his squat test was higher than the national norm (1.83 versus  $1.79 \text{ kg}\cdot\text{kg}^{-1}$ ). The result of the bench press test was lower than the national norm (1.39 versus  $1.48 \text{ kg}\cdot\text{kg}^{-1}$ ). The muscular strength results in our study are similar to those reported by Mirzaei et al. (2009) ( $1.4$  and  $1.9 \text{ kg}\cdot\text{kg}^{-1}$  for bench press and squat, respectively). It has been noted that, in general, successful wrestlers showed a higher dynamic and isokinetic strength than unsuccessful wrestlers (Yoon, 2002).

In conclusion, the performances of our subject on the physical fitness tests in this study were generally better than the national norms for the 55 kg weight class and may help in part to explain his success. These traits are used by our subject to employ his high skill (technical- tactical) and psychological ability that weren't investigated in the present study, but are also essential elements for success.

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