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Fitness profile of Oyama karate and kickboxing athletes – initial concept

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Abstract

Background & Study Aim: Adequate physical fitness is fundamental to the training of any athlete. Combat sports and martial arts are characterized by a variety of physical demands, which depend on the practiced style fight. Research often focuses on determining the impact of various forms of training. Therefore, the aim of this study is to knowledge about the profile of combat sports athletes classified into a homogeneous group in terms of the form of direct confrontation (i.e. hits) – Oyama karate and kickboxing.

Material & Methods: Thirty Oyama karate fighters and thirty kickboxers had their fitness tested and their body composition was determined. The indicators included strength, endurance, agility and flexibility and body composition based on weight, height, BMI index.

Results: The difference of mean BMIs in both groups of athletes was statistically significant ($p = 0.045$). Static strength results were between 56.60 & 58.07 kg (karatekas) and 56.47 & 56.99 kg (kickboxers). Respectively: standing long jump mean was 277.67 and 276.60 cm; the mean of number of intervals in Beep Test was 95.27 and 94.67 (VO_2max: 50.86 and 50.53 ml/kg/min); agility mean was 18.88 and 18.74 s; flexibility was on average 59.80 and 62.47 cm. No statistically significant differences between karatekas and kickboxers.

Conclusions: Oyama karate and kickboxing competitors have high level of static and dynamic strength, VO_2max and flexibility. Agility is the skill developed in the similar level as in other athletes. There are no significant differences in fitness profile between Oyama karate competitors and kickboxers. This means that, regardless of combat sport qualified as a form of direct confrontation in a vertical stance, allowing strikes with arms and legs, the same motor and conditioning abilities are stimulated.

Key words: combat sports • fighter • martial arts • motor skills • technique • training load

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INTRODUCTION

Combat sports and martial arts have many different forms depending on the chosen style of fighting (relations between combat sports and martial arts see glossary). There are many differences in the training process as well as the in techniques used in the chosen form. Depending on the combat sport or martial art the fighters have various predispositions which are usually developed in a long-lasting training process [1]. Except for training development so called "genetic predispositions" are another prevailing factor indicating competitor's skills. They are however independent on a competitor and we have no influence on it. To measure the level of competitor's fitness we can use various fitness tests [2]. Such measurements are made mostly in a selection stage or in case of precise adjustment of the training load.

In combat sports such as karate, taekwondo or kickboxing the fitness profile of a competitor usually includes flexibility which enables doing high kicks [3]. Moreover the energetic background of a competitor include the presence of so called "mixed processes" that is a combination of both aerobic and anaerobic processes [4]. This fact is related to diverse level of intensity of the fight dependent on the level of the competition. Simple reaction time is a consecutive factor indicating competitor's skills, not only in martial arts (combat sports) but also in running, swimming or team sports. Appropriately short reaction time allows the competitor to respond faster to stimulus. A quick response to a start signal often prejudge the outcome of a short distance run or swim. In combat sports and martial arts quick reaction is important during the whole time of the competition since it allows to defend properly against the rival. Other meaningful details of the training process include strength, speed and coordination skills. Proper developing of all skills for chosen sport can also indicate the proper level of competitor's preparedness to sporting competition, both in amateur and professional levels. Additionally being fit has also many pro-health values that influence the general lifestyle [5].

The fitness profile is related to both motor function and biological reaction of the organism. Functions and predisposition of the organism constitute the foundation and its symptoms include specific locomotor effects and correct posture. In all theoretical concepts the fitness of the human body include both motor skills like speed, endurance, strength, hand-eye coordination, and physical performance level. There are different motor skills necessary for different types of sports [6].

Many scientific studies conducted on handball players indicate their highly developed strength and speed skills. The energetic background of handball players include both aerobic and anaerobic processes [7]. High level of an anaerobic strength was also found in the studied handball players. Due to large number of throws the hand ball players have also high level of arm muscles strength as well as jumping ability. Good hand-eye coordination and sense of direction are additional values of all players [8].

The fitness profile of volleyball players most of all consists of explosive strength of legs and arms. Every player has highly developed jumping ability and hand-eye coordination. During the game aerobic processes in a player's body are ca. 10%, mixed processes 40 to 80% and anaerobic processes 10 to 60%. Flexibility and speed of the players are on a medium level [9].

Agility and endurance are the main features of football players. Additional values of their fitness profile include high level speed and leg muscles strength. The process of developing endurance is based on both maximal and average physical effort. In the study which included various team sport players the footballers had the best results in the "Beep Test" [10].

When talking about water sports, the best feature of swimmers is their chest. Swimmers have to overcome the external resistance and that is why they have to have endurance and strength abilities. Another important aspect of a swimmer's fitness profile is their flexibility which allows faster swimming thanks to the increasing range of motion [11].

The fitness profile of gymnasts includes most of all highly developed flexibility thanks to complicated routines and positions. Gymnasts usually have weaker cardiopulmonary efficiency, but their muscle strength, hand-eye coordination and jumping ability are well above the average [12].

Power sports is a set of sports in which success is determined by strength preparation. In weightlifting, the level of explosive strength is decisive. In

Kickboxing – combat sport where the form of combat are strikes, performed by hands and legs [26]; alternative definition: ***noun*** a form of boxing that involves kicking as well as punching [29].

Combat sports – disciplines of sports where two contestants fight against each other [26]; alternative definition: ***noun*** a sport in which one person fights another, e.g. wrestling, boxing and the martial arts [29].

Oyama karate – full-contact karate style, whose creator is Shigeru Ōyama [27].

Martial arts – are systems of fight practices (practiced in many reasons: self-defence**,** competition, self-improvement, physical health and fitness, mental and physical development) [28] alternative definition: ***plural noun*** any of various systems of combat and self-defence, e.g. judo or karate, developed especially in Japan and Korea and now usually practised as a sport [29].

Main relationship between combat sport and martial arts – "every combat sport is martial arts but not vice versa" [30, p. 18].

Division of the combat sports under forms of the direct confrontation – workings of weapons (fencing, kendo etc.); hits (boxing, karate, kickboxing, taekwondo etc.); throws and/or grips of immobilisation of opponent's body (judo, sumo, wrestling etc.) [30].

Fighter – ***noun*** a competitor in a full-contact sport such as boxing or taekwondo [29].

Technique – ***noun*** a way of performing an action [29].

Motor skills – ***plural noun*** the ability of a person to make movements to achieve a goal, with stages including processing the information in the brain, transmitting neural signals and coordinating the relevant muscles to achieve the desired effect [29].

Training load – "A simple mathematical model of training load can be defined as the product of qualitative and quantitative factor. This reasoning may became unclear whenever the quantitative factor is called 'workload

power triathlon and athletic throwing, on the other hand, absolute strength becomes decisive [13].

Track and field athletes have various motor skills depending on the kind of sport they do. Runners' fitness profile include mostly speed and endurance skills. Yet due to the running distance the athletes have various cardiac efficiency. It is caused by the presence of different energetic processes between sprinters and marathon runners. In the throwing events the athletes have not only highly developed strength but also speed. Speed skills are also crucial in jumps, where additionally strength, hand-eye coordination and flexibility are important. Moreover the track and field athletes' motor skills are on the highest level of development among all athletes. It may be related to a variety of competitions in decathlon or heptathlon [14].

The aim of this research is to knowledge about the profile of combat sports athletes classified into a homogeneous group in terms of the form of direct confrontation (i.e. hits) – Oyama karate and kickboxing.

MATERIAL AND METHODS

Participants

The study included Oyama karate ("karate" or "karatekas" in the Tables and alternatively in the text) and kickboxing athletes ("kickboxing" or "kickboxers" in the Tables and text) because in both sports competitors fight in a standing position (posture). The study included 60 fighters aged 19-25. Thirty of them were Oyama karate athletes and 30 were kickboxers. All of them had at least five years of training in a chosen sport.

Study design

Body composition characteristics are based on weight, height and the BMI index.

Their fitness test was conducted twice (better result was taking into account). Five different trials were used in order to asses wide range of fitness of the participants:

- satic strength – a hand dynamometer was used in the trial; a subject was to squeeze the instrument in left and right hand with as much strength as possible; the result was measured in kg, the trial was repeated;
- dynamic strength – standing long jump was used in the study; a subject was to jump as long as possible from a standing position; the result was measured in cm;
- endurance – the Beep Test was used in the study; the trial consisted of 21 levels; each level included 20-metre shuttle running test; each level has different number of running intervals with various intensity; sound signal determined the intensity of the test; the higher the sound the greater the speed; the result of the trial was the level and the interval of the level reached; based on the result the maximal oxygen consumption (VO_2max) was computed;
- agility – 5-metre shuttle running test was used in the study; a subject was to run a 5-metre distance ten times; the result was the total time of the run measured in seconds rounded to a decimal place.
- flexibility – a box and a measuring tape were used in the trial; a subject was standing on the box with a measuring tape attached; the tape was 5 cm over the box; then the subject was to bend over and touch the tape as low as possible; the result was measured in cm.

Statistical analysis

The statistical analysis of the data was made using Statistica 13.1 software (StatSoft Poland Ltd, Krakow, Poland). The chosen indicators were the arithmetic mean with standard deviation (± or SD) and coefficient of variation (V). To examine the differences between the indicators in both populations samples ($d = \bar{x}_1 - \bar{x}_2$) the Student test for independent variables was used. The level of significance was chosen at $p<0.05$.

RESULTS

The mean body weight of kickboxers was 82.8 ±11.06 kg and Oyama karate athletes weighed on average 79.33 ±3.24 kg. The difference of 3.47 kg was not statistically significant. The mean body height of karatekas was 180.27 cm and kickboxers was 179.27 cm. The difference of 1 cm was not statistically significant. The difference of mean BMIs in both groups of athletes was statistically significant ($p = 0.045$) (Table 1).

volume' or 'training volume' interchangeably with 'volume of physical activity'. Various units have been adopted as measures i.e. the number of repetitions, kilometres, tons, kilocalories, etc. as well as various units of time (seconds, minutes, hours) (...) As in the real world nothing happens beyond the time, the basic procedure of improvement of workload measurement should logically start with separation of the time factor from the set of phenomena so far classified together as '***workload volume***'. (...) Due to the fact that the heart rate (HR) is commonly accepted as the universal measure of workload intensity, the product of effort duration and HR seems to be the general indicator of ***training load*** defined as the amount of workload. It is useful in analyses with a high level of generality. (...) In current research and training practice the product of effort duration and HR was referred to as conventional units' or further calculations have been made to convert it into points." [31, p. 238].

PE – *abbreviation* physical education [29].

Table 1. The basic indicators of body composition for Oyama karate athletes (n = 30) and kickboxers (n = 30); in the presentation of the results of subtraction (d = $\bar{x}_1$ karate – $\bar{x}_2$ kickboxing) the sign was omitted.

Sample	$\bar{x}$	SD	V	d	t	p
body weight [kg]						
Karate	79.33	3.24	4.09	3.47	1.16	0.254
Kickboxing	82.80	11.06	13.36			
body height [cm]						
Karate	180.27	4.32	2.39	1.00	0.48	0.637
Kickboxing	179.27	6.88	3.84			
Body Mass Index [kg/m2]						
Karate	24.43	1.11	4.54	1.23	2.10	0.045*
Kickboxing	25.66	1.99	7.75			

All differences of the five fitness indices between the two groups of athletes were statistically insignificant (Table 2).

DISCUSSION

The comparison of static strength of Oyama karate and kickboxing total athletes (57.02 ±4.57 kg) competitors against the results of football players (43.5 ±38.2 kg) showed significantly higher level of static strength of the former [15]. The development of static strength is strictly related to series of static exercises done during the training of techniques. Properly developed strength skills are very important in the training process. Iermakov et al. [16] came to similar conclusion, he proved that static strength plays an immense role in the career of martial arts athletes.

Another comparison concerning dynamic strength of lower limbs showed that martial arts (combat sports) competitors are much better (277 ±11.48 cm) than PE students [17] in that field, the difference in the results was 51 cm (226 ±24.15 cm). The strength of leg muscles is based on various kicking techniques which are developed during the training process [18]. Probst et al. [19] who examined the strength and endurance of lower limbs of karate fighters came to the same conclusion. According to Szeligowski [20] properly developed muscle strength may effectively block technical skills of the opponent in a fight.

The most even results were denoted in the comparison of agility of total combat sports competitors (81.81 ±0.88 s) against PE students (81.48 ±1.00 s). The difference in the mean results was only 0.33 s [17]. Sekulic et al. [21] analysed the level of agility of combat sports competitors. He came to a conclusion that balance, speed and strength are in a strong correlation with competitors' agility. During a sport fight in contact formulas agility of a competitor is important, yet not so much as his strength. That is the reason for a possible little lower level of agility comparing to other motor skills among combat sports fighters.

The results of Beep Test showed that the endurance of combat sports fighters-was better (94 ±11.48 number of intervals) than endurance of football players (78 ±18.88 number of intervals) [22]. The test showed also that the level of VO_2max of combat sports competitors (50.70 ±3.11 ml/kg/min) was higher than football players (45.18 ±5.73 ml/kg/min) [22]. A score >50 ml/kg/min is an indicator of high level of training [23]. Energetic background of acombat sports competitor during a fight is based on mixed processes, both aerobic and anaerobic processes occur. The former are related to various combinations of techniques made with maximal strength and speed. The latter occurs when a fighter relaxes after a combination of techniques he has just made. This is the reason why forming a good endurance profile during the training process is the important key to success [19].

The greatest difference in all trials made was the one in flexibility between total combat sports

Table 2. The fitness indices for Oyama karate athletes (n = 30) and kickboxers (n = 30); in the presentation of the results of subtraction (d = $\bar{x}_1$ karate – $\bar{x}_2$ kickboxing) the sign was omitted.

Sample	$\bar{x}$	SD	V	D	T	P
static strength – right hand [kg]						
karate	56.60	3.58	6.33	0.13	0.07	0.942
kickboxing	56.47	6.09	10.79			
static strength – left hand [kg]						
karate	58.07	2.96	5.10	1.14	0.69	0.497
kickboxing	56.93	5.65	9.92			
dynamic strength [cm]						
karate	277.67	12.63	4.55	1.07	0.19	0.851
kickboxing	276.60	17.77	6.42			
endurance [number of intervals]						
karate	95.27	10.6	11.13	0.60	0.14	0.888
kickboxing	94.67	12.36	13.05			
VO_2max [ml/kg/min]						
karate	50.86	3.25	6.39	0.33	0.29	0.776
kickboxing	50.53	2.97	5.87			
agility [seconds]						
karate	18.88	0.96	5.09	0.13	0.41	0.682
kickboxing	18.74	0.80	4.25			
flexibility [cm]						
karate	59.80	6.17	10.31	2.67	1.01	0.323
kickboxing	62.47	8.20	13.13			

competitors (61.14 ±7.19 cm) and physiotherapy students (9.39 ±2.04 cm) [24], who can be seen as people not connected with any kind of professional sport. Karate fighters and kickboxers had the result better by 51.21 cm. In general the development of flexibility is the base of training concept created for martial arts athletes and combat sports competitors. According to Piepiora et al. [25] flexibility in martial arts is usually developed by solitary stretching, passive stretching in pairs, gymnastic exercises and practicing of martial arts and combat sports techniques.

Thanks to highly developed flexibility it is possible to do complicated routines with ease. However in order to carry out an effective attack it is necessary to combine flexibility, which allows to perform complicated techniques with properly developed strength and speed. Adequate strength and speed are necessary to guarantee efficiency of the fight and allow to terminate it ahead of time. That is why the training process in martial arts and combat sports should be enriched by general fitness development.

CONCLUSIONS

Oyama karate and kickboxing competitors have high level of static and dynamic strength. Moreover they have high level of maximal oxygen uptake (VO_2max) responsible for their endurance. It is however flexibility which is their the most highly developed motor skill. Agility is the skill developed in the similar level as in other athletes. There are no significant differences in

fitness profile between Oyama karate competitors and kickboxers. This means that, regardless of combat sport qualified as a form of direct confrontation in a vertical stance, allowing strikes with arms and legs, the same motor and conditioning abilities are stimulated.

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