

EFFECT OF CIRCUIT TRAINING ON FIGHTING PERFORMANCE OF YOUNG SILAT ATHLETES - A CASE STUDY

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Abstract

Background & Study Aim: The purpose of the current case study was to describe the activity pattern of individual exponents during competitive fights completed before and after six weeks circuit training programme. **Material & Methods:** Thirteen and 16-year-old experimental (E13 and E16) and control (C13 and C16) participants were paired and videoed with fighting before and after 6-week training. Exponents were chosen based on their age, maturation, weight, competitive standard (none had participated in an official silat match), and initial fitness performance. All matches were converted into .mpg files and analysed using the same procedure. The distribution of outcomes was analysed and used as an index of performance for more detailed analysis. **Results:** The E13 increased the frequency of kicking during competition post-training, which is suggested to reflect transference of improved fitness to competition. Both E13 and C13 improved the ability to dodge their opponent attacks, likely reflecting a response to technical coaching. The frequency of actions during competition generally decreased for both older participants, suggesting limited fitness transference to competition. All individuals demonstrated some meaningful improvements in fitness following the intervention period. However, these responses did not necessarily reflect the group finding. **Conclusions:** This was the first case study to examine the changes in competitive fighting performance of four young performers from experimental and control groups following a silat-specific circuit training programme. Therefore, fitness gains together with technical coaching may transfer to competition in younger exponents, while alterations in strategy may have been more decisive in the older group. The research has provided further insight of fitness development and trainability, and also transference

fitness into competitive performance in youth silat which may help to facilitate coaches of the demands and requirements of the combat sport.

Keywords: Circuit training, silat, fighting performance, Seni Silat Malaysia

Introduction

The scientific approach to understanding the demands of combat sports and the physiological characteristics that contribute to success has received much attention for the past 20 years, particularly in those sports included in the Olympic Games (Heller et al. 1998; Kazemi, Waalen, Morgan, & White, 2006; Smith, 2006; Yoon, 2002; Callister et al. 1991; Guidetti, Musulin, & Baldari, 2002; Khanna & Manna, 2006). There are also several other combat sports that have received scientific attention and used an empirical approach to inform training and the fitness requirements of sports such as mixed martial arts (Ammann, Ammann, & Spath, 2008; Bounty, Campbell, Galvan, Cooke, & Antonio, 2011), karate (Francescato, Talon, & Prampero, 1995; Beneke, Beyer, Jachner, Erasmus, & Hutler, 2004; Doria et al. 2009), muay thai (Turner, 2009; Crisafulli et al., 2009), kickboxing (Buse & Santana, 2008; Zabukovex & Tiidus, 1995), and silat (Aziz, Tan, & Teh, 2002). Moreover, Douris et al. (2004) reported that participation in martial arts increases strength, anaerobic capacity, balance, and flexibility as well as an overall improvement in cardiorespiratory fitness, which is supported by the work of other researchers (Heller et al. 1998; Hain, Fuller, Weil, & Kotsias, 1999) and in part by Shapie et al. (2011). However, only a few studies have examined young athlete's fitness and training requirements (Violan, Small, Zetaruk, & Micheli, 1997; Melhim, 2001) in combat sports. This is important as compared with training studies in adults, relatively less is known about the trainability of adolescents (Naughton, Farpour-Lambert, Carlson, Bradney, & Van Praagh, 2000). Importantly, adolescence is a stage of development characterised by unprecedented physiological changes in musculoskeletal, cardiorespiratory and reproductive systems of the body (Naughton et al., 2000). It has also been argued that it is important for coaches to fully maximise a young athlete's potential at every stage of development, as proposed in the Long-Term Athlete Development (LTAD) model (Balyi & Hamilton, 2004). However, to the author's knowledge there is no published research documenting adolescent's physical characteristics and training in silat. Consequently, the research provides valuable information regarding the fitness characteristics of male and female silat performers aged 13 to 16-year-old (Shapie, Oliver, O'Donoghue, & Tong, 2014) and also the effect of a silat-specific training programme on the fitness development of young silat performers.

It was then shown by Shapie et al. (2011) that six weeks of silat-specific circuit training provided significant improvements in several fitness variables. The improvements observed across a number of groups were dependent on the type of training employed (circuit training versus traditional silat training) and the age/maturation status of the participants. Thus, the authors concluded that improvements in fitness following a circuit training intervention appeared to be related to age and maturation, whereas the traditional silat training may be better at improving upper body strength and power.

Developing a sport-specific training programme to enhance physical fitness for competition in the young silat performers has never been researched before; such an approach may be applicable to coaching to develop specific silat training programme, particularly in young athletes. Implementing this approach is useful to the silat coach for examining individual responses to any specific intervention or training programme. Moreover, a case study can help the silat coach to evaluate the relationship between training programme stress (intensity, frequency, duration, density, and specificity) and the training outcome (competitive performance). However, it is not known if improving fitness can enhance an exponent's performance in silat competition. Further research is required in order to examine whether improvements made throughout a training programme can help improve competitive performance. In particular, whether improved fitness allows an exponent to maintain a greater work/complete a greater number of strikes and better avoid being hit, both of which contribute to winning a match.

Therefore, the objectives of this study are to use a case study approach to describe the activity pattern of individual exponents during competitive fights completed before and after a 6 week circuit training programme in the 13-year-old and 16-year-old exponent.

Material and methods

Participants

Four silat exponents aged 13 ($N=2$) and 16-year-old ($N=2$) served as participants for this study. Exponents were chosen based on their age, maturation, weight, competitive standard none had participated in an official silat match, and initial fitness performance (Table 1). For each age, there was one control and one experimental participant. Biological maturity was assessed via the non-invasive technique proposed by Mirwald, Baxter-Jones, Bailey, and Beunen (2002) using measures of standing height, sitting height, age and body mass. Descriptions of individual characteristics are presented in Table 1. None of the participants reported injury at the time of sparring, and all were involved in regular silat training. All information letters and assent forms outlining the study details and scope of the child's involvement were handed out to the children. Written informed assent was obtained from the child as well as the consent of the parent/guardian consent. Participants were asked to wear their silat uniform with footwear and to avoid drinking, eating and participating in any exercise activities up to two hours before sparring. All procedures were granted ethical approval by the University Research Ethics Committee.

Table 1: Descriptive details for all participants involved in the case study.

Group	Height (cm)	Arm Length (cm)	Sitting Height (cm)	Body Mass (kg)	Age (years)	Estimated age at PHV (years)	Years from PHV
C13	138.3	64.4	71.4	29.65	12.33	14.53	-2.20
E13	143.0	65.2	72.0	31.75	12.92	15.04	-2.12
C16	158.5	78.1	83.3	75.70	15.67	14.50	1.17
E16	169.2	82.1	87.0	84.25	15.83	14.13	1.70

C13 = age 13 control group; E13 = age 13 experimental group; C16 = age 16 control group; E16 = age 16 experimental group

Procedures

Thirteen (n=1) and 16 (n=1) year old boys participated in silat-specific circuit training (SSCT) twice weekly during their normal silat lessons, while control groups (CG) of 13 (n=1) and 16 year (n=1) olds continued with their normal training. The control group continued with their normal silat training for 2 hours per session (twice per week) while the experimental group underwent 30-45 minutes circuit training plus 75-90 minutes of normal silat training. Participants in the intervention group were prescribed with an intervention programme which involved circuit training activities that consisted with 8 silat-specific activities (2 times per week for 6 weeks) (Shapie et al., 2011).

The participants took part in the research and followed all the activities described in the training programme. In addition, the participants in the current case study were paired (based on age) and required to spar under competition rules before and after the training programme. The sparring took place indoors on the silat matt with the same dimensions as a silat olahraga ring and followed all the rules of a silat olahraga competition (Anuar, 1987). A qualified silat instructor was appointed as referee for the match. The participants performed a 15-minute warm-up before being allowed to fight. All matches were held between 1800 – 2100 hours and the temperature ranged from 27-30°C and humidity was between 64-70%. The sparring consisted of 3 rounds of 2 minutes, each followed by 1-minute of recovery, during which the subject passively rested at their own corner. The round consisted of a series of attack and defensive actions, and only strikes with either the arms or legs are considered legal. The exponents were verbally encouraged to perform maximally through the match. Each match was recorded using a video camera (JVC, Everio model). Each participant was required to attend 1 silat match during the pre- and post-training programme. Participants were advised not to eat at least 2-hours before the silat match.

The pre-matches were held 2-days before the starts of the circuit training, while the post-matches were organised 6-days (which included 2 days of post-test fitness testing) after the 6-weeks of training. All matches were converted into .mpg files and analysed using the same procedure by Shapie, Oliver, O'Donoghue, and Tong (2013).

Statistical Analysis

All the raw data generated by the FOCUS X2 (Elite Sport Analysis, Delgaty Bay, Scotland) was exported into a Microsoft Excel Spreadsheet and then transferred into SPSS for more detailed analysis. The system was used to identify 14 different types of event or action performed by both exponents as well as the start and end of action periods. Information could be entered into the computer system using a 'Mouse', via representation on the screen of the silat match, and specially designed screen functions for each exponent (experimental or control group), action (14 different types of actions) and outcome (4 different types of outcomes). The display in the computer split the action into 14 cells of silat actions such as block and kick, block and punch, block and swipe, block, catch, dodge, fake kick, fake punch, kick, *others*, punch, self-release, swipe and topple down categories. The distribution of outcomes are hit target, miss opponent, hit elsewhere, and none or none available and were analysed and used as an index of performance. Statistical analysis was conducted using Statistical Package for Social Scientists, version 14.0 (SPSS, Chicago, IL).

Results

Fighting performance

1) Competition Performance Pre- and Post-Training in 13-year-old Participants

The pre- and post-match information can be observed in Table 2 and 3. The overall frequency highlights the increase of the total frequency of actions post-training (207 actions) compared to pre-training (170 actions) with both exponents E13 (70 to 95 actions) and C13 (81 to 100 actions) performing more total actions post-training. Overall, there was a decrease in all silat action variables (blocks, punches, and kicks) in the post-training match except in other activities (dodge, catch, and off- fight contact actions/ low-intensity activities [*others*]), which shows a big increase from 28 to 73 actions. The E13 performed 15 more kicking actions and 20 more other actions (dodges) in the post-training match. Whereas, the C13 performed more punches (increased by 2 actions), blocks (increased by 4 actions) and other (dodges) actions in the post-training match compared the pre-training match. The E13 shows a decrease in the number of blocks (decreased by 7 actions) and punches (decreased by 3 actions), while C13 shows a bigger decreases in kicks, with a reduction of 19 actions post-training compared to the pre-training match.

Table 3 shows the increase in the number of total successful 'hit target' outcomes pre- and post-training in E13 (from 17 to 28 actions) or C13 (from 15 to 40 actions). The number of successful block performance in E13 decreased (decreased 6 actions) along with the total number of block actions post-training (Table 2).

Even though there was an increase in the overall frequency of kicks due to the training intervention in E13; the successful number of kicks decreased by 3 actions. There was an increase in the number of 'miss opponent' (35 actions kick outcomes in E13).

2) Competition Performance Pre- and Post-Training in 16-year-old Participants

The pre- and post-match training information can be observed in Table 4 and 5. The overall frequency of the pre- and post-training events between both silat exponents shows that there were decreases in the total frequency of actions post-training (135-actions) compared to pre-training (222-actions). The overall frequency of kicks showed an increase (increased by 20-actions) compared to other silat activities (decrease in block, punch, and other actions) post-training match. The overall performance of the experimental exponent (E16) decreased by 23-actions across all silat actions (block, punch, and other actions) except in kicks, which increased from 37 to 63-actions post-training. The overall performance of the control exponent (C16) decreased by 54 actions (block, kick and punch) except in other actions (catch and topple down), which was increased by 4 to 10-actions following the training programme.

Table 5 shows the decrease in the number of successful 'hit target' outcomes pre- and post-training either in E16 (from 44 to 4 actions) or C16 (from 38 to 19 actions). There was a decrease in the number of successful hit outcomes in blocks (decreased by 26 actions), punches (decreased by 12 actions) and other actions (decreased by 2 actions); while there was no change in the number of successful kick outcomes in E16 in the post-training match. There were increases in the number of successful kicks (increased 1-action) and other actions (increased 2-action) of C16 post-training. However, there was decrease in both successful blocks (decreased by 7 actions) and punches (decreased by 15 actions) post-training compared to the pre-training fighting performance.

Table 2: Pre- and post-training competition overall frequency of events during round 1, 2 and 3 for the 13-year-old group.

Action	Pre-Training Overall Frequency			Total Frequency	Post-Training Overall Frequency			Total Frequency
	<i>EG</i>	<i>CG</i>	<i>Others</i>		<i>EG</i>	<i>CG</i>	<i>Others</i>	
Block	9	5	0	14	2	9	0	11
Kick	56	64	0	120	71	45	0	116
Punch	3	5	0	8	0	7	0	7
Other	2	7	19	28	22	39	12	73
Total	70	81	19	170	95	100	12	207

* EG = Experimental group silat exponent; CG = control group silat exponent; *Others* = means off fight-contact actions or low intensity activities performed by both exponents; Other = any silat actions other than block, kick and punch

Table 3: Pre- and post-training competition overall outcomes of events during round 1, 2 and 3 for the 13-year-old group.

Action	Pre-Training Overall Outcomes							Total Outcomes	Post-Training Overall Outcomes							Total Outcomes
	<i>Hit elsewhere</i>		<i>Hit target</i>		<i>Miss opponent</i>		<i>None</i>		<i>Hit elsewhere</i>		<i>Hit target</i>		<i>Miss opponent</i>		<i>None</i>	
	<i>EG</i>	<i>CG</i>	<i>EG</i>	<i>CG</i>	<i>EG</i>	<i>CG</i>			<i>EG</i>	<i>CG</i>	<i>EG</i>	<i>CG</i>	<i>EG</i>	<i>CG</i>		
Block	2	0	7	5	0	0	0	14	1	8	1	1	0	0	0	11
Kick	21	28	8	5	23	24	11	120	2	1	5	2	58	35	13	116
Punch	0	0	0	1	2	2	3	8	0	0	0	3	0	3	1	7
Other	0	1	2	4	0	2	19	28	0	0	22	34	0	5	12	73
Total	23	29	17	15	25	28	33	170	3	9	28	40	58	43	26	207

* EG = Experimental group silat exponent; CG = control group silat exponent; Other = any silat actions other than block, kick and punch; None = means action that did not count as an outcome by the researcher; Hit elsewhere = any attacking or defensive silat actions that miss or did not successfully hit the ‘target’; Hit target = any successful attacking or defensive silat actions (some contributes to scoring points; but some did not) or any silat actions that hit the ‘target (scoring point area); Miss opponent = any attacking or defensive silat actions that miss the ‘target’ or failed to deliver points. None = any attacking or defensive silat actions that did not contribute to point score.

Table 4: Pre- and post-training competition overall frequency of events during round 1, 2 and 3 for the 16-year-old group.

Action	Pre-Training Overall Frequency			Total Frequency	Post-Training Overall Frequency			Total Frequency
	<i>EG</i>	<i>CG</i>	<i>Others</i>		<i>EG</i>	<i>CG</i>	<i>Others</i>	
Block	35	22	0	57	7	9	0	16
Kick	37	39	0	76	63	33	0	96
Punch	25	43	0	68	2	2	0	4
Other	3	4	14	21	0	10	9	19
Total	100	108	14	222	72	54	9	135

* *EG* = Experimental group silat exponent; *CG* = control group silat exponent; *Others* = means off fight-contact actions or low-intensity activities performed by both exponents; *Other* = any silat actions other than block, kick and punch

Table 5: Pre- and post-training competition overall outcomes of events during round 1, 2 and 3 for the 16-year-old group.

Action	Pre-Training Overall Outcomes							Total Outcomes	Post-Training Overall Outcomes							Total Outcomes
	<i>Hit elsewhere</i>		<i>Hit target</i>		<i>Miss opponent</i>		<i>None</i>		<i>Hit elsewhere</i>		<i>Hit target</i>		<i>Miss opponent</i>		<i>None</i>	
	<i>EG</i>	<i>CG</i>	<i>EG</i>	<i>CG</i>	<i>EG</i>	<i>CG</i>			<i>EG</i>	<i>CG</i>	<i>EG</i>	<i>CG</i>	<i>EG</i>	<i>CG</i>		
Block	4	4	28	16	3	2	0	57	2	0	2	9	3	0	0	16
Kick	14	8	1	3	22	27	1	76	39	2	1	4	23	27	0	96
Punch	2	0	13	16	9	24	4	68	0	0	1	1	1	1	0	4
Other	0	0	2	3	1	1	14	21	0	0	0	5	0	5	9	19
Total	20	12	44	38	35	54	19	222	41	2	4	19	27	33	9	135

* *EG* = Experimental group silat exponent; *CG* = control group silat exponent; *Other* = any silat actions other than block, kick and punch; *None* = means action that did not count as an outcome by the researcher; *Hit elsewhere* = any attacking or defensive silat actions that miss or did not successfully hit the ‘target’; *Hit target* = any successful attacking or defensive silat actions (some contributes to scoring points; but some did not) or any silat actions that hit the ‘target (scoring point area)’; *Miss opponent* = any attacking or defensive silat actions that miss the ‘target’ or failed to deliver points. *None* = any attacking or defensive silat actions that did not contribute to point score.

Discussion

For analysis purposes, each participant was treated as a single subject design case study. Advantages of this design were such that observed changes in data obtained could be more confidently attribute to specific interventions for each individual (Brown & Hughes, 1995). Both qualitative and quantitative data (as in this study) are regarded as legitimate sources of information in case study designs (Smith, 1988).

Effect of Training on Fighting Performance in 13-year-old Participants

The analysis of fighting performance of the 13-year-old participants before and after the 6-weeks silat-specific training programme will be explained based on two elements; frequency and outcomes of the silat actions in the match. In this study the following observations were made:

1. **Other action.** The study shows a large improvement (160% increased) post-test in other actions in both participants. Here, the other actions referred to any silat actions other than blocking, kicking and punching (i.e., low-intensity actions, catching, dodging, swiping, self-release or topple down actions). Further analysis on the match ('other' actions) shows that the dominant action of the other actions was the dodge. During the pre-test match, there were no dodge actions applied during the match, this suggests both E13 and C13 exponents had not been exposed to this defensive movement yet by their coach. The increase of (the E13 increased by 22-actions and C13 by 32-actions) dodge actions in both participants was likely due to the introduction of this technique by the silat coach during the 6-week training programme. Therefore, technical training at this young age may give more of an impact on fighting performance than physical conditioning. The importance of evading/dodging strikes in a silat match is one of the defensive skills that require exponents to avoid being hit; moving the body quickly either to the left, right or retreating. There are 10 techniques related to evading/dodging techniques in silat olahraga that have been discussed in detailed by Anuar (1993). This post-match analysis showed that both exponents have the ability to evade the strike from their opponent well with 100% success of this action. Thus, the current study shows that dodge or evading skills are the best defensive technique in 13-year-old group and can be learnt during a 6 week training period.
2. **Block action.** There was a 21% decrease in the number of blocking actions pre- to post-training. The percentage of successful blocking actions dropped from 85% in the pre-training match to 18% post-training match. There was an increase in number of blocks in C13 but not in E13 (5 to 9 for C13 and 9 to 2 for E13). As the E13 improved their dodging skills post-intervention period, they became less reliant on the need to block. Moreover, as a consequence of E13 increasing the number of kick actions, C13 was required to increase the number of dodges and blocking actions in the post-training. This is similar with the results in Shapie et al. (2013), where when one exponent is dominant in the attack, the other opponent has to defend to avoid being hit. Therefore, increasing the number of kicks made E13 more dominant in the post-training match (E13 won the post-training match).

3. **Punch action.** There was a 12.5% decrease in the number of punches in the post-training match. However, there was an increase in the number of successful punches of from 12.5% to 42.8% in C13, while there was no punch action in a post-test match in E13. It was suggested that the increase in punches was due to a decrease in the number of kicks in C13, reflecting a change in fighting/style tactics post-training interventions. This again suggests that skill/tactical coaching, or adapting to an opponent's style (i.e., as E13 increase kicks, C13 increase punches in the post-training match) may have more of an influence on competition performance than the physical conditioning.
4. **Kick action.** The results show that there was 3% decrease in overall kick frequency post-training. The overall outcome shows that the successful kicks that hit the target was better in the pre-training match (11%) compare to post-training match (7%). This was partly due to the improvements made by both participations at dodging/evading. Consequently, it became more difficult for them to hit their opponents target area during the silat match.
5. **Low-intensity action (others).** There was also a decrease in the number of low-intensity actions in the post-training match of 13-year-old. This decrease might due to less disruption of the match, with less actions of catch, no self-release and swipe occurring during the post-training match, no referee judgement was needed to stop the fight, and the match continued without any disruption. It is also suggested that improved in whole body or local muscular endurance, allowing participants to maintain a greater work rate and complete a greater total number of high-intensity actions (increase from 151 in pre-training to 195 actions in the post-training match).
6. **Overall outcomes.** The current study shows that there was an increase in 'hit target' overall outcomes, increasing from 18.8% to 32.8% pre- to post-training match. However, the analysis showed that there were only increases in punch (increased by 2-actions) and other (increased by 36-actions) activities. Conversely, there were decreases of some hit target outcomes; 83% on block and 46% on kick. These results suggested that the decrease of successful blocking actions was due to the increase of other activities (e.g., dodge).

During the pre-training match, E13 and C13 did not perform any successful dodge, but E13 successful dodged 22 times and C13 32 times in the post-training match (detailed analysis on 'other' actions). Moreover, the ability of both exponents to dodge attacks (e.g., kick strikes) raised the 'miss opponent' outcomes (93-actions) post-training. This is explained by other results, which showed that there was no dodge action in the pre-training match, most kicks landed either hit elsewhere or were successfully blocked by the other exponent.

7. **Overall analysis.** Overall analysis of both matches in the 13-year-old group suggested that the E13 performed more kicks and evading actions while C13 increased block and dodge/evading actions in the post-training match. It is speculated that two reasons influenced this outcome; Firstly, the silat syllabus

emphasizes basic blocking techniques (hand-block) should be coached during the first three months of the silat training programme. Secondly, both silat exponents benefited from the silat training/coaching and consequently improved dodging/evading actions. Furthermore, the circuit training may have promoted the physical conditioning of E13, with improved kick test performance reflected in increased kicking contribution in the post-training match, requiring C13 to block more.

Effect of Training on Fighting Performance in 16-year-old Participants

As per the 13-year-old group the analysis of fighting performance of the 16-year-old group will be explained based on two elements (frequency and outcomes). In this study the following observations were made:

1. **Other actions.** The study shows a decrease post-training in other actions in the experimental (decrease to zero action) but not in control participants (increase 150%). The C16 performed more actions in other (increased by 6-actions), which relates the improvement of toppling down and catch abilities within the silat training (detailed analysis on 'other' actions). Both E16 and C16 improved aspects of fitness that may be associated with improved catching and topple down techniques. It is likely the improvement in catch was due to this silat skill being taught to C16 during the normal silat training.
2. **Block action.** Shapie et al. (2013) highlighted that 11% of the total frequency of activities during a silat match between young adults were blocks. While, the current results shows 8% (pre-test) and 5% (post-test) for 13-year-old and 26% (pre-test) and 12% (post-test) of 16-year-old groups. These values support the importance of this defensive technique in a silat match. A single block action does not deliver a point-score in a silat match, but any blocking technique (either with hand or leg) that is followed with a legal strike that hits the target (i.e., punch, kick, or topple down) will be awarded an extra bonus point. The results of the current study also reflect that the numbers of block actions can be as high as 26% (pre-training 16-year-old) when both athletes rely more on kick strikes and decrease as low as 5% (post-training 13-year-old) when the exponents improved other skills such as catching or dodging. Thus, it is speculated that the number of block actions in the current study moves close to adults (12% in post-match 16-year-old and 11% in Shapie et al., 2013) once the exponents increased age, training history, and improvements of other attacking and defensive techniques in silat.
3. **Punch action.** Early observation shows that the biggest decrease (94%) of match actions was in the punch. It was observed that C16 produced more punches than E16 in the pre-training match. However, this is not the case in the post-training match as there was a big decrease in the overall frequency of punching for both exponents (E16 decreased from 25 to 2 actions, and C16 decreased from 43 to 2 actions in pre- to post-training match). Kazemi et al. (2006) reported that success in competition is indeed a combination of physical attributes, talent, skill, technique, determination, psychological preparedness and tactical or strategy.

Thus, it was speculated that changes in match tactics/strategy (Kazemi et al., 2006; Crisafulli et al., 2009) influenced the frequency and outcomes of the fights.

Both the E16 and C16 might improve aspects of fitness that may be associated with improved upper body attacking and defensive skills. However, it seems much more likely that the improvement in the fitness failed to influence the match outcomes in the number of punches thrown.

4. **Kick action.** The biggest increase of the post-fighting performance was kick action, with an increase in frequency in E16 (70% increase) but not in C16 (15% decrease). Similar with the younger group, the E16 performed 88% of his total action with kicks. However, even with the improvement in frequency of kick, there was no improvement in the number of successful hits with kick actions. There was only an increase in the number of kicks that hit elsewhere. It was speculated that a change in tactics had more of an influence in the 16-year-old fight.
5. **Low-intensity action (others).** There was a 36% decrease in low-intensity events post-intervention. The reasons for this decrease similar with what was observed in the 13-year-old match, where due to less disruption of the match, with less actions of successful topple down (all topple down actions were unsuccessful), no self-release and swipe occurring during the post-training match no referee judgement was needed to stop the fight.
6. **Overall frequency and outcomes.** In contrast to the 13-year-old group, the pre-post match data shows that E16 decreased 28% and C16 decreased 50% in the overall frequency of silat actions. The pre- to post-test match of E16 shows a 100% decrease in other actions, 92% in punch, and 80% in block performance but an increase in kicks (increased by 70%). Meanwhile, C16 shows a decrease in all silat actions (block [decreased 59%], punch [decreased 95%] and kicks [decreased 15%]) except in other actions (catch and topple down). The outcomes of the other actions show C16 successfully implemented the catch techniques (5 actions) in the post-test match but failed in all topple down activity which also known as 'miss opponent' (detailed analysis on 'other' actions).

The current study shows that there was a decrease in the overall 'hit target' outcomes, which is shown by the 72% decrease in this category in the post-training match. Details showed that there was a decrease in block (decreased by 75%) and punch (decreased by 93%) actions. Conversely, there was a small increase of hit target outcomes by 1-action in kick. There was also no improvement of the numbers of other actions (any silat actions other than block, kick, punch and low-intensity activity [others]) between pre and post-test match. These results suggested that the decrease (28 to 2 actions pre-post training) of the successful blocking activities were due to the changing strategy by the experimental participant (E16), which performed more kicks in the post-training match. The number of kicks performed by E16 increased from 37 – 63 pre-post training. Thus, it was speculated that this changed influenced the number and types of activities performed by E16 and also C16. Due to the increased number of kicks by E16, the

control group exponent tended to catch and topple down the kicks performed by E16, which is supported by the results. However, the result shows only 5% of the kicks performed by both exponents hit the target while the other kicks miss opponent or hit elsewhere. These interpretations suggest limited transference of fitness into competition over the intervention period, with match tactics seeming to have a greater influence on competition performance in the older group.

7. **Overall analysis.** Overall analysis of both matches in the 16-year-old group suggested that the E16 performed more kicks while C16 increased catching and topple down actions in the post-intervention match. It is speculated that three reasons influence this outcome. Firstly, it was speculated that both E16 (silat training and intervention) and C16 (silat training) responded to the training programme due to several improvements made in fitness in the post-training. Secondly, the C16 benefited from traditional silat training by improving catch and topple down actions. Thirdly, it is speculated that other factors relating to knowledge, skill, and performance (Thomas & Thomas, 1994) contribute to current outcomes which become more decisive than physical fitness, with participants changing tactics pre- to post-training.

General Issues of 13 and 16-year-old in Fighting Performance

There are several points that are important to be addressed in this study based on all the aforementioned discussion on the effect of silat-specific circuit training in two 13 and 16-year-old boys. This study highlights the individual responses to the specific intervention training on competitive performance. Even though some individuals might improve their fitness more (than an opponent), it does not necessarily mean they can transfer those characteristics into silat.

1. This is important as while on a group basis most 13-year-old exponents might improve muscular endurance, lower body strength and motor coordination and most 16-year-old benefitted from increased endurance, concentric strength, and muscular endurance as stated by Shapie et al. (2011), there is considerable individual variability within the group response. Moreover, what has the researcher showed throughout the applied methodology in this study might be useful to coaches to replicate those methods to targeted individuals, in order to predict the effectiveness of a training programme on fighting performance. Also, the applied nature of this study might be taking into coaching perspectives how effectively training is transferred to competitive performance. Two aspects that the coaches need to aware of are; do not rely solely on fitness data in order to predict fighting performance and second, there are technical and tactical issues in the silat match that need to be put into consideration in order to understand the factors that influence competitive fighting performance. For example, a previous study showed that aerobic power in lightweight senior Indian male boxers was $58.30 \pm 2.2 \text{ mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ (Khanna & Manna, 2006), even though the junior boxer can easily reach that level of endurance, it does not mean the junior can have similar skills and technical abilities to compete with his senior counterpart.

2. Technically, one interesting point to highlight was that research by Shapie et al. (2013) showed that the percentage of punch and kick actions contributed around 57% of the overall match frequency. However, the current study shows that the amount of both actions in 13-year-old contributed 75% in the pre-test and 59% in post-training matches; whereas the 16-year-old contributed 65% in the pre-test and 74% during the post-training matches. These results suggest the 13-year-old groups rely more on both actions during the pre-test match but adaptation to other skills such as dodge and catch post-training match. This change is speculated to result from the technical coaching received by both participants during the intervention period. Furthermore, the decrease of punch actions in E13 did not mean that the exponent lacked upper body skill or the ability to perform a strike, but the adaptation to lower body endurance gains during the intervention might influence E13 to perform more kicks and dodge during the latter match. It has been reported that children performances differences tend to be less skill related and more knowledge-based (French & Thomas, 1987; McPherson & Thomas, 1989). Both skill and knowledge increase as a result of practice, experience, and maturation, however, younger children demonstrate less variation in skill than older children and adults (Thomas & Thomas, 1994). Thus, E13 performed more kicks, and dodge actions compare to other silat skill due to the above factors. It would be suggested for E13 to practice punching technique in training to aid further development.
3. Meanwhile, a large increase of kick actions was found in E16 but not in C16. It was speculated that this increase was related to knowledge, skill, and performance as described by Thomas and Thomas (1994). The authors described that novices lack declarative knowledge such as goals and subgoals of the game, rules of the game, offensive and defensive strategies, terminology, and etiquette. E16 successfully punched his opponent 13/25 times compared to only 1/37 kicks in the pre-training match. Therefore, the incapability of E16 to recognise his appropriate skill in the post-training match resulted in a poor performance with only 1 successful kick from 63 kicks applied and 1/2 punch. Thus, the inability for E16 to determine punching as an appropriate skill that can contribute points in the post-training match was a limitation of his performance. Novices often do not know which skills to execute or when to execute a skill (Thomas & Thomas, 1994).
4. Tactically, compared to 13-year-old performance, a change of strategy is speculated to have influenced the frequency and outcomes in the post-training match of the 16-year-old. Even though E16 performed well in punching exercise during training (author observation), there was a decrease in the number of block and punch actions, suggesting that there was no influence of physical conditioning on silat fighting performance. Moreover, the increases in kicks by E16 suggest the opportunity for C16 to implement more catch and topple down actions to gain more points during the post-test match. These activities happened particularly because E16 used a different strategy (using kicks instead of punch) than that adopted in the pre-training match.

5. The current study did not provide the points scored for each exponent in all matches. However, in order to give a better understanding about the fighting performance, the author thought that this point needs to be raised in order to understand the importance of selecting a proper silat skill (i.e., punch, kicks, block + punch, dodge + punch amongst others) in order to score points in silat match. The ability for silat exponents to score maximum points during 3-rounds of a fight is critical to win the silat match match (Anuar, 1993).

Conclusion

This was the first case study to examine the changes in competitive fighting performance of four young performers from experimental and control groups following a silat-specific circuit training programme. The younger experimental exponent showed a change in combative fighting performance with increases in kick and dodge/evade actions and with more successful evading actions. This improvement was suggested to be associated with training improvements in upper body endurance and power, lower body strength, kicking speed-endurance, kick speed and agility which promoted relates to increase of kicks and dodge actions during a silat match. The older experimental exponent might gain in isometric strength, upper body endurance and power, and lower body strength but did not transfer this positive improvement into fighting performance, probably due to the tactical strategy during the silat match. Both C13 and E13 increased in dodge particularly due to the technical training. Kick performance might be the only transferred to competition. Gains in fitness may have some positive influence in performance in younger silat athletes. However, it is suggested that all silat fitness testing protocols could be used as valuable elements of information to evaluate an athlete's performance, although other important factors also need to be considered.

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