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АЭРОБНЫЕ И АНАЭРОБНЫЕ СПОСОБНОСТИ, ГИБКОСТЬ И МЫШЕЧНАЯ ПРОИЗВОДИТЕЛЬНОСТЬ МАЛАЗИЙСКИХ МОЛОДЫХ ЖЕНЩИН, ВЕДУЩИХ СИДЯЧИЙ ОБРАЗ ЖИЗНИ, А ТАКЖЕ ЛИЦ, ЗАНИМАЮЩИХСЯ СИЛАТ И ТХЭКВОНДО

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Аннотация. *На сегодняшний день опубликованные данные о сопоставлении компонентов физической подготовленности Малазийских молодых женщин, ведущих малоподвижный образ жизни, а также практикующих силат и тхэквондо, ограничены. Цель: данное исследование посвящено изучению аэробных и анаэробных способностей, гибкости и мышечной работоспособности Малазийских молодых женщин, ведущих сидячий образ жизни (КГ), а также занимающихся силат и тхэквондо (ЭГ1 и ЭГ2).* ***Материалы и методы:*** *в исследовании приняли участие 36 девушек (возраст от 15 до 20 лет) в трех группах: КГ, ведущая сидячий образ жизни, ЭГ1, ЭГ2, занимающиеся силат и тхэквондо (по 12 человек в группе). Все участники выполнили измерения по антропометрии и составу тела, по оценке аэробных возможностей, (максимальное потребление кислорода (VO2max). С помощью теста Вингейта, проводили тестирование анаэробных возможностей. Гибкость измерили через сидячий тест достижения, мышечную силу и взрывную мощность измерили с помощью теста по определению силы руки (динамометр), тестировали силу спины и ног, взрывную силу определяли с помощью прыжков в длину с места. Однофакторный дисперсионный анализ был проведен для определения различий измеряемых параметров между группами.* ***Результаты:*** *ЭГ1, практикующая силат, показала достоверно (P <0,05) большую гибкость и силу при определении силы доминантной и не доминантной рук по сравнению с КГ, ведущей сидячий образ жизни. ЭГ2, занимающаяся тхэквондо, показала большее значение расчетного VO2max по сравнению с КГ и ЭГ1, занимающейся силат, соответственно. Среди КГ, ведущей сидячий образ жизни, ЭГ1 и ЭГ2, практикующих силат и тхэквондо, достоверных различий в силе спины и ног, взрывной силе прыжков и тестированию анаэробных способностей по Вингейту, не выявлено.* ***Заключение:*** *Силат и тхэквондо могут усилить определенные компоненты физической подготовки по сравнению с сидячим образом жизни. Женщины, практикующие силат, характеризовались высокой гибкостью и сильной мышцей руки. Обе группы, ЭГ1 и ЭГ2, занимающиеся тхэквондо и силат, обладали аналогичными анаэробными способностями, однако, ЭГ2, занимающаяся тхэквондо, показала более высокую аэробную способность, чем ЭГ1, практикующая силат. Эти результаты могут быть использованы в качестве руководящих принципов для планирования программы обучения для занимающихся тхэквондо и силат, а также содействия активному образу жизни, участвуя в боевых искусствах, таких как тхэквондо и силат.*

Ключевые слова*: аэробный и анаэробный потенциал, состав тела, измерение гибкости, мышечная работоспособность, силат, тхэквондо.*
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AEROBIC AND ANAEROBIC CAPACITIES, FLEXIBILITY AND MUSCULAR PERFORMANCE OF MALAYSIAN YOUNG FEMALE SEDENTARY INDIVIDUALS, SILAT AND TAEKWONDO PRACTITIONERS

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Abstract. *To date, published data on comparisons of physical fitness components of Malaysian young female sedentary individuals, silat and taekwondo practitioners are limited.* ***Aim****: This study investigated aerobic and anaerobic capacities, flexibility and muscular performance in Malaysian young female sedentary individuals, silat and taekwondo practitioners.* ***Materials and Methods:*** *Thirty-six young female participants (age ranged 15 to 20 years old) with three groups, i.e. sedentary control, silat and taekwondo groups (12 participants per group) were recruited in this study. All participants performed anthropometric and body composition assessments, aerobic capacity measurement via estimated maximum oxygen uptake (VO_{2max}) test, Wingate test anaerobic capacities test, flexibility measurement via sit and reach test, muscular strength and explosive power measurements via hand grip strength test, back and leg strength test and standing long jump explosive power test. One-Way ANOVA was performed to determine the differences of the measured parameters among groups.* ***Results:*** *Silat group showed significantly ($p<0.05$) greater flexibility and handgrip strength of dominant and non-dominant hands compared to sedentary control group. Taekwondo group showed greater value of estimated VO_{2max} compared to sedentary control group and silat group respectively. There were no significantly differences in back and leg strength, jumping explosive power and Wingate anaerobic capacities among sedentary control, silat and taekwondo groups.* ***Conclusion:*** *Silat and taekwondo could enhance certain physical fitness components compared to sedentary lifestyle. Silat practitioners are characterised by high flexibility and strong hand muscle. Both taekwondo and silat practitioners possessed similar anaerobic capacity, however, taekwondo practitioners showed higher aerobic capacity than silat practitioners. These results can be used as guidelines for planning training program for taekwondo and silat practitioners, as well as promoting active lifestyle by engaging in martial arts such as taekwondo and silat.*

Key words: *aerobic and anaerobic capacity, body composition, flexibility measurement, muscular performance, silat, taekwondo.*

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INTRODUCTION

Physical activity is important in providing healthy body. Through performing exercises and physical activities in daily life, physiological and psychological well-being of an individual can be enhanced (Biddle, 2002). Silat is a form of martial art that has being practiced in Malaysia for self-defense purpose, as well as for enhancing physical fitness components and to continue the tradition and culture of Malay people (Silat Cekak Pusaka Hanafi, 2016). Taekwondo is a martial arts which originated from Korea (Morris, 1994). It is unarmed combat for self-defense that involves skillful application of techniques such as punching, jumping kicks, blocks, dodges, parrying actions with hands and feet. It is believed that taekwondo and silat can improve flexibility, muscular strength, anaerobic and aerobic fitness, fat loss and reaction time, postural control, bone mineral density and psychological health.

In a previous study conducted by Aziz *et al.* (2002) which determined the physiological responses during silat matches and profile of elite pencak silat exponents, it was found that silat athletes showed slightly lower aerobic fitness, and hand grip strength but greater explosive leg power than judo athletes. They also mentioned that silat

athletes showed higher levels of lower anaerobic power capabilities compared to upper body anaerobic capability. Based on their result of vertical jump test, they also found that silat athletes have greater explosive power implying that quick and explosive limb movement is more important in silat striking skills.

Fong and Ng (2014) mentioned that adult taekwondo practitioners were more flexible in their hamstrings and lower back muscles compared to the sedentary individuals. In comparison of novice and professional taekwondo athletes, the hip adductor muscles of well-trained taekwondo athlete were more flexible than those of novice athletes. The continuous training of taekwondo may have caused improvement of flexibility in lower part of body. Toskovic *et al*. (2004) reported that highly trained recreational taekwondo athletes tend to have lower body fat and higher aerobic fitness compared to a newcomer in taekwondo. Heller *et al*. (1998) found that taekwondo practitioner who has low level of body fat and high levels of aerobic fitness and flexibility tend to become a successful taekwondo athlete. According to Bouhlel *et al.* (2006) mentioned that high performance taekwondo athletes can be identified by low fat, well-developed aerobic and anaerobic capacities.

Markovic *et al.* (2005) carried out a study to investigate physical fitness and motor abilities in female Croatian elite taekwondo athletes, aiming to distinguish between successful and less successful peers. Based on their study, the successful athletes have higher explosive leg power compared to less successful athletes, they also have significantly higher aerobic endurance and lateral agility. Their study also found that successful taekwondo athletes have higher speed in running and their anaerobic threshold was significantly higher compared to less successful athletes.

Study in skill-related fitness that being conducted by Suzana & Pieter (2006) has shown that there was no deference between winners and loser within gender in explosive leg power and aerobic fitness among young taekwondo athletes. Their results showed that the boys had greater explosive leg power compared to woman even after matching a body mass with an empirically derived exponent. In combat sports, developing strong muscular strength is important. A study conducted by Thompson and Vinueza (1991) did not find any muscular strength improvement with taekwondo training.

To our knowledge, to date published data on comparisons of physical fitness components of sedentary individuals, silat and taekwondo practitioners in Malaysia are limited. Therefore the present study was proposed.

MATERIALS AND METHODS

Participants

Thirty six participants were recruited. They were age matched and being assigned into three groups with 12 participants per group, i.e. sedentary control group (n=12), silat group (n=12) and taekwondo group (n=12). The silat and taekwondo participants were individuals who practiced silat or taekwondo for at least two years in training. The sedentary control group were individuals who were not involved in any competitive sports, and exercised less than 2 times per week.

Research Design

This was a cross-sectional study. All participants performed anthropometric and body composition assessments, aerobic capacity measurement via estimated maximum oxygen uptake (VO_2max) test and Wingate test anaerobic capacities test, flexibility measurement via sit and reach test, muscular strength and explosive power measurements via hand grip strength test, back and leg strength test and standing long jump explosive power test. This study was carried out in the Sport Science Laboratory, Health Campus, Universiti Sains Malaysia. The test were monitored by qualified and experienced laboratory staffs.

Procedures

Physiological characteristics

Participant's body weight and body height were measured using a stadiometer (Seca 220, Hamburg, Germany). Participant's body

composition i.e. percent body fat (% BF) and fat-free mass (FFM, kg) were measured by using a "foot-to-foot" body composition analyser (Tanita model TBF-140). Participant's resting heart rate (beats per minute) and blood pressure (mmHg) were measured by using an automated upper arm blood measure monitor (TM-2540, San Jose, USA).

Aerobic Capacity Measurement: Estimated of Maximum Oxygen Uptake (VO_{2max}) via 20 Meter Shuttle Run Test.

Estimated maximum oxygen uptake (VO_{2max}) was determined via 20 meter shuttle run test. This test required the participants to run 20 meter in time with a "beep" sound from a CD recorder. The run was repeated until the participants could not keep pace with the "beep". The estimated VO_{2max} was calculated based on the number of accomplished laps via website http://www.topendsport.com/testing/beep calc.htm.

Measurement of Anaerobic Capacities via Wingate Test

In Wingate anaerobic capacity test, participants performed a 30 second maximal cycling on a cycle ergometer (H-300-RLode, Groningen, Holland). Mean power (MP), peak power (PP), anaerobic capacity (AC), anaerobic power (AP) and fatigue index (FI) measured throughout the 30 second cycling test was recorded.

Flexibility Measurement via Sit and Reach Test

Participants' flexibility was tested via sit and reach test. Participants were required to sit and place the feet at the sit and reach testing box and then bent as further as possible by pushing the marker on top of the box to get the reading.

Muscular Performance Measurement via Hand Grip Strength Test, Back and Leg Strength Test and Standing Long Jump Test

Hand grip strength test was conducted by using a handgrip dynamometer. Participants hold the dynamometer in the dominant hand. The handle of the dynamometer was adjusted with the base rest on first metacarpal and the handle rest on middle of four fingers. The participants, squeezed the dynamometer with maximum effort and maintained for about 5 seconds without any other body movements was allowed. When completed with dominant hands, the same steps were applied to the non-dominant hands.

Back and leg strength test was conducted by using a back and leg strength dynamometer. The dial was required to be reset to zero before the test was started. Participant was required to stand upright on the base of the dynamometer with feet shoulder width apart, arms hang straight down to hold the center of the bar with both hands, and with the palms facing toward the body. The chain was required to be adjusted so that the knees were bent at approximately 110 degrees. Participants did bend back, pulled as hard as possible on the chain and tried to straighten the legs and kept arms straight. They were required to pull against the weight steadily with no jerky movements, and kept keep the feet flat on the base of the dynamometer. Maximum performance was achieved when legs were almost straightened at the end of the lift.

While for standing long jump power test, participants were required to stand in front of non-slip rubber mat with feet slightly apart. Swinging of the arms and bending of the knees were required to provide forward drive. The participants were required to jump as far as possible and landed on both feet without falling backwards. The distance of the jump was recorded.

Statistical Analysis

All data were analysed using the Statistical Package for Social Science (SPSS) version 22.0. One-way ANOVA was used to determine the differences of the measured parameters among groups. Results are presented as mean and standard deviation (mean ± SD). Statistical significance was accepted at p value < 0.05.

RESULTS

Anthropometry and Body Composition of the Participants

There was statistically significant greater ($p<0.05$) value of body height in silat group compared to sedentary control group. However there were no significant differences in body height between taekwondo and sedentary control group, as well as between taekwondo and silat groups. There were no significant differences observed in age, body weight, body mass index (BMI) percentage of body fat, fat free mass, resting heart rate, diastolic blood pressure and systolic blood pressure between silat and sedentary groups, taekwondo and sedentary groups, as well as taekwondo and silat groups. (Table 1)

Table 1

Means age, body height, body weight, body mass index (BMI), percentage body fat (% BF), fat free mass, resting heart rate, diastolic blood pressure systolic blood pressure in sedentary, silat and taekwondo groups.

Parameters	Sedentary control group (n=12)	Silat group (n=12)	Taekwondo group (n=12)	*p* values		
				Silat versus sedentary	Taekwondo versus sedentary	Taekwondo versus silat
Age (Yr)	17.5 (1.6)	17.6 (1.6)	16.8 (1.5)	1.000	0.920	0.753
Body height (cm)	**153.5 (5.6)**	**156.6 (5.3)***	153.4 (3.5)	**0.013**	0.475	0.347
Body weight (kg)	46.3 (7.1)	51.7 (11.2)	46.8 (8.3)	0.467	1.000	0.583
Body mass index ($kg^{-1}m^2$)	20.0 (3.4)	21.0 (4.3)	20.0 (3.3)	1.000	1.000	1.000
Percentage body fat (%)	27.1 (7.0)	29.3 (9.7)	25.3 (7.0)	1.000	1.000	1.000
Fat Free Mass	33.4 (2.6)	35.6 (3.7)	34.5 (3.1)	1.000	1.000	0.671
Resting heart rate	82.6 (9.8)	78.8 (12.5)	84.8 (9.3)	0.269	1.000	1.000
Diastolic blood pressure	66.3 (8.0)	69.8 (7.7)	71.0 (4.3)	0.092	0.891	0.719
Systolic blood pressure	107.3 (11.6)	116.8 (10.7)	111.8 (8.7)	0.667	0.338	1.000

Values are expressed as means (SD). *p* value corresponds to comparison between groups
*, $p < 0.05$ significantly different from sedentary control group
Bold number indicate statistically significant

Flexibility, Hand Grip Strength, Back and Leg Strength and Standing Long Jump Explosive Power

There was statistically significant greater ($p<0.05$) flexibility in silat group compared to sedentary group. There was no significant difference observed in flexibility between taekwondo and sedentary control groups. Similarly, there was no significant difference in flexibility between taekwondo and silat groups. Regarding hand grip strength, there were statistically significant greater hand grip strength in dominant hand for silat group ($p<0.05$) compared to sedentary control group. However, there was no significant differences observed in hand grip strength between taekwondo and sedentary control group, as well as silat and taekwondo groups. There were no significant differences observed in back and leg strength and standing long jump power among all the groups. (Table 2)

Table 2

Flexibility, hand grip strength, back and leg strength and standing long jump in sedentary, silat and taekwondo groups.

				p values

Parameters		Sedentary control group (n=12)	Silat group (n=12)	Taekwondo group (n=12)	Silat versus sedentary	Taekwondo versus sedentary	Taekwondo versus silat
Hand grip strength (kg)	Dominant hand (kg)	**20.8 (4.2)**	**26.5 (4.8)***	23.0 (4.5)	**0.017**	0.763	0.240
	Non-dominant hand	**18.4 (4.1)**	**23.5 (5.9)***	21.1 (6.0)	**0.048**	0.465	0.862
Flexibility (cm)		**28.8 (4.3)**	**34.8 (4.3)***	32.8 (6.5)	**0.025**	0.216	1.000
Back and leg strength (kg)		55.7 (18.2)	68.3 (18.4)	56.9 (20.6)	0.343	1.000	0.460
Standing long jump (cm)		99.9 (24.3)	119.2 (13.3)	112.3 (20.4)	0.053	0.079	1.000

Values are expressed as means (SD). *p* value corresponds to comparison between groups
*, $p < 0.05$, significantly different from sedentary control group.
Bold numbers indicate statistically significant

Aerobic Capacity (Estimated VO_{2max}) and Wingate Anaerobic Capacities

Taekwondo groups exhibited statistically significant higher ($p<0.001$) estimated VO_{2max} value than sedentary control group. Similarly, taekwondo group also showed higher ($p<0.001$) estimated VO_{2max} than silat group (Table 4.3). There was no significant difference between silat and sedentary control groups. There was no statistically significant difference in mean power, peak power, anaerobic capacity, anaerobic power and fatigue index among sedentary control, silat and taekwondo groups (Table 3).

Table 3

Aerobic capacity (estimated VO_{2max}) and Wingate anaerobic capacity parameters in sedentary, silat and taekwondo groups

Parameters	Sedentary control group (n=12)	Silat group (n=12)	Taekwondo group (n=12)	*p* values		
				Silat versus sedentary	Taekwondo versus sedentary	Taekwondo versus silat
Aerobic capacity: Estimated VO_{2max} ($mL.kg^{-1}$,min)	**21.0 (1.4)**	**21.3(1.3)**	**24.8 (2.8)** *** ###	1.000	**<0.001**	**<0.001**
Wingate anaerobic capacity parameters						
Mean power (Watt)	209.4 (53.1)	243.1 (55.2)	196.4 (54.8)	0.417	1.000	0.129
Peak power (Watt)	421.0 (30.9)	429.1 (68.7)	407.9 (58.2)	1.000	1.000	1.000
Anaerobic capacity ($Watt.kg^{-1}$)	4.6 (1.0)	4.7 (0.8)	4.2 (0.6)	1.000	0.747	0.309
Anaerobic power ($Watt.kg^{-1}$)	9.2 (1.5)	8.6 (1.8)	9.0 (1.9)	1.000	1.000	1.000
Fatigue index ($Watt.sec^{-1}$)	10.9 (1.7)	10.3 (2.6)	11.2 (4.0)	1.000	1.000	1.000

Values are expressed as means (SD). *p* value corresponds to comparison between athlete and non- athlete groups
***, $p < 0.001$ significantly different from sedentary control group
###, $p < 0.001$ significantly different from silat group
Bold numbers indicate statistically significant

DISCUSSION

This study found that silat group showed significantly greater body height compared to sedentary control group. However, there were no significantly differences between taekwondo group and sedentary control group, as well as between taekwondo and silat group. Study of Pieter *et al*. (2009) on somatotype of elite combative sport athletes found that there was no difference in somatotype between silat and karate athletes. Inconsistent with finding of Pieter *et al*. (2009), this present study found that silat practitioners were taller than taekwondo practitioners and sedentary individuals. The present finding may reflect that silat training with high impact activities such as lift kick and cat kick could elicit beneficial effects on bone growth in length and subsequently contribute to the greater body height in adolescent silat practitioners. This is based on the fact that osteogenic responses are high during adolescence, and bone responds with great rate to load produced by high impact physical activities (Ooi *et al*. 2009). In combat sports, height gives advantage for longer reach. Falco *et al*. (2009) mentioned that standing further from an opponent gives an advantage to a taller competitor to kick from a further distance. Thus extra height is advantage for an athlete involved in combat sport.

One of the main finding of the present study was that silat group showed significantly greater flexibility compared to sedentary control group. However, there was no significant difference between taekwondo and sedentary groups, as well as between taekwondo and silat groups. This result implies that involvement in silat is better than sedentary lifestyle in enhancing flexibility. According to Shamsuddin (2005), involvement in silat is a great way to develop and to increase physical fitness, such as flexibility. Nevertheless, a previous study conducted by Cynthia (2017) which involved silat athletes found that there was no significantly difference in flexibility between athletes and non-athletes. The present study found that the flexibility value in taekwondo group was only slightly lower that silat group, despite the difference of flexibility values between these two groups did not reach significant level statistically. These results imply that taekwondo training may enhance flexibility of the practitioners.

Practice of martial art is believed can cause improvement in flexibility due to training. The daily routine of martial art requires the practitioner to stretch and this can help in improving their flexibility. For instance, a previous study by Taylor-Piliae (2006) on tai chi practitioners found that after 12 weeks of training, there were improvements in upper- and lower-body flexibility, balancing, upper- and lower-body muscular strength and endurance in older Chinese adults. Flexibility has a close relation with martial arts, the reason is that when involving a combat skill such as kicking, it requires ones to move a joint through their full range motion, especially in the roundhouse and axe kicks. According to Erie *et al*. (2007), lower limb flexibility allows athletes to kick higher which is need for scoring of higher point in taekwondo. In taekwondo matches, kicking to head successfully can grant more points compared to other parts of the body. In addition, flexibility can help in minimising the risk of injury. Similarly, it was mentioned by Chandler (1990) that in tennis sports, dominant shoulder was more flexible than non-dominant shoulder in tennis players.

Another main finding in the present study was that silat group showed statistically greater hand grip strength in both dominant and non-dominant hands compared to sedentary control group. However, there was no significant difference between taekwondo and sedentary groups, as well as between taekwondo and silat groups. This implied that involvement in silat is beneficial in enhancing hand grip strength, in other words strong hand muscle.

Aziz *et al.* (2002) reported that hand grip strength of silat athletes was slightly lower compared to athletes from other martial

arts, such as taekwondo and judo. The authors mentioned that this is due to difference in race. The authors collected data from Asian population in their study and their data were then compared to other races from Europe countries.

It is speculated that the strong hand muscle in silat practitioners observed in the present study was due to the nature of silat itself, because silat requires silat practitioners to work on grappling. This helps in developing and strengthening muscle of hand. It is also speculated that silat requires the practitioners to use hand to bring down opponents to get more point compared to taekwondo which requires a high kicking to head of opponents to get a higher point. The present study finding agreed with finding of Abián-Vicén (2012) which also showed that the nature of badminton sport and tennis sport involving hands can enhance strength of the hand muscle. Their studies also showed that involvement in tennis elicited two to three times higher hand grip strength compared to badminton. The authors mentioned that this is due to tennis racquet is heavier compared to badminton racquet, and requires a stronger hand grip strength in tennis players to hold the racquets compared to badminton players.

There are two categories in silat, i.e. artistic and contact (Aziz *et al.*, 2002). Silat pencak is an artistic category of self-defense, In contrast, silat olahraga is a contact sport that emphasises ability of a silat exponent to perform his silat techniques in combat, with striking and defensive actions such as punching, kicking, throwing, catching, parrying and blocking and any others skills related to silat techniques. In the present study, the silat practitioners are involved in silat olahraga, therefore it is speculated that the punching, throwing, catching and blocking silat techniques which they mastered in have resulted the present finding of greater hand muscle strength compared to sedentary controls.

In the present study, it was observed that there were no significant differences in back and leg strength and standing long jump explosive power among sedentary control, silat and taekwondo groups. Inconsistent with the present study, previous study by Aziz *et al.* (2002) on explosive leg power in silat reported that silat exponents have higher lower body power than taekwondo and judo athletes, when they compared their data with the results from other studies on taekwondo and judo athletes. The authors mentioned that this may be due to silat uses a single type of knockout in matches, where lower body part was used, especially legs to grip and target limb of opponents to bring them down to collect a point.

The absence of the significant differences in leg explosive power in the present study between female adolescent silat and taekwondo practitioners with mean age of 17 years old and Aziz *et al.* (2002) may be due to the lower competition level, and differences in gender and age of the female silat and taekwondo practitioners in the present study compared to the elite male athletes with mean age of 24 years old in Aziz *et al.* (2002). In addition, the female adolescent silat and taekwondo practitioners of the present study were involved in training not strictly for competition, thus their training level was not high enough for them to show a difference in back and leg strength and standing long jump explosive power compared to sedentary controls.

The most notable finding in the present study was that taekwondo group showed statistically significant higher estimated aerobic capacity (VO_{2max}) compared to sedentary control group and silat groups. However, there was no significant difference between silat and sedentary groups. This study implies that involvement in taekwondo can elicit more beneficial effects in increasing aerobic capacity, i.e estimated VO_{2max} in taekwondo compared to silat and sedentary lifestyle. Similarly, Heller *et al.* (1998) and Markovic *et al.* (2005) also found that taekwondo practitioners have higher level of aerobic fitness. In general, taekwondo training involves continuous jumping and high kicking movements over a period of time, and this requires aerobic fitness. Therefore, it is speculated that this is the

reason of the present observation that high aerobic fitness was observed in taekwondo practitioners.

Regarding Wingate anaerobic capacities, the present study found that there were no statistically significant differences in mean power, anaerobic power, peak power, anaerobic capacity and fatigue index among sedentary control, silat and taekwondo groups. This result implies that silat and taekwondo training regimens did not affect anaerobic capacities significantly of silat and taekwondo practitioners in the present study. These study findings are in agreement with Aziz *et al.* (2002), which reported that there were only slightly lower peak power and mean power in silat athletes compared to taekwondo and judo athletes.

Comparison between Borkowski *et al.* (2001) and Heller *et al.* (1998) showed that elite female judo athletes have similar anaerobic capacity compared to elite female taekwondo athletes. Nevertheless, when compared the present study results with these two previous studies, it was found that adolescent female silat and taekwondo in this study showed lower anaerobic capacity parameters, i.e. mean power and peak power compared to elite judo and taekwondo in Borkowski *et al.* (2001) and Heller *et al.* (1998). The differences in anaerobic capacity parameters reported by these two previous studies with the present study could be due to difference in age, gender, competition level, levels of training, ethnicity or genetic make-up, and type of martial art involved.

CONCLUSIONS

These findings imply that engagement in silat and taekwondo could enhance certain physical fitness components compared to sedentary lifestyle. Silat practitioners are characterised by high flexibility and strong hand muscle. Both taekwondo and silat in practitioners possessed similar anaerobic capacity, however, taekwondo practitioners showed higher aerobic capacity than silat practitioners. It is hoped that the present findings obtained from this study can be used as guidelines for planning training program for taekwondo and silat practitioners, as well as promoting active lifestyle by engaging in martial arts such as taekwondo and silat.

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КОНЦЕПТУАЛЬНЫЕ ОСНОВЫ ФИЗИЧЕСКОГО ВОСПИТАНИЯ В ВЫСШИХ УЧЕБНЫХ ЗАВЕДЕНИЯХ НАШЕЙ СТРАНЫ

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Аннотация*: Анализ научно-методических источников по основным позициям развития и совершенствования физического воспитания в высших учебных заведениях позволяет автору сделать заключение о том, что развитие физического воспитания в нашей стране характеризуется периодической сменой направленности и приоритетов содержания. Эти приоритеты напрямую связаны с внешней политикой государства, с состоянием и уровнем здоровья нации, с новыми теоретическими и практическими научными разработками ведущих ученых и педагогов страны.* ***Материалы.*** *Смена направленности – довольно частое явление в отечественном физическом воспитании в высших учебных заведениях. Причина такого явления заключается, прежде всего, в том, что создание методики физической культуры в образовательных учреждениях нашей страны проходило в условиях, когда еще*