

**DESCRIPTIVE ANTHROPOMETRY
KELANTANESE RECREATIONAL ADOLESCENT
TAEKWONDO PRACTITIONERS**

by

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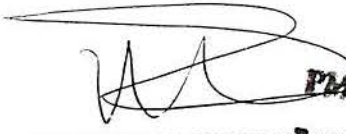
**Dissertation submitted in partial fulfillment of the
requirements for the degree of
Bachelor of Health Sciences (Exercise & Sports Science)**

May 2009

CERTIFICATE

This is to certify that the dissertation entitled ' *Descriptive Anthropometry Kelantanese Recreational Adolescent Taekwondo Practitioners* ' is the bonafide record of research work done by *Fadzliana binti Majid @ Jalil [89071]* during the period of January [2008] to April [2009] under my supervision. This dissertation submitted in partial fulfillment for the degree of Bachelor of Health Sciences (Exercise & Sports Science). Research work and collection of data belong to Universiti Sains Malaysia.

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Diperakui bahawa disertasi yang bertajuk ' *Descriptive Anthropometry* *Kelantanese Recreational Adolescent Taekwondo Practitioners* ' merupakan kerja dan penyelidikan yang asli dari *Fadzliana binti Majid @ Jalil [89071]* dari tempoh Januari [2008] hingga April [2009] adalah di bawah penyeliaan saya. Disertasi ini merupakan sebahagian daripada syarat untuk penganugerahan Ijazah Sarjana Muda Kesihatan (Sains Senaman & Sukan). Segala hasil penyelidikan dan data yang diperolehi adalah hak milik Universiti Sains Malaysia.

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ABSTRACT

Objective: The objective of this study was to describe the anthropometric profile of Kelantanese adolescent taekwondo practitioners and in specifically to compare the anthropometric profile between the males and females.

Methods: Subjects were members of the taekwondo Kelantan state team training to participate in SUKMA 2008 (8 males, 18.63 ± 1.92 years, 168.65 ± 7.37 cm, 68.29 ± 20.69 kg, and 10 females, 18.10 ± 1.37 years, 158.22 ± 4.11 cm, 59.72 ± 10.03 kg). Somatotype was assessed according to the Heath-Carter method (Carter and Heath, 1990), while the sum of 8 skinfolds (biceps, triceps, subscapula, supraspinale, iliac crest, abdominal, anterior thigh and medial calf) was used to represent relative total body fat. All measurements were taken following the ISAK protocol. An independent t-test was used to determine the differences between males and females. The level of significance was set at 0.05.

Results: The males were taller ($p=0.002$, $\eta^2=0.476$) but no difference in weight ($p = 0.264$, $\eta^2 = 0.077$). Although the females recorded a higher sum of 8 skinfolds (127.72 mm vs. 99.11 mm), this was not statistically significantly different ($p=0.259$, $\eta^2=0.079$). There was a difference in proportional weight between the males and females but no difference was found in proportional sum of skinfolds. There were also no differences in endomorphy (3.73 vs. 4.64, $p=0.340$, $\eta^2=0.057$), mesomorphy (5.45 vs. 4.86, $p=0.431$, $\eta^2=0.039$) or ectomorphy (2.34 vs. 1.44, $p=0.254$, $\eta^2=0.081$).

Conclusion: This study concluded that the mean somatotype of the participants was endo-mesomorphic for both sexes. The females were more endomorphic than the males, while the males were more mesomorphic and ectomorphic from a practical point of view. It is not clear why there were no differences in somatotype between the males and females. It might be due to competition levels of these athletes or due to the weight divisions of the athletes.

ABSTRAK

Objektif: Objektif kajian ini adalah untuk menghuraikan profil antropometric remaja-remaja Kelantan yang menyertai taekwondo dan secara spesifiknya, untuk membandingkan profil antropometrik tersebut diantara lelaki dan perempuan.

Metodologi: Subjek-subjek kajian adalah pasukan taekwondo dari Kelantan yang akan menyertai SUKMA 2008 (8 lelaki, 18.63 ± 1.92 tahun, 168.65 ± 7.37 cm, 68.29 ± 20.69 kg, and 10 perempuan, 18.10 ± 1.37 tahun, 158.22 ± 4.11 cm, 59.72 ± 10.03 kg). Somatotype diukur mengikut cara Heath-Carter, manakala jumlah 8 skinfolds (biceps, triceps, subscapula, supraspinale, iliac crest, abdominal, anterior thigh and medial calf) digunakan untuk mewakili jumlah keseluruhan lemak badan secara relative. Segala pengukuran yang diambil adalah mengikut protocol-protokol ISAK. "Independent t-test" digunakan untuk mencari perbezaan diantara lelaki dan perempuan. Manakala, had signifikan ditentukan pada 0.05.

Hasil: Lelaki lebih tinggi ($p=0.002$, $\eta^2=0.476$) tetapi tiada perbezaan untuk berat ($p = 0.264$, $\eta^2 = 0.077$). Walaupun perempuan menunjukkan jumlah 8 skinfolds yang lebih tinggi (127.72 mm lwn. 99.11 mm), tetapi ia tidak berbeza secara signifikan ($p=0.259$, $\eta^2=0.079$). Terdapat perbezaan pada perkadaran berat diantara lelaki dan perempuan tetapi tiada perbezaan pada perkadaran jumlah-jumlah skinfolds. Tiada perbezaan juga pada endomorphy (3.73 lwn. 4.64, $p=0.340$, $\eta^2=0.057$), mesomorphy (5.45 lwn. 4.86, $p=0.431$, $\eta^2=0.039$) or ectomorphy (2.34 lwn. 1.44, $p=0.254$, $\eta^2=0.081$).

Kesimpulan: Kajian ini menyimpulkan bahawa purata somatotype untuk subjek-subjek ini adalah endo-mesomorphic untuk kedua-dua jantina. Secara praktikalnya, perempuan lebih endomorphic daripada lelaki, manakala lelaki lebih mesomorphic dan ectomorphic daripada perempuan. Factor-faktor adanya perbezaan diantara lelaki dan perempuan tidak dapat diketahui dengan jelas. Ini mungkin disebabkan tahap pertandingan subjek-subjek ini atau mungkin disebabkan pembahagian berat badan atlit-atlit tersebut.

CHAPTER 1

INTRODUCTION

1.0 Introduction

Human physiques are variable and different from one another. To assess them is done through kinanthropometry, which assesses the physical structure of individuals in relation to function (Carter, 1985). In the past 60 years, many attempts were made by biologists and medical doctors to group these human physical characteristics into appropriate categories. In 1940, Dr. William H. Sheldon, a medical doctor from USA, introduced a method called somatotyping that is still used until now. Somatotyping is a method for describing the human body in terms of a number of traits that are related to body shape and composition. Bloomfield *et al.* (1994) stated that by using a photoscopic approach, the somatotype is digitized into three components: endomorphy, mesomorphy and ectomorphy. Endomorphy represents relative fatness; mesomorphy represents relative muscularity and robustness, and ectomorphy, relative thinness or linearity of the subject (Geithner *et al.*, 2006, Reis *et al.*, 2007).

Anthropometric profile and morphological characteristics are very important in determining the success of an athlete (Bandyopadhyay, 2007). This is because athletic success in many sports largely rely on specific physical characteristics, including anthropometric dimensions, somatotype and body composition (Bayios *et al.*, 2006). For example, a study done by Molousaris *et al.* (2007) showed that having a tall stature

in sports such as volleyball is important, as it is well known that body height positively influences body segmental lengths and, in turn, athletic performance. Claessens *et al.* (1999) found that performance scores are associated primarily with degree of fatness or endomorphy of the gymnasts, which means fatter or endomorphic gymnasts tend to score lower.

Carter (1985) also stated that the nature and level of sport performance are likely to influence the physical characteristics of an athlete. With reference to Olympic levels of performance, it is seen that lack of the proper physique may make it almost impossible for an athlete to reach that degree of success. Studies of international (Olympic and world-class) and national level athletes indicate that there are differences in physical characteristics depending on sports or events within sports (Carter, 1985, Rienzi *et al.*, 2000).

For instance, Bayios *et al.* (2006) compared the anthropometric, body composition and somatotype characteristics of Greek elite female basketball, volleyball and handball players. The authors revealed that the volleyball athletes were the tallest, had the lowest amount of body fat and their somatotype was characterized as meso-endomorphic (3.4-2.7-2.9). Basketball athletes were also characterized as meso-endomorphic (3.7-3.2-2.4), but were taller and leaner than the handball athletes (4.2-4.7-1.8). In relation to differences in physical characteristics among athletes between events (playing position) within the same sports, Molousaris *et al.* (2007) found that liberos had a smaller body size (body height and body mass) than hitters, centres and opposites, while setters were shorter than opposites and centres and had lower body mass and fat free mass than centres. Stamm (2004) stated that height is not a primary

requirement for liberos, but they should have a high value in mesomorphy and low fat mass since their role during the game is to defend which needs them to have good technical skills, strategy and reaction time. Opposites showed a strong tendency for a higher ectomorphy rating compared to hitters and setters (Molousaris *et al.*, 2007) because they were the main attackers of the team, they attack and block the opposing team's attacks over the net and therefore they should be tall with long arms and legs.

Anthropometric characteristics play a major role in the success of athletes at all levels of sport competition (Hasan *et al.*, 2007). Elite adult competitive climbers were found to be small in stature with low body mass and very low body fat percentages (Watts *et al.*, 2003). The importance of morphological characteristics is especially evident in 'artistic' sports, such as gymnastics, figure skating, diving, and many more in which the body is a primary element in obtaining high performance scores, while scoring may be influenced by judges' perceptions (Claessens *et al.*, 1999).

A morphological characteristic is not the only contributor in the success of athletes but they need a combination of morphological characteristics, training programs and the motivation to be the best they can (Hasan *et al.*, 2007). The performance of athletes is not only based on their physical characteristics but their level of skill, cardiovascular fitness and psychological status should also be considered (Bloomfield *et al.*, 1994). It has been suggested that in addition to anthropometric characteristics experience should also be considered relative to athletic performance (Olds and Kang, 2000).

A number of factors can affect human physical characteristics. They can be classified as: genetic, hormonal and environmental. Environmental factors, such as

lifestyle, dietary intake, exercise, physical training and emotional status can affect human physique (Bloomfield *et al.*, 1994). It is said that one's genetic make-up is the major factor that influences the anthropometric and body composition measures (Reis *et al.*, 2007). Biological development of the body is determined by the genotype. But, all the external modifiers (environmental factors) may positively or negatively influence the formation of these biological features or characteristics. Researchers are more interested to know the effect of physical activity on the human body, especially in terms of functional and structural changes. This effect can be seen more clearly when systematic physical activity is performed and when the loads are significant, like in the case of sport training (Ostrowska *et al.*, 2005).

The anthropometric profile is one of the determinants to the suitability of players' body types for particular sports so that high performance may be achieved. Hasan *et al.* (2007) also stated that a comparison of physical characteristics of female handball players of 3 different performance levels with those in the normal population showed that the top players were taller and heavier than the second and third level players and than inactive women in the normal population. The greatest differences were found in the amount of body fat that is, the top handball players had a lower amount of body fat than the others. However, it is different in sprint events as reported by Uth (2005), who showed that sprinters have a lower body mass than the normal population.

It is believed that having very low or very high body mass could be detrimental in sprinting. High body mass will cause the sprinters to exert higher force to accelerate a larger mass. In addition, to be strong sprinters, they should have more muscle mass

instead of fat mass and therefore be heavier than sprinters, who are not as strong (Tanner, 1965). Cureton *et al.* (1988) found that the larger the muscle mass of sprinters, the higher their strength. The higher the muscle strength, the better the sprinters can perform. Anthropometric characteristics show an influence on muscle strength and step length of sprinters (Uth, 2005). Rienzi *et al.* (2000) reported that the relationship between an individual's anthropometric profile and performance is only reasonable for gross motor skills, such as strength, endurance and flexibility, whereas performance in fine motor skills such as typing does not show this relationship. It is therefore possible that physical activities, which rely on strength, power, speed and endurance require somatotypes of an athlete that are best suited for the requirements of the respective sports.

1.1 Statement of the Problems

Past studies have shown that the anthropometric profile, such as body composition and body shape, plays an important role in athletes' sport performance and in the self-selection of individuals for competitive sport. Findings show the importance of studying human physique characteristics, which is suggested to lead to a better understanding of the relationship between physique and performance (e.g., Carter and Heath, 1990).

Data are still lacking regarding this matter on Malaysian athletes, especially for taekwondo athletes in the period of adolescence. Aiwa and Pieter (2007) assessed the sexual dimorphism in body composition indices in Malaysian adolescent martial arts

athletes, while Suzana and Pieter (2006) examined the effects of training on general motor abilities in young Malaysian taekwondo athletes.

On the other hand, the situation is different in other countries. Measurements of a full range of anthropometric characteristics have been done in many sports, including volleyball (Gabbett and Georgieff, 2007), handball (Hasan *et al.*, 2007), soccer (Rienzi *et al.*, 2000) and rock climbing (Watts *et al.*, 2003).

For combat sports like taekwondo, the change in body weight is very important to be observed. This is because if the weight increases due to accumulation of fat, it may lead to poor performance. Therefore, it is important to assess the amount of fat mass (FM) and fat free mass (FFM) of the athlete. The interest in the scientific study of taekwondo has increased, especially after the sport's inclusion in the 2000 Olympic Games (Suzana and Pieter, 2006). So, studies about the anthropometric profile of taekwondo athletes are important because all these characteristics play a contributing role in determining the athlete's performance and in the self-selection of individuals for high level competition.

1.2 Significance of the Study

1. This research is significant because no studies have ever been done in Malaysia on taekwondo athletes' physique, regardless of the level of competition.

2. This study is also part of a sports science support project with the Kelantan Taekwondo Association.

1.3 Objective of the Study

The purpose of this study was to describe the anthropometric profile of Kelantanese adolescent taekwondo practitioners and, specifically, to compare the anthropometric profile of males and females.

1.4 Limitations of the Study

1. Body fat in this study was indirectly assessed. Although measuring skinfolds is the most appropriate approach in determining body fat in the field, the validity and reliability of the study might be threatened by the skinfold site selection, the experimenter's ability and other factors (Norton and Olds, 1996).
2. The small sample size precludes any generalizations.

1.5 Definitions of Terms

Anthropometry - The measurement of the human body in terms of the dimensions of bone, muscle and adipose (fat tissue) (NHANES III, 1988).

Crucal index - the length of the foreleg or lower leg in relation to thigh (Bloomfield *et al.*, 1994).

Fat free mass - The mass of the body that is not fat, including muscle, bone, skin, and organs (Åstrand *et al.*, 2003, Lorenzo *et al.* 2000).

Fat mass - The absolute amount or mass of body fat (Åstrand *et al.*, 2003, Lorenzo *et al.* 2000).

Frankfort plane - The skull is in the anatomical position; with the orbitale (lower edge of the eyesocket) is in the same horizontal plane as the trignon (the notch superior to the tragus of the ear) (Carter, 1999).

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Kinanthropometry - The quantification of size, shape, proportion, composition, and maturation in relation to gross motor function (see Figure 1.1) (Carter, 1985).

Morphometry - The measurement of the shape of organisms or their parts (Carter, 1985).

Somatotype Attitudinal Distance (SAD) - The distance in three dimensions between any two somatopoints (Carter, 1999).

Somatotype Attitudinal Mean (SAM) - The average of the SADs of each somatopoint from the mean somatopoint of a sample (Carter, 1999).

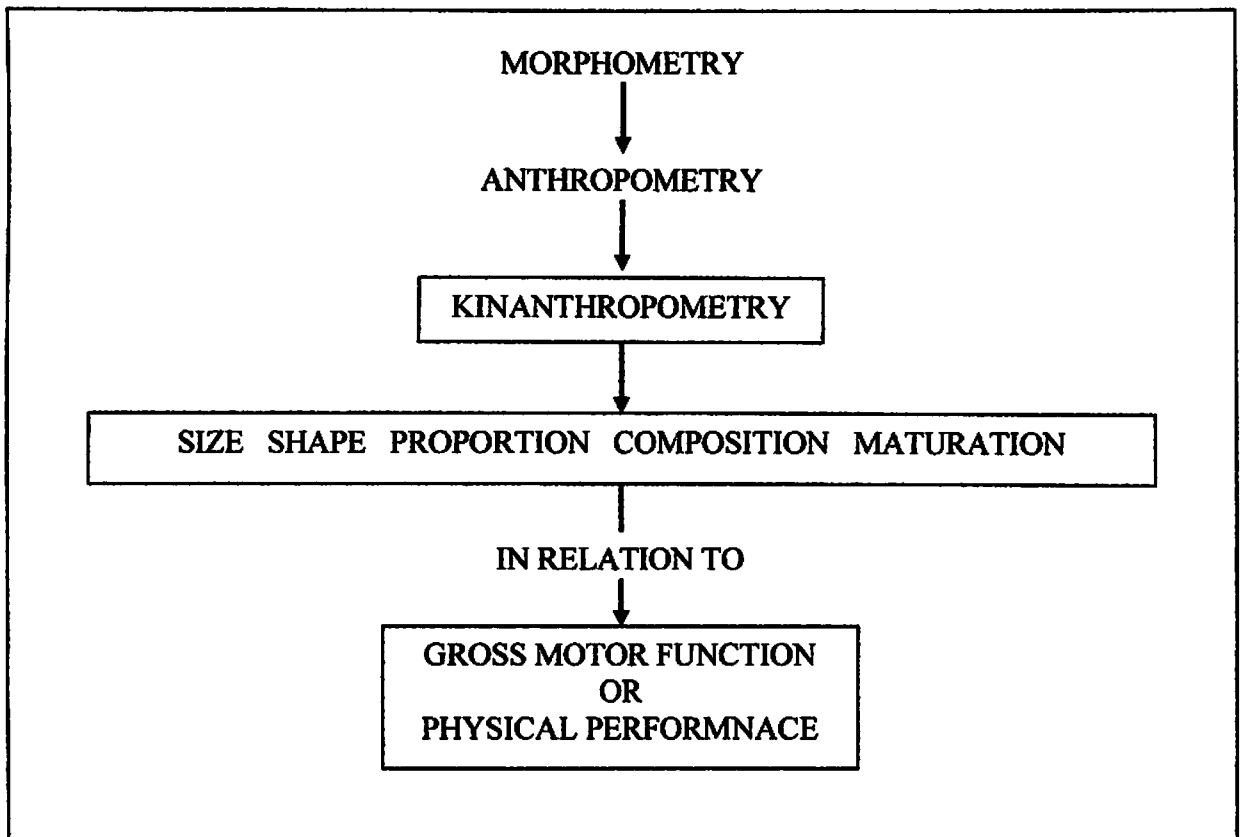


Figure 1.1: Derivation and content of kinanthropometry (Carter, 1983).

Somatotype Dispersion Distance (SDD) – the difference between two somatoplots on a two dimensional somatochart (Carter and Heath, 1990).

Somatotype Dispersion Mean (SDM) - The mean SDD of all the somatoplots in a group from its mean somatoplot (Carter and Heath, 1990).

Somatotype - The quantification of the present shape and composition of the human body as expressed in a three-number rating representing endomorphy, mesomorphy and ectomorphy components, respectively (Carter, 1999).

CHAPTER 2

REVIEW OF LITERATURE

2.0 Review of Literature

Taekwondo is one of the popular martial arts that originated in Korea. It has become a global sport and was included as a medal sport at the 2000 Olympic Games in Sydney, Australia, after having been a demonstration event at the 1988 and 1992 Olympic Games in Seoul, Korea and Barcelona, Spain, respectively. Taekwondo means “the way (do) of kicking (tae) and punching (kwon)”.

Taekwondo is practiced in two forms with each represented by its own international governing body: the International Taekwondo Federation (ITF), which is the oldest, and the World Taekwondo Federation (WTF). The ITF claims to be more “traditional”. However, their form of taekwondo is based on Japanese karate (Capener, 1995). Taekwondo as practiced by the WTF is the version that is included at the Olympic Games and is focused on performance, i.e., the main concern is with sparring competition. It is pure Korean and was first introduced to the world in 1973.

Taekwondo is an intermittent activity that varies in intensity from kicking to punching and jumping (Nauta, 1994). The demands on the players change continuously between offensive and defensive situations. So, to achieve top performance, the athletes require a good level of endurance and strength as well as appropriate physical

characteristics. Successful taekwondo athletes tend to have low body fat, high anaerobic abilities, high aerobic fitness, strength and flexibility (Heller *et al.*, 1998., Rae, 1997).

2.1 Physical Characteristics

Just like any other sport, taekwondo performance is influenced by a number of variables, which include psychological state, physiological function, sociocultural context, biomechanical constraints and the environment (Carter, 1985). Physical characteristics are suggested to play a role in the success of an athlete at any level of competition (Hasan *et al.*, 2007). They constitute an important element in the selection of athletes (Giampietro *et al.*, 2003; Rienzi *et al.*, 2000), which should also take into account their motivation as well as the quantity and quality of their training (Hasan *et al.*, 2007). Several studies, especially those conducted at the Olympic Games, showed that there is a difference in the anthropometric profile of athletes between sports and within sports in different events and player positions (Rienzi *et al.*, 2000).

The importance of physical characteristics is apparent in artistic sports, such as gymnastics, figure skating, diving, bodybuilding, and so on (Claessens *et al.*, 1999) and in weight categorized sports (Giampietro *et al.*, 2003). For example, karate athletes have long-limbed physiques (Giampietro *et al.*, 2003). Taaffe and Pieter (1990) observed that physical and physiological characteristics of elite taekwondo athletes are similar to those in other combat sports.

Taekwondo athletes were found to have an advantage being taller and being more muscular at the elite level compared to judoka, who have a competitive edge by having long trunks, short arms and legs and fairly large breadth and circumferential measurements, with an endo-mesomorphic body type (Taaffe and Pieter, 1990). In other words, physical characteristics that are suggested to be related to sports performance include somatotype, body composition and proportionality (Claessens *et al.*, 1999).

2.1.1 Somatotype

Body type is classified into three components: endomorphy, mesomorphy and ectomorphy. The somatotype or physique of each individual is different because of genetic factors as well as alterations as a result of dietary intake and physical activity (Bloomfield *et al.*, 1994., Ross and Marfell-Jones, 1991). Morphological confirmation and characteristics are also suggested to vary according to age, gender, and ethnicity (Carter and Heath, 1990). Anthropometric markers play a role in talent identification, development and selection of athletes (Norton and Olds, 1996).

Bloomfield *et al.* (1994) claimed that martial arts athletes are highly mesomorphic because of the requirements of the activities, which include strength, power, speed and agility. However, they have various ratings in ectomorphy and endomorphy secondary to the weight divisions in which they compete.

For instance, elite male judoka are mesomorphs with a mean somatotype of 2.0-6.5-1.5 but, if they are classified according to weight categories, the heavyweight

classes show a higher rating in mesomorphy and endomorphy but they are lower in ectomorphy than the lighter judoka, whereas elite female judoka are mesomorphic-endomorphic with a mean somatotype of 4.0-4.0-4.2 (Bloomfield *et al.*, 1994). Heavyweight class boxers showed the same characteristics as the judoka. There is an increase in endomorphy and mesomorphy but a decrease in ectomorphy when their weight classes increase with a mean somatotype of 2.0-5.5-2.5 and a range of 1.5-5.0-3.0 to 2.5-6.0-2.0 (Bloomfield *et al.*, 1994).

Zabukovec and Tiidus (1995) showed that the somatotype of elite professional kickboxers was mesomedial with a mean of 2.6 (range 1.5-4.0), mesomorphy of 4.3 (range 4.0-4.5) and ectomorphy of 2.5 (range 2.0-3.5). On the other hand, Katic *et al.* (2005) showed that elite *karateka* have an ectomorphic body type with low fat mass. Giampietro *et al.* (2003) revealed that there were no differences in the 3 somatotype components between the top level professional *karateka*, who trained 7-9 times per week, and their amateur colleagues, who trained 2-6 times per week. However, the amateur *karateka* were more mesomorphic than their top level colleagues. Finally, the top level *karateka* were more ectomorphic than the amateur group.

Taaffe and Pieter (1990) showed that elite US male taekwondo athletes were more ectomorphic but less mesomorphic and endomorphic than Belgian elite male *karateka* and *judoka*. Figure 2.1 displays the somatoplots of the American *taekwondo-in* and other combat sport athletes. According to Pieter (1991), elite senior male *taekwondo-in* were more ectomorphic but less mesomorphic than wrestlers and judoka.