The relationship between some structural properties of body and aerobic/anaerobic power in members of national female judo team

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Abstract: The aim of this study is to determine the relationship between some structural properties (fat percentage, fat free mass and mass index) of the body in members of national female judo team with aerobic/anaerobic power. For this purpose, 7 judokas with the age of 23.4±1.90 and weight of 67.5±10.87 were selected through a purposed selection and participated in tests of fat percentage, fat free mass and mass index and aerobic/anaerobic in Physical Abilities Measurement Center In national Olympics Academy. Hypothesis of the study were tested using Pearson's correlation coefficient in P≤0.05 level. The results showed that fat percentage, fat free mass and mass index in female judokas' body have a significant and negative relationship with aerobic an anaerobic power (P≤0.05). Also results of the anaerobic power show that there is a negative relationship between fat percentage and the absolute average of anaerobic power in female judokas (P≤0.05), but the relationship between fat free mass and relative average of anaerobic power was not meaningful(P≤0.05). Also participant's fat percentage and mass index had no meaningful relationship with their relative average of anaerobic power(P≤0.05), but between relative average of anaerobic power and fat free index there was a positive relationship(P≤0.05). The results suggest that increasing the muscular mass and decreasing the fat percentage, can improve physiological abilities of female judokas, but this should be considered far more carefully by the coaches in heavy weights, because the negative relationship between muscular mass and aerobic power could limit the athletes.

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Introduction

Aerobic and anaerobic powers are amongst the most important physiologic abilities in movement performance, which can lead to victory in competitions. In the way of reaching the optimized level of these abilities which can interact with their competitive needs, athletes may find a pattern of body structure, analysis of which can be useful to organize efforts of those working in the same field. Judo, regarding the nature of its movement skills, needs a special body physique. [1][2].A judoka needs to maintain his/her inertia and stability, at the same time he/she must keep his pace in movement and reaction and preserve muscular power for the contest[3]. Therefore some specific structural properties alongside with ideal physiologic abilities could be vital in their success. For this reason, researchers claim that it's important to study the relationship between body structure and physiologic abilities from a practical view. For instance, Emerson (2007) suggested that in judo a high percentage of fat in movements which need a massive move has a negative relation with performance and judokas with a higher level of aerobic power show a better performance in activities with greater intensity[4]. Among the physiologic systems of body, experts put more effort on determining the executive capacity of systems like muscular, skeleton, cardiac, respiratory and nervous systems. This bias is based on the hypothesis that if other systems do their haemostatic job well these 5 systems (muscular, skeleton, cardiac, respiratory and nervous systems) can perform as expected. So, successful execution of movements by muscular system can coordinate other systems and improve the quality of nervous, cardiac and respiratory systems[5,6]. Form this aspect, in capacity measuring tests for execution, this idea was always on the table that exterior form or physique affects the optimized performance of a person[7]. For instance, basketball players with more height are more successful than the others if all other factors are the same.[8,9]

Researches in other sport fields suggested that mass index and fat percentage in body have an inverse relationship with aerobic power (Mayhew et al 2007; Benoit LA Marché 2004; Christian 2007)[10]. Also a negative relationship has been reported between fat percentage and anaerobic power (Hang-Mei 2009; Ozkan et al 2009; Vardar et al 2007; Bing-Hang et al 2006)[11]. In judo results ofBing-Hang et al 2006 showed that fat and fat free mass increase as the weight in which judokas are competing increases[12]. Also body weights, muscular mass and total protein all have a positive relationship with anaerobic power in judokas[13]. Despite all these analyses, information about the relationship between structural properties

of the body are limited and in need of more attention[14]. Therefore, regarding the limitation of existing studies, current study aims determining the relationship between some structural properties of the body including fat percentage, fat free mass and mass index of the body and aerobic/anaerobic power in female judokas in national team.[15]

Methodology

Present study is a correlation kind from the aspect of method, from the purpose aspect it's fundamental and from the time view its present looking. Participant were 7 female judokas in national team of I.R.I in 1388, who were competing in -48, -52, -57, -63, -70, -78, +78 divisions according to the international judo federation. Participants were chosen intentionally, so that they agreed on participating after being informed about the goals and procedures of the study. Participants' age range was 21-27 and they were completely healthy according to assessments of the medical federation of I.R.I. also none of the participants were on their menstrual cycle and also none them was on any kind of medicine which could affect the variables of this study.

To perform the current study first all the coordination were made with the judo federation of I.R.I. then in an introduction session, goals, steps, necessity and importance of this study were explained and they were asked to sign a testimonial and fill an individual information questionnaire. After that participants were gathered in the National Olympic Academy's physical abilities' measurement center. The tests for this study were taken in 2 days.

In the first day, first assessments of physique were conducted. They stood on the Physique Analyzer machine and took the handles for two minutes wearing the least cloths they could so that the machine can measure the weight and other physical compositions (fat percentage, mass index of the body and fat free weight of the body). The results of the tests were taken through the printer linked to the machine.

The second assessment took place in the second day which was devoted to the anaerobic power. To measure anaerobic power, the test of anaerobic bi-acid lactic Winget was conducted on the force assessor bicycle (March Monarchy Pelliki, model E894; Winget tests special). Before the test, the machine was adjusted. First participants started a warm up session for 45 seconds in 60-70 RPM. Then they stood by for 5 minutes and then the bicycling pace increased gradually so that they cycled with the maximum speed for 8 second which was accompanied by resistance. And finally absolute anaerobic power indexes were calculatedin Watt and recorded by the force assessor bicycle for 8 seconds.

In the second day the maximum treadmill (made in Italy, Techno Gym Company) test was used to measure the aerobic power. First the participants started the standard warm up (7 minutes of stretching and 3-4 minutes of walking on the treadmill). In this test unlike those of Bruce and other tests there was no limitation for stopping the machine. Athlete stood on the machine and the individual information like age, sex and weight were entered. Then the athletes started running fast through the slope right up to the exhaustion point. The tests were being conducted in the presence of a doctor and the coach to stop the athletes from continuing the test in the case of undesired physical or exterior situation (vertigo, change in face color, vomiting or losing balance). After the test, athletes continued running in order to get back to the initial condition. In this test the maximum heart beat was calculated using following formula: Age-220 In analysis variables were reported through mean and SD. We made sure that the distribution is normal and then using the Shapiro Wilk test and correlation coefficient of $P \leq 0.05$ the relationship between 2 variables were calculated. All analyses were conducted using the SPSS 16 software.

Findings

Table 1 shows descriptive statistics for this study's variables. According to this table participants have a fat percentage of 21.2±6.22 percent, fat free mass: 52.7±5.67 KG, mass index of the body: 24.0±5.32 KG/M2, maximum aerobic Oxygen46.9±5.32 ML/KG per minute, absolute average anaerobic power 259.7±34.15 Watt, and at last relative average anaerobic power was 3.92±0.72 Watt/KG.

Table1:Descriptive statistics of research variables (7 = N)

Standard deviation	variable	Mean
fat percentage(%)	6.22	21.2
fat free mass(Kg)	5.67	52.7
mass index of the body($Kg/m^{2)}$	3.27	24.01
maximum aerobic Oxygen (ml/Kg per minute)	5.32	46.9
absolute average anaerobic power(W)	34.15	259.7
relative average anaerobic power(W/Kg)	0.72	3.92

The results for the Pearson correlation coefficient in table 2(in next page) shows that fat percentage (039/0=p, 574/0- = (6)r), fat free mass (048/0=p, 758/0- = (6) r) and mass index of the

body (047/0=p, 762/0- = (6) r) have a meaningful relationship with aerobic power in female judokas. Nomination coefficient of latter relationships suggests that fat percentage, fat free mass and mass index of the body respectively are responsible for 32.9%, 61.6% and 58% of variation in the aerobic power. Also there is a meaningful relationship between fat percentage with absolute average anaerobic power (041/0=p, 547/0- = (6)r) and explains 29.1% of its variations, but fat free mass and mass index of the body had no meaningful relationship with absolute average anaerobic power(05/0< p). Furthermore, fat percentage and mass index of the body don't have any meaningful relationship with relative average of anaerobic power (05/0< p). But fat free mass have a positive and significant relationship with relative average anaerobic power (037/0=p, 687/0= (6)r) and explains 45.9% of its variation.

Discussion

Current study tried to determine the relationship between some structural properties (fat percentage, fat free mass and mass index) of the body in members of national female judo team with aerobic/anaerobic power. The results of the study for correlating factors to the aerobic power suggested that fat percentage, fat free mass and mass index have a negative relationship with aerobic power. These results are consistent with the prior researches of Mayhew et al 2001, Hosseini 1379, Mogharnasi 1378, Kristin 2007, and Benoit 2004. Also results are consistent with those of MahmoodAbadi 1386 and Mazani 1376 as they found a negative relationship between mass index of the body and aerobic power. The major reason for this consistency can be mechanisms involving in aerobic energy system. It means that athletes should have more aerobic exercises to have a higher level of Oxygen for using, for which body tends to use more of fat sources (Rajabi et al c). So, we expect people with a higher level of maximum oxygen to have less fat sources and mass index of the body. Although some factors including inheritance, sex and age can affect one's aerobic power, aerobic preparation can be affected by training and Physique. Lots of studies showed that training can improve the aerobic power; meanwhile the improvement through training plans is less than quantity of athletes. Experts believe that the maximum Oxygen used may be improved 5-20% through different methods like long sessions of medium intensity or short sessions of high intensity (Jasem et al 2001)[16]. As a result, female judokas can experience an increase in aerobic power with trainings through which they decrease fat level.

On the other side, researches on the relationship between physique and aerobic power focused on the relationship between fat and maximum oxygen used. People with more fat feel extra weight as a result of extra fat which makes their movements harder and harder. On this basis, Emerson (2007) studied Brazilian male judokas' structural properties and body preparation profile and found out that high percentage of fat has a negative relationship with performance in movements in which a massive move is needed, and judokas with a higher aerobic power have a better performance in high intensity moves. The study conducted on male undergraduates of PE showed that the relationship between their fat percentage and aerobic power is both significant and positive. Also the study on female students both athletes and non-athletes shows that there is a significant negative relationship between aerobic power and fat percentage of all participants. Researchers found that fat is an important factor in aerobic power decrease. Generally, the results of the current study are consistent with all other studies in which a negative relationship between fat percentage and mass index of the body was observed[17].

Table 2: Results of Pearson correlation coefficient to determine the relationship between two variables (7 = N)

independent variable	dependent variable	*r*	*p*	R^2
Fat percentage	aerobic power	-0.574	0.039*	0.329
fat free mass		-0.758	0.048*	0.616
mass index of the body		-0.762	0.047*	0.58
fat percentage	absolute average anaerobic power	-0.547	0.041*	0.291
fat free mass		0.15	0.748	0.022
mass index of the body		0.354	0.436	0.125
fat percentage	relative average anaerobic power	-0.360	0.428	0.129
fat free mass		0.687	0.037*	0.459
mass index of the body		0.549	0.202	0.301

*The relationship is significant in level $0.05 \geq \alpha$

Also, the inverse relationship between fat free mass and aerobic power could be attributed to fight patterns in different weights; it means that in light weights, judokas have more mobility and conversely heavier weights have less mobility. Regarding the latter issue, Bing-Hang et al (2006), in a study on elite Chinese judokas, found out that fat percentage increases with the weights in which judokas compete. Similarly in wrestling, Hang-Mei (2009) suggested that heavier weights have more

percentage of fat. Considering these results we expect judokas in heavier weights to have less aerobic power[18].

Results for anaerobic power show that fat percentage has a negative relationship with absolute average anaerobic power; while fat free mass and mass index of the body had no significant relationship with absolute average anaerobic power. Also, fat percentage and mass index of the body in female judokas had no meaningful relationship with relative average anaerobic power; while there was a positive relationship between fat free mass and relative average anaerobic power. These results are consistent with those of Hang-Mei (2009), Ozkan et al (2009), Vardar et al (2007), and Bing Hang et al (2006) as they recognized a positive relationship between fat free mass and relative average anaerobic power.

Although, finding no relationship between mass index of the body and anaerobic power is inconsistent with findings of Mazani (1376) and May-Hew (1989)[19]. This inconsistency can be attributed to physical preparation level of the participants in Mazani's study. His sample was collected from non-athlete people which makes a lot of difference comparing to the sample for present study who are elite national team members. It seems that, the negative relationship between fat percentage and anaerobic power is associated with the resistance force from fat mass in moving performance. As cited before, people with a high percentage of fat face more resistance from fat mass in their moves. Then, considering the nature of anaerobic power -which is theability of a muscle or a group of muscles to generate a big power with high velocity against a resistance in a period of time- we expect fat percentage to limit anaerobic power. On the other hand, the direct relationship between fat free index and anaerobic power is explained by the muscular mass' role in generating force. Power is one of the most important factors in muscles preparation plan and shows the coordination between speed and strength. In fact, increasing power or speed or both these elements, increases the power and creates a situation in which athletes can do more in less time. On the other side, regarding the fact that training generates an important consistency in phosphogeneand anaerobic system's capacity, we expect people in higher levels of competition to improve their muscular efficiency through training. In phosphogene system, the capacity increases with increase in sources of muscular Adenosine Tri Phosphate and phosphocreatine and change in key enzymes. Researchers showed that after a seven month training plan of endurance race including 2 to 3 days training per week, muscular Adenosine Tri Phosphate increases approximately 25%.Also the density of phosphocreatine in muscles showed that the activities of phosphates, miocenase and creatinekinaz enzymes in 8 weeks of speed training plans has increased 20, 30 36 % respectively. The type of training is one of the most important factors in increasing anaerobic power. To explain this process for judo, one must pay mind involvement level of athletes. According to prior researches anaerobic power has a 70% influence in judo (Wilmore & Castillo 1994)[20]. So, it seems that judokas have more ability to create positive consistency, regarding the nature of their field. This way there is a positive relationship between muscular mass and anaerobic power.

Like other descriptive studies, present study faced some limitations; so future semi-empirical studies can approve our results; especiallybecause analyzing the relationship between body structures and aerobic/anaerobic power in puberty with tendency toward effects of losing weights and changes in structural properties of the body on aerobic/anaerobic power and also effects of changes in structural properties of the body due to the relaxation periods after the competitions, could be so helpful in clarifying the subject of this study.

Generally, results of the present study suggest that aerobic power in female judokas has an inverse relationship with fat percentage, fat free mass and mass index of the body. These findings suggest that more muscular mass and less fat percentage have a positive effect on physiologic abilities of female judokas, but this should be considered more carefully by coaches as the negative relationship between muscular mass and aerobic power can lead to limitation of the movements in heavier weights. Regarding these findings, first we wish to make a piece of advice for the coaches in national judo team in female department to consider aerobic power more carefully as it's an important physiologic factor in heavier weights. Also according to our findings, we advise coaches and athletes to care more for their nutrition plans they conduct before the competition to lose weight in order to prevent assimilation of muscular mass and as a results prevent assimilation of anaerobic power and movement performances.

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