Would Customized Gym Sessions Enhance General Performance of State-Level Athletes? A Pilot Study

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Article

Would Customized Gym Sessions Enhance General Performance of State-Level Athletes? A Pilot Study

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Abstract: Karate is a martial art that originated in Japan It is characterized by its diverse techniques, including punches, kicks, strikes, and open hand techniques. Generally, karate practitioners shall execute techniques fast, with an impactful finishing towards the target. The present study aims to examine the effectiveness of customized gym sessions in enhancing the athletes' general performance with a duration of 3-months'time. A total of 7 tests were monitored, i.e., anthropometric measurement, sit and reach test, stork balance stand test, T-test, counter movement jump, 20m sprint, and Yo-Yo endurance test. 4 male amateur athletes (state representative) that has practiced karate for at least 6 years, with at least 5 days training per week, were selected. The age ranges from 15 to 20 years old. The athletes were requested to have a proper rest (at least 7 hours sleeping time) five days before the actual test day. The results show that all athletes have at least maintained or improved stork balance for both legs. The balance improvement ranges from 0% up to 134.69%. However, both the T-test and 20m sprint test demonstrated a negative outcome. The time consumed to complete 20m is increased, which deteriorated the linear speed capability by 1.89% up to 8.93%. Also, 3 out of 4 athletes show that the T-test performance does not provide a satisfactory achievement. The agility of athletes was found to drop by 3.58% up to 10.60%. Interestingly, the athletes' stamina was found to improve based on the VO_2 max prediction and Yo-Yo test. The enhancement of VO_2 max prediction and Yo-Yo test recorded as 0% - 7.53% and 9.09% - 20%, respectively. So far, there is no clear indicator on the flexibility of the athletes' spine and length of the hamstring muscles, based on the sit and reach test. Short-term gym sessions with a duration of 3 months might improve the strength and body balance of athletes. However, the impact on the responsiveness and agility of athletes did not show any significant breakthrough. In future study, it is recommended that a large sample of participants should be included in the analysis.

Keywords: state athletes; gym sessions; martial art; karate

1. Introduction

Karate is a martial art that originated in Okinawa, Japan [1]. It is characterized by its diverse techniques, including punches, kicks, strikes, and open hand techniques. To date, the martial art has a population of over 10 million athletes and 100 million practitioners in the world [2]. Generally, karate could be categorised into two modes, which are "KATA" and "KUMITE" [3]. The former refers to the performance of predefined movements, or commonly known as imaginary fighting movements. The latter refers to the free fighting or sparring between two practitioners. As a karate practitioner, execution of techniques should be fast, sharp and impactful finishing towards the target. Past study proved that karate athletes with appropriate anthropometric characteristics could be advantageous in mastering the sport outcome [4]. Also, flexibility, balance and strength were identified as 3 fundamental components for a karate practitioner to reduce the risks of injury [5]. Sufficient joint flexibility has been

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associated with maximize performance among martial art practitioners, such as technique execution, range of motion, speed and agility [6].

A recent study reported that physical fitness training could elevate the martial art practitioners performances [7]. With the aid of sport science knowledge, sports performance by the karate athletes could be further enhanced. In terms of strength and conditioning, sport science could provide in-depth understanding on necessary physical attributes. On the other hand, proper nutrition and hydration could be one of the important elements in optimising the performance and recovery in karate [8]. On average, the caloric needs for athletes training with moderate or high intensity training may require 40-70kcals/kg/day [8]. For elite athletes, the require energy intake would be even higher than the mentioned amount [9]. Also, biomechanics under the sport science knowledge could provide the biomechanical analysis to examine the optimal body positioning, angles, and timing to maximise the outputs of techniques. Biomechanics could help in analysing the forces involved in different executed techniques, and taking necessary simulation approach to further enhance the movements [10]. Such human movement's biomechanics exploration could be conducted by integrating existing engineering techniques and continuing development of new technology [10].

To the best of authors knowledges, the study on the integrating the customised gym sessions in affecting martial art athletes' performance are rarely reported. Therefore, the present study aims to examine the effectiveness of customized gym sessions in enhancing the athlete's general performance. The gym sessions were included for a duration of 2-months, under the supervision of strength and conditioning experts.

2. Methodology

In the present study, 4 male athletes' that has practiced karate for at least 6 years, with at least 2 years' experience of representing state, have been selected. These athletes belong to "KATA" event (performance-based), which is one of the branches under the karate competition. The present study does not include "KUMITE" athletes as the morphological parameters between "KATA" and "KUMITE" are different [3], which might affect the consistency of test results. All the four athletes undergo 5 days karate training per week, with at least 2.5 hours training per day. Their age ranges from 15 to 20 years old. To monitor the effect of integrating gym sessions into the regular karate training regime for a two-months period, the tests were performed twice: pre-gym sessions and post-gym sessions. The test for pre-gym session was conducted in March 2019, while the test for post-gym session was conducted in June 2019. In the two-month time, the karate training programme is resumed as usual, with the inclusion of additional gym training sessions. The gym sessions were conducted three days per week, with the gym programmes specifically customised for karate athletes. The technical difficulty for the first month gym session is rated as moderate level, while the second month gym session is rated as moderate to high level. The brief overall gym training regime is listed as in Table 1.

Table 1. Customised gym training programme for two months.

Month	
1st	**2nd**
Session 1 (Basic weight training to lateral movement) 1. 20 minutes dynamics movement with increase body temperature and hear rate 2. Goblet squat + squat jump 3. Body weight push up 4. Dumbbell shoulder press 5. Lateral jump to sprint 6. Nordic ham curl 7. Plank press 8. Plank rotation exercises	Session 1 (Power, leg) 1. 15 minutes dynamics movement with increase body temperature and heat rate 2. Bang clean + bungee broad jump 3. Back squat 4. Bench press + dumbbell shoulder press 5. Leg curl 6. Landmine core rotation

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	9. Abs crunch 10. Jack knife 11. Ankle touch 12. Leg raises		7. Cable wood chop 8. Single leg single hand plank
Session 2 (Basic weight training and explode movement)	1. Bird dog + rotator band exercises 2. Burpees technique + fire hydrant + mountain climber 3. Power throw to forward jump 4. Bench press 5. Bent over row + plate frontal raise 6. Single leg hip raise 7. Plank to forward plank 8. Single leg single hand plank	Session 2 (Push, pull)	1. Bird dog + rotator cuff band exercises 2. Burpees technique + fire hydrant + mountain climber 3. Body weight pull up 4. Barbell bent over row + dumbbell bent over reverse fly 5. Dumbbell incline chest press + bodyweight push up 6. Dumbbell bench press 7. Pallof press to shoulders rise with lunge 8. Leg raises 9. Leg raises to knee raise 10. Rotation leg raises
Session 3 (Unilateral pull and leg)	1. Agility ladder exercise with dynamics warm up 2. Dumbbell shoulder rotation 3. Barbell deadlift + single leg jumps to squat 4. Dumbbell goblet static lunges 5. Reverse push up + mountain climber 6. Plank press to sprint 7. Bungee power rotation exercise 8. Bungee anti rotation exercise	Session 3 (Unilateral pull and bilateral leg)	1. Agility ladder exercise with dynamics warm up 2. Pallof press 3. Single leg press + goblet side lunges 4. Barbell front squat 5. Weight reverse push up 6. Single leg single hand cable bent row + dumbbell shrug 7. Arm exercises 8. Stir the pot 9. V pike 10. Mountain climber 11. Power wood chop

All karate training sessions were supervised by the state coach (8 years' experience of supervising state team athletes), while the gym sessions were monitored by the strength and conditioning experts from state sports council. The purpose of having the experts' monitoring was to ensure that the executed movements and postures are correct. A recent study reported that out of 293 athletes surveyed, 24.2% of them had suffered serious knee injury [11]. Surprisingly, 54.9% of them contracted with the injury during training [11]. Therefore, such a monitoring practice could reduce the risk of injury and effective gain from the training sessions. Throughout the 2 months period, the athletes were given supplements such as multivitamin, whey protein (24g-48g per serving after each gym session), electrolytes sports drink (30g per during gym session), and creatine (10g-20g per serving). The actual karate training and gym sessions are shown in Figure 1.

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(a) (b)

(c) (d)

Figure 1. Regular karate training session of (a) dynamic stretching, (b) kicking techniques; Gym sessions of (c) goblet squat activity, (d) landmine rotation.

3 days before the actual test day, the athletes were requested to have a proper rest (at least 7 hours sleeping time). Prior to the tests, all athletes were required to perform light warm up and stretching sessions, which lasted for approximately 35 minutes. A total of 7 tests were monitored, i.e., anthropometric measurement, sit and reach test, stork balance stand test, T-test, counter movement jump, 20m sprint, and Yo-Yo endurance test. The progress of the tests is shown in Figure 2.

(a) (b) (c)

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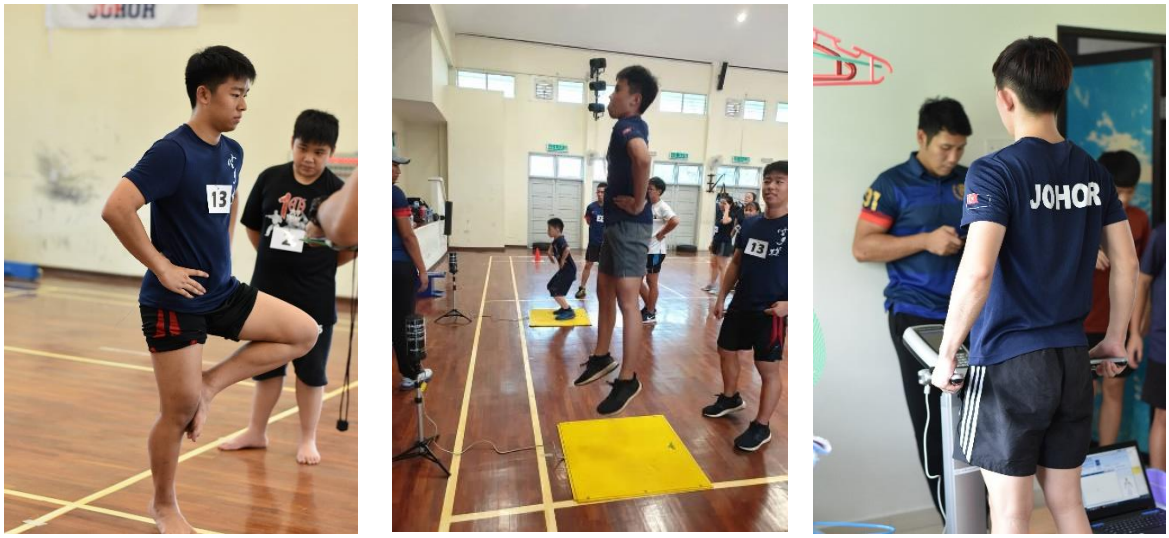

(**d**) (**e**) (**f**)

Figure 2. The athletes undergoing (a) sit and reach test, (b) T-test, (c) Yo-Yo endurance test, (d) stork balance stand test, (e) counter movement jump, and (f) anthropometric measurement.

Anthropometric measurement is an evaluation of athlete's physical attributes that could affect the athletic performance in sports. It is a non-invasive quantitative measurement of the athletes body [12], such as the relative proportions of skeletal muscle mass, body fat mass, fat free mass, and bone mass in the body [13]. An InBody 230 body composition analyser was used to perform the anthropometric measurement. To ensure the reliability of measurement, the analyser was outsourced calibration. This analyser using the bioelectrical impedance analysis, which measure the body resistance towards the electric flow in the athletes body. A higher electric resistance indicates that the higher body fat the athletes owned. To complete each body composition analysis, each athlete took about 30s to 60s standstill on the body composition analyser. For T-test, sit and reach, 20m sprint and stork balance test, each athlete is given three chances to retrieve the optimum results. Upon completing aforementioned tests, the athletes were given 15 minutes rest before attempting the Yo-Yo test.

3. Results and discussion

Based on the visceral fat analysis, the fat level for all four athletes falls within the scale of 1 to 3 out of 59. Scale 1 denotes to extremely lean condition, while scale 59 denotes to highly obesity condition. Based on the body composition test, the body fat percentage for four athletes were 13% and below. This value indicates that all athletes are physically fit and under healthy conditions. For the pre-gym session test, all athletes were identified in good performance conditions, with no injury reported. For the post-gym session test, athlete A was identified with injury at biceps femoris muscle. Therefore, Athlete A only performed tests which are deemed suitable, to prevent aggravation of the injury. Athlete A was constantly undergoing the physiotherapy sessions at a public hospital. The brief descriptions of the four athletes are tabulated in Table 2.

Table 2. Brief description of 4 karate athletes.

Athlete	Age	Height	Sitting height	Visceral fat level	Basal metabolic rate	Waist-hip ratio	Experience as state representative	Ranking in nation (<21 years old)	Remarks
A	20	167.6cm	89.0cm	Level 2	1492kcal	0.83	7 years	3rd	Injury at biceps femoris muscle (undergoing physiotherapy)-

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									during second test
B	17	165.0cm	88.5cm	Level 1	1366kcal	0.76	2 years	> 5th place	-
C	15	158.0cm	81.0cm	Level 3	1208kcal	0.79	2 years	> 5th place	-
D	18	152.6cm	81.0cm	Level 2	1174kcal	0.79	2 years	> 5th place	-

Referring to Table 3, the sit and reach test shows that 3 out of 4 athletes not having significant improvement in terms of flexibility. In contrast, the flexibility of hamstrings and lower back of athletes A and C was identified reduced by 5.54% and 7.41%, respectively. This occurrence could be due to the inappropriate stretching session after each gym session. Past study has reported that under proper cool down session, the resistance training shall result in no negative effects on flexibility. In terms of stork balancing, all athletes show a significant improvement up to 134.69%. Only the left leg of athlete A does not perform well due to the leg's injury. The relative CMJ also shows a positive gain after attempting the two months gym sessions. Athlete D has the highest gain of 14.28% improvement, followed by athlete C with 3.78% enhancement. Due to athlete A unable sustained injury, the relative CMJ peak power does not show positive gain.

Table 3. Various tests focus on strength and conditioning.

Tests	Athlete	Pre-gym session	Post-gym session	Difference
Sit and reach	A	43.4cm	41cm	-5.53%
	B	49.5cm	50cm	1.01%
	C	40.5cmc	37.5cm	-7.41%
	D	36.5mc	36.5cm	0.00%
Right stork balance	A	00:30.47s	00:52.78s	73.22%
	B	00:36.41s	00:52.41s	43.94%
	C	00:22.98s	00:39.68s	72.67%
	D	00:52.13s	00:52.13s	0.00%
Left stork balance	A	00:59.85s	00:28.66s	-52.11%
	B	00:19.72s	00:46.28s	134.69%
	C	00:17.32s	00:29.60s	70.90%
	D	00:26.12s	00:26.12s	0.00%
Relative CMJ peak power	A	62.23 W/kg	54.72 W/kg	-12.06%
	B	63.36 W/kg	60.39 W/kg	-4.68%
	C	64.93 W/kg	67.38 W/kg	3.78%
	D	72.57 W/kg	82.94 W/kg	14.28%

As shown in Table 4, the T-test and 20m sprint performances of post-gym sessions were found to drop up to 10.6% and 8.93%, respectively. This result indicates that the agility and acceleration were dropped, which could be due to the muscle stiffness. However, the Yo-Yo test shows a significant improvement, ranging from 9.09% up to 20%. This finding shows a positive relation between the gym training and endurance performance.

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Table 4. Agility and endurance tests for pre- and post-gym sessions.

Tests	Athlete	Pre-gym session	Post-gym session	Difference
T-test	A	00:09.73s	00:10.05s	3.25%
	B	00:10.02s	00:09.66s	-3.58%
	C	00:11.10s	00:09.92s	-10.60%
	D	00:10.37s	00:09.72s	-6.27%
20m sprint	A	00:02.99s	-	-
	B	00:03.27s	00:02.98s	-8.93%
	C	00:03.20s	00:03.06s	-4.25%
	D	00:03.07s	00:03.01s	-1.89%
VO_2 max prediction	A	48.30 mL/kg/min	-	-
	B	41.98 mL/kg/min	41.98 mL/kg/min	0.00%
	C	41.98 mL/kg/min	45.14 mL/kg/min	7.53%
	D	41.98 mL/kg/min	45.14 mL/kg/min	7.53%
Yo-Yo test (total meter covered)	A	1860m	-	-
	B	1320m	1440m	9.09%
	C	1400m	1560m	11.43%
	D	1300m	1560m	20.00%

4. Conclusion and recommendation for future works

The present study shows that integrating a short-term gym session with a duration of 2 months, could improve the strength, body balance and endurance of athletes. Based on the stork balancing result, all athletes show a significant improvement up to 134.69%. However, the impact on the responsiveness and agility of athletes did not show any significant breakthrough. This scenario could be due to the neglectedness of appropriate cooling and stretching after the gym sessions. The T-test and 20m sprint performances of post-gym sessions were found to drop up to 10.6% and 8.93%, respectively. In future study, it is recommended that a large sample of participants should be included in the analysis. The performance of various tests could be correlated to the athlete's body composition studies. Also, coefficient of determination (R^2) could be used to measure the goodness of fit of the regression predictions approximate the athlete's performance data. Alternatively, the investigation of different gym periods on the performance outcome could be an interesting study.

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