Journal of Combat Sports and Martial Arts
© MEDSPORTPRESS, 2016; 1(2); Vol. 7, 51-55
DOI: 10.5604/20815735.1223401

ORIGINAL ARTICLE

Fitness Profile of Indian Male Karate Players

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Keywords: Karate, agility, body fat, flexibility, HIE, VO_{2max}

Summary

Background. Regular Karate training improves physical fitness and protects an individual from potential health diseases. Fitness profile of Karate players have been reported from different countries but pertinent data is unavailable in Indian Karate players. The present study was conducted to evaluate the fitness profile parameters in male Karate players of Kolkata, India and to compare the data with the sedentary control group and their overseas counterparts.

Material and methods. State level male Karate players (n=60, age: 22.73±1.91 yrs) were recruited in the study from different Karate academies of Kolkata, India. Sedentary control subjects (n = 60, age: 22.51±1.53 yrs) with similar socio-economic background were randomly sampled from the same localities. Physical parameters, body composition, flexibility, agility, high intensity effort (HIE) and maximum oxygen uptake (VO_{2max}) were measured by standard methods.

Results. Body height, flexibility, VO_{2max}, body density (BD), percentage of lean body mass (%LBM) and LBM were significantly ($p<0.001$) higher in Karate players whereas time taken for agility and HIE tests, %fat and total fat (TF) were significantly ($p<0.001$) lower in Karate players than the control group.

Conclusions. Karate training improved the fitness profile and this data would serve as the National standard of the fitness profile in Indian male Karate players. The present finding will help the coaches and sports medicine specialists to implement more specific training.

Introduction

Sedentary life style leads to onset of various health problems which cause reduction in bone density, muscle mass and physical fitness [1]. Different forms of martial arts, e.g., Judo, Tai Chi, Soo bahk do, Taekwondo, Karate etc. have gained worldwide popularity because of their beneficial effects to maintain the normal health [2,3]. Long term and short term practice of martial arts improved the high intensity effort (HIE), cardiorespiratory fitness and flexibility in Filipino athletes [4].

Karate is a trendy form of martial art that has gained incredible popularity in Korea, Japan, China and India. It is being used as a mean to boost self protection especially in some Western countries [1]. Training of Karate reduced the physiological disorders associated with aging and improve general fitness profile of older individuals due to its beneficial effects on cardiorespiratory fitness (VO_{2max}), HIE, muscle development, muscular endurance, muscle strength, speed and motor ability [5,6]. VO_{2max} plays a predominant role in Karate performance since it prevents fatigue during training as well as during the competitive events [5]. Japanese Karate practitioners performed this martial art as a precise technique to develop muscle mass, strength, power and motor skills [7].

Fitness profile of Karate players have been reported from different countries [2,3]. But pertinent data is unavailable in Indian Karate players. The present study was therefore aimed to evaluate the fitness profile parameters, e.g., morphological parameters, cardiorespiratory fitness in terms of VO_{2max}, HIE, agility and flexibility in male Karate players of Kolkata, India and to compare the data with the sedentary control group and their overseas counterparts.

Material and methods

Selection of Subjects

Sixty (60) male state level Karate players (age: 22.73± 1.91 yrs, range 20–26 yrs) with at least five years of regular involvement in Karate training were recruited in the study from reputed sports academies of Kolkata, India. Sedentary control subjects (age: 22.51±1.53 yrs, range 20–26 yrs) with similar socio-economic background were randomly sampled from the localities where the players reside. Subjects were neither suffering from any disease nor under any medication during the study period. They had no history of major diseases, bone fracture or heavy injury. The study was conducted at temperature ranging between 20–23°C and relative humidity ranging between 40–45%. Ethical clearance was obtained from the Human Ethics Committee of the Department of Physiology, University of Calcutta and written informed consent was taken from all the subjects.

Study design

Each subject came to the laboratory for three days with a gap of at least 7 days in between two consecutive days of visit. They reported in the laboratory at 9 am in all the occasions. Familiarisation trial was conducted on the first visit when they were explained and demonstrated all the experiments to allay apprehension and familiarised with the entire experimental protocol. Pre-exercise heart rate, blood pressure, skinfolds and VO_{2max} were measured in the second visit while flexibility, agility and HIE were measured during the third visit. Pre-exercise heart rate and blood pressure were measured after a rest for half an hour. Body height and body mass were measured to an accuracy of ±0.50 cm and ±0.1 kg, respectively, by using a weight measuring instrument fitted with height measuring rod (Avery India Ltd., India) with the subject standing barefoot and wearing minimum clothing. The body surface area (BSA) and body mass index (BMI) were computed from standard equations [8,9]. Subjects refrained from any energetic activity on the days of evaluation and took light breakfast 2 to 3 hrs before the test.

Determination of Body Composition [10]

Body composition was determined by skinfold measurement with the help of a skinfold calliper with constant tension (Holtain Ltd., UK) by using the following formulae:

Body density (BD; $gm.cc^{-1}$) was determined from the following equations: $BD=1.10938-0.0008267X_1+0.0000016X_1^2-0.0002574X_2$ (X_1=sum of chest, abdominal and mid–thigh skinfolds, X_2= Age in nearest yrs), Percentage of body fat was measured by Siri in 1961 equation [11], i.e., %Fat = 495/BD – 450, Total Fat or TF (kg) = %Fat/100 × Body Mass (kg), % Lean Body Mass (%LBM) = 100 − %Fat, LBM (kg) = Body Mass (kg) − Total Fat (kg).

Measurement VO_{2max}, motor fitness and HIE

Motor fitness parameters (e.g., Agility and flexibility), HIE and direct estimation of VO_{2max} were performed by using the standard procedures [12].

Statistical analyses

Data have been presented as mean±SD. Two-tail student's t-test was performed to test the significance of difference between means values recorded in Karate group and sedentary control group.

Results

Values of age, body height, body weight, BMI, BSA, pre-exercise heart rate, systolic and diastolic blood pressure were presented in Table 1. Age and blood pressure did not show any significant difference between the groups. Body height depicted significantly ($p<0.05$) higher value in the Karate players while other parameters were significantly lower in the Karate group than the sedentary group (Table 1). BMI of the both groups were in the normal range. The value of chest, abdominal and mid-thigh skinfolds was significantly ($p<0.001$) lower in Karate players than the sedentary group (Table 1).

Body compositions, agility, flexibility, HIE and VO_{2max} were tabulated in Table 2. BD, %LBM, flexibility, VO_{2max} and LBM depicted significantly ($p<0.001$ and $p<0.05$) higher values in Karate group, but %fat, TF, HIE and agility exhibited significantly ($p< 0.001$) higher values in Karate players than the sedentary group.

Discussion

Agility, force, speed and strength are the major components of motor fitness that is a key determinant of performance in

Table 1. Physical parameters, BMI, BSA, blood pressure and pre-exercise heart rate of the subjects

	Age (yrs)	Body height (cm)	Body weight (kg)	BMI (kg/m^2)	BSA (m^2)	Blood Pressure (mm of Hg)		Pre-exercise heart Rate ($beats.min^{-1}$)
						Systolic	Diastolic	
Sedentary (n=60)	22.51 ±1.53	164.99 ±2.62	58.14 ±3.47	21.36 ±1.26	1.63 ±0.05	116.03 ±5.28	76.67 ±5.77	78.02 ±4.84
Karate (n=60)	22.73 ±1.91	166.08 ±2.95*	56.12 ±5.42**	20.33 ±1.76**	1.62 ±0.08**	117.45 ±5.26	74.02 ±6.09	70.97 ±3.79**

Values are expressed mean±SD, *p<0.05,* *p<0.001.

Table 2. Values of body composition, Agility, flexibility and HIE and VO_{2max}

	Skinfolds (mm)			Sum of Skin folds (mm)	Body density (gm/cc)	%fat (%)	Total body Fat or TF (kg)	%LBM (%)	LBM (kg)	Agility (sec)	Flexi-bility (cm)	HIE (sec)	VO_{2max} ($ml.kg^1.min^{-1}$)
	Chest	Abdo-minal	Thigh										
Sedentary (n=60)	6.61 ±0.63	14.63 ±1.26	17.79 ±1.89	39.03 ±2.59	1.07 ±0.001	10.99 ±0.78	6.39 ±0.63	89.003 ±0.78	51.75 ±3.07	12.16 ±0.68	20.29 ±6.16	9.65 ±0.87	41.05 ±4.65
Karate (n=60)	3.55 ±0.83 **	7.26 ±1.47 **	8.89 ±2.3 **	19.7 ±3.37 **	1.09 ±0.003 **	5.01 ±1.11* *	2.83 ±0.79 **	94.98 ±1.11 **	53.28 ±4.91 *	10.39 ±0.37 **	43.55 ±4.44 **	8.96 ±0.50 **	53.65 ±3.69 **

Values are expressed mean±SD, *p<0.05, **p<0.001

Karate. The pragmatic objective of the current study was to evaluate the fitness profile of male Karate players of Kolkata, India and to compare the data with the sedentary control group and their overseas counterparts. Fitness profile parameters were significantly better among Karate players than the control group due to their involvement in the regular training as also reflected in earlier studies in Karate players of America and Canada [1].

Body Composition

Fat and fat-free tissues are the main components of body composition which is improved following Karate training [1] although insignificant difference in %fat was also reported in highly competitive and novice Japanese Karate athletes [6]. Present study depicted significantly ($p<0.001$) higher value of body density in Karate players than the sedentary group. This finding corroborated with the finding in national Polish Karate players [13]. Percentage of body fat was significantly ($p<0.001$) lower in Karate players than the sedentary control group as also reported in American Karate players [1]. Present Karate players had lower %fat (5.01%) than their American (18.9%), French (13.7%), Polish (16.8%) and Japanese (7.5%) counterparts [1,13-15]. Significant alteration in %fat following three years' rigorous training helped the Italian and European Karate players to excel an outstanding performance [16,17]. Lower %fat helped Japanese Karate athletes to exert wonderful performance [13].

Existence of significantly ($P<0.05$) higher LBM in Karate group than the sedentary control group corroborated with the earlier studies in Japanese, Italian and Polish Karate players [6,13]. However, the LBM (53.28±4.91 kg) of presently studied Indian Karate players was lower than their Japanese (59.1± 6.1 kg) and Polish (69.9±8.20 kg) counterparts [6,13]. A strong association between LBM and performance in Karate was ported and it has been postulated that LBM played an advantageous role in Karate performers although a significant difference persists in LBM between top level and novice Karate athletes [6].

VO_{2max}

Existence of significantly ($P<0.001$) higher VO_{2max} in Karate players than the sedentary group (Table 2) corroborated with the earlier report in American and Japanese Karate players [1,6]. The VO_{2max} of the presently studied Karate players was higher than the Jordanian and Italian male martial art athletes but lower than their French and Swedish counterparts and Swedish mixed martial art (MMA) players [18,19,20]. VO_{2max} of Iranian male martial art athletes was lower than the Canadian martial art athletes [22]. It has been reported in Egyptian martial art players that regular use of martial art exercises raise the functional status of the respiratory system and thus increase the aerobic capacity which is required to avoid fatigue during training and to facilitate the recovery process between consecutive competitions [6,21]. VO_{2max} is independent of the level of Karate practitioners [6,14]. Long term training leads to an increase in VO_{2max} due to substantial increase in muscle mass and greater involvement of aerobic metabolism. The existence of significantly higher value of VO_{2max} among Karate players in the present investigation might be attributed to their significantly higher value of muscle mass than their sedentary counterparts [1,23]. It has been reported that male Brazilian Karate players had much higher percentage of aerobic metabolism when judged against their taekwondo counterparts [24]. This might be attributed to the difference in kumite duration or involvement of different types of limb movements, especially the involvement of more upper limb movements in Karate training than the Taekwondo [24]. However, a different finding with insignificant difference in VO_{2max} between Karate and Taekwondo players was also reported in American population [25].

Flexibility

Data of flexibility is scanty in Karate players. Present study depicted that Karate training improved the flexibility in young Indian male Karate players. Conflicting result was reported in male Filipino martial art athletes who had no significant difference in flexibility than their sedentary counterparts. The flexibility score of the present studied Karate players (44.25±4.04 cm) was higher than the Filipino male martial art players (38.6±6.6 cm) but lower than the Croatian female martial art players (55.8±4.8 cm) [26]. Present and previous findings indicated that Karate training helped to achieve better flexibility that is essential for this sport because flexibility allows larger range of movement which helps in better kicking and also reduces the incidence of injuries [4,27]. Greater flexibility was observed in the right and left hip flexion of Karate players compared to the control group and it might be attributed to the training effect that stimulates repetitive flexion of the hip muscles for the duration of the early phase of kicking [28]. Success score of flexibility might also be due to both the attacking and defensive kumite techniques which largely depend on the ability to rapidly initiate the change of body position in horizontal direction [29]. The repetitive use of techniques involving the limb movements might also explain this finding [29].

Agility

Training of Karate had significant impact on agility, coordination and core-strength which are major determinants of fighting efficiency in Karate [30]. Existence of significantly ($p<0.001$) higher agility score in Karate players than sedentary control group (Table 2) corroborated with the study in Croatian male and female Karate players of 18–29 years of age [31]. Higher agility score in Karate players might be attributed to the practice of frequent kicking during the event escort by controller of muscle tone that is the primary energy component in technique performance [30]. Karate players also undergo plyometric training that might have also had positive impact on agility score since it improves the efficiency of leg muscles by generating ground output power [32]. Contradictory finding is unavailable in this regard.

HIE

Speed and force were significantly increased following Karate training to improve the fighting efficiency [30]. The Indian young male Karate players of the present study had significantly ($p<0.001$) higher value of HIE than their sedentary counterparts. Similar finding was reported in Croatian adolescent Karate players of 11–12 yrs of age [33]. Karate training consists of very short periods of high-intensity intermittent movements that are interspersed with recovery periods [33]. Earlier result demonstrated that anaerobic power or HIE is the key determinant of maximal power output that distinguishes Karate athletes at different competitive levels since such high force intermittent actions rely mostly on anaerobic energy sources which in turn act as a major determinant factor to achieve success [18]. Such frequent decisive actions like "kick and punch" as well as repeated forceful movements of the upper and lower limbs to generate explosive power were probably the attributing factors for having significantly higher HIE score in Karate players [6,18]. These movements of the limbs and other body parts helped them not only to develop and sustain their muscular strength and endurance but also to promote their speed and acceleration that influence the fast execution of skill and techniques involving swift movement of the body in a short span of space [6,18].

Conclusion

This is the first report of fitness profile parameters in Indian male Karate players and therefore the data reported in this study may be treated as a National standard of the fitness profile data of Indian male Karate players. The Karate practitioners had significantly higher aerobic capacity, HIE, flexibility, agility, LBM and less body fat content than the sedentary control group probably due to their regular participation in Karate training. Therefore, health professionals may promote and recommend the regular practice of Karate as an as an alternative of other forms of exercises for health and fitness promotion among common people. Further studies may be conducted to explore the short term effects of Karate practicing on fitness profile parameters.

Acknowledgement

Authors are indebted to the University of Calcutta for financial help (vide Teachers' Research Grant no. BI92(7)] to complete the study. Authors also express their heartfelt thanks to all the participants for their cooperation and assistance without which the study could not be completed.

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Financial support:
Research Contingency Grant [(BI92(7)] of University of Calcutta was partly used for conducting the study.

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Received: 25.05.2016
Accepted: 21.10.2016