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Effects of Cross-Training Using Silat Practice on Psychological Profiles of Young Tennis Players

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Abstract

Background. Silat has been found to support the development of psychological aspects in enhancing the mental toughness of an athlete. In tennis performance, psychological skills are important and it is crucial to include in the training routines.

Problem and aim. Psychological factor has been identified by coaches that may affect the performance of junior tennis players. Psychological attributes that can be developed through silat practice may assist young tennis players improve their psychological performance. Therefore, this study investigated the effects of silat practice as a cross-training program on the mental toughness of junior tennis players in Malaysia.

Material and methods. Thirty (n=30) nationally ranked junior tennis players between the ages of 12 to 16 years old (18 males and 12 females, mean age 14.29 ± 1.65 years) were selected using purposive sampling method and were equally divided into experimental and control groups. Both groups were involved with the same training sessions every day for eight weeks. However, the experimental group performed a 30-minute silat practice prior to their normal training sessions. All participants completed a 42 items Psychological Profiles Inventory (PPI) Questionnaire one day before and after the intervention.

Results. The experimental group (n=15) showed significant improvement after the intervention while the results of the paired t-test analysis indicated that all the psychological profiles except negative energy showed a significant difference between the experimental (n=15) and the control (n=15) groups after the 8 weeks of the intervention program.

Conclusions. The results in this study validate the positive effect of silat practice on the mental toughness of junior tennis players.

Introduction

Sports performance is a complex blend of different areas of performance. Athletes' achievements and performance are subject to a combination of various factors including physical, tactical, technical, and psychological factors. Optimal performance requires an integration of all these important elements. Sports performance has recently engaged further developments in training methods in order to achieve the objectives of the training process. Effective training is about providing not only quantity but also quality programs.

There are many essential features in achieving excellence in athletes' performance such as the drive to succeed, the ambition to push beyond limits and the desire to be the best in sports. An effective interaction among physical, technical, tactical, and psychological preparations should exist within each of the critical phases of the training program such as preparatory, competition, and transition in order to achieve a high level of proficiency [Blumenstein *et al.* 2005]. Any psychological intervention introduced to elite athletes during their training should reflect the aims of each critical phase of the program.

There have been increasing efforts by coaches to use scientific approaches in enhancing athletes' performance including the training methods to improve performance in physical, technical, tactical, and psychological skills. The development of performance in competitions is achieved through an organized and systematic training process that is planned to enhance skills or abilities of athletes. Training is the total process of preparation of athletes, through various means and forms for better performance. It also promotes self-confidence and tolerance for higher training levels and competitions. In order to improve skills and performance during competitions, athletes must prepare themselves through a training process where the fundamental objective is to improve the body as well as mental function and optimize performance. One of those training processes is cross-training which is used by many coaches at different levels as an approach for designing a training program to improve competitive performance among athletes in a specific sport by training in a variety of sports.

The psychological aspect plays an important part in determining the player's performance at the highest level. Singgih *et al.* [1996] stated that sports psychology related to athletes' emotional processes becomes a key contributor in developing and upgrading athlete performance. Junge [2000] stated that successful performance in sports does not only require the athlete to be healthy and physically fit but also mentally prepared to play. The game of tennis is psychologically challenging. In the world-class tennis tournaments, the difference between a good player and a champion is mental strength. All elite players have the physical and technical ability to excel on the court but what defines a champion is the ability to thrive under the pressure of competition. The psychological factor is usually the determinant that differentiates a winner and a loser in sports [Brewer 2009]. For example, Weinberg and Gould [2003] indicated that mental ability contributed over 50% to athletes' success when competing against opponents. Scharneck [2017] defined mental toughness as a personal ability to perform at a high level in dealing with obstacles, challenges, and difficulties. Mental toughness is an attribute that distinguishes athletes who consistently perform better than others. Some athletes are in this zone while others fall apart shortly after the competition starts [Przybylski, 2018].

It is commonly accepted that psychological preparation for athletic pursuits is critical for the best performance. Sports psychology has been defined as "the sub-discipline of exercise science that seeks to understand the influence of behavioral processes on skilled movement" [Hatfeld, Brody 1994]. It can be a great help to sports coaches and those who want to understand the mental aspects of sport and how to enhance the performance of their athletes. Participation and success in any kind of activity, exercise or sport not only relies on

physical ability but also requires some degree of mental strength. An athlete's performance can be affected by many factors such as their confidence level, ability to concentrate, other people such as spectators, competitors, and the environment in which they are performing.

Mental toughness refers to a collection of psychological traits which are significant to optimal performance. Athletes, coaches, and sports psychologists have consistently implicated mental toughness as one of the most important psychological characteristics related to excellence in sports performance. The factor of mental toughness concludes that the athletes need to equip themselves with a package of combined psychological skills starting in the early stage of involvement, training session, during and after the match [Jones, Hanton, Connaughton 2007]. Gucciardi, Gordon, and Dimmock [2009] use the concept 'Mental Toughness' as an umbrella term for athletes who are considered to possess superior mental characteristics and they believe that it is the mental game that will differentiate the performers. Middleton *et al.* [2004] and Gould *et al.* [2002] indicate that mental toughness plays an effective role in controlling the ideal state of performance as it aims to build mental and emotional strength.

Mental training is aimed at supporting competitive athletes to perform at their most optimal level. Acknowledging the essential need for mental toughness, coaches have come to agree that mental toughness is a factor that could determine the success of an athlete [Gould, Hodge, Peterson, Petlichkoff 1987] and it is also seen as an important element that could shape a successful athlete to be a champion [Norris 1999]. Both athletes and coaches admitted that at least fifty percent of the success is influenced by psychological factors that are related to mental toughness [Loehr 1982, 1986]. Lefkowitz [2003] and Lowther [2002] indicated that mental toughness is the ability to stabilize ideal performance when competition pressures intensify, and this requires good tactics and mental skills. There are also some researchers who found out that when two teams that share the same strength, skills, and tendency to win, 90% of the determining factor to be the champion depends on the mental aspect [Gouldsmith 2006].

Cross-training refers to a sport's training other than the one that the athlete competes in, with the objective of improving overall performance and is a relatively recent training method which aims to enhance or maintain performance through the practice of non-sport specific activities. Hassan [2004] and Brislin [1998] stated that cross-training is an organizational form for methods and means of sports training as it depends on diversity in practicing various activities and sports related to the specialized activity practices in order to maintain the physical, physiological and psychological requirements of the players. The cross-training hypothesis suggests that despite the principle of specificity of training, athletes

may improve performance in one mode of exercise by using another mode. Taylor [2000], Pedersen [2000], and Hasan [2004] agree that cross-training is important for development of general and specific physical capabilities, as it allows for additional effort to be performed during basic sport with less risk of over-training and burnout. Its use can reduce the chances of injuries as cross-training allows the use of additional muscle groups that are not involved in basic sports.

Cross-training is useful as an activity in a warm-up and cool-down exercises where it offers psychological comfort and fun. According to Gomez [2019] cross-training is a way of motivating oneself as well as enjoying the different new ways of training. From a psychological standpoint, cross-training provides athletes with the opportunity to uphold a competitive edge and allows athletes to motivate the mind and body. Hayes [1998] stated that the most important characteristics of cross-training are the variety of exercises that exist in the program which maintain excitement for a long time, and it also contributes to the upgrading of different muscle groups in different ways. The cross-training (XT) hypothesis suggests that despite the principle of specificity of training, athletes may improve performance in one mode of exercise by training using another mode.

Silat is the type of martial arts that originated in Malaysia [Shapie 2021] and is deeply entrenched in the traditions and culture of Malaysian civilization [Shapie, Elias 2016]. The word silat means a kind of sport or game, which consists of quick movements in attacking and defending [Anuar 1987]. The knowledge of self-defence is especially concerned with methods of defending oneself from any attacks, be they through erosion, parrying, dodging and others, which may endanger the attacker [Shapie *et al.* 2015]. This will make every silat exponent ready to receive any strike either one-on-one or in group strikes.

Dongoran *et al.* [2019] concluded that martial sports had a higher characteristic of activity and aggressiveness in general. The personality of martial sports athletes has a disciplined value that is more prominent when compared to the value of cooperation and sportsmanship [Hermawati 2014]. There are several factors in martial arts that support the development of psychological aspects, including self-confidence, training mental endurance, developing self-awareness, a knight's soul, and higher discipline and tenacity [Gristyutawati, Purwono, Widodo 2012]. Shapie [2021] reported that silat students were equipped with psychology training on how to control their emotions when facing their enemy either in one on one or more than two opponents. The best way in self-defense is to avoid any quarrel or fight. However, if the silat exponents cannot avoid the quarrel, they can choose either to face their opponent with two options. Firstly, the first option is to fight without hurting their opponents. This is because the purpose of learning silat

is to avoid clashes. Fighting techniques without injuring the opponents will give them an opportunity to apologize for their mistakes to start the fight. The best fighting style to be used is the avoiding technique. Usually, this technique will follow by counterattack to the opponent's weak limbs such as elbow, knee, shoulder, and wrist. Secondly, the second option is to attack before being attacked. This method is used to fight with the armed opponents, or more than two people. This method would normally injure the opponent as an attack directed at the killer parts of the human body such as the heart, ribs, stomach, eyes, and neck. According to Shapie *et al.* [2015] silat can be a means of character building. *Silat was practiced* not only for physical defense but also for *psychological* purposes. In silat mental training, some techniques are useful to increase the confidence or performance of athletes [Shapie *et al.* 2018].

The art of silat revolves around the culture to defend and to preserve the existence and the integrity of the environment to reach the harmony of life to improve people's beliefs and religious attitude [Shapie *et al.* 2016]. A lot of benefits can be gained from silat, such as the development of cognitive, affective, and psychomotor aspects. Cognitive ability develops as the conceptual training of silat is given. The fast-thinking process is required in facing the problems to solve and taking the decision correctly and accurately. Affective ability develops as the training related to sportive attitude, respecting each other, discipline, and being humble, as the principles of silat, and other affective aspects are given.

In order to play tennis at a competitive level, certain standards need to be achieved in all major components of performance. A high level of performance can only be achieved through a meticulously planned and well-controlled training system based on scientific knowledge and proven methods of training fundamentals. As such, many sports scientists have been researching methods and studying new approaches or tools to help train tennis players in the lab and on the court. This is to facilitate tennis players to reach their full potential during competitions as well as in their playing career. Most players set goals that they would like to achieve for the year or in the certain distant future. However, daily training activities that are not well-connected with common objectives may not effectively target goals. This lack of focus can decelerate the player's progress. If performance training activities are out of track, the athlete will not be able to get the quickest possible results. But there is a strategy to get to peak performance through a systematic and structured training program or model.

In tennis, the psychological aspects are considered to be very important, especially at the higher performance level [Weinberg, 1988]. In the past years, more and more research has demonstrated that psychological skills play a crucial role in becoming an elite athlete [Elferink-Gemser *et al.* 2004; van Yperen 2009]. Given the

individual nature of competitive tennis, helping junior tennis players to develop a sense of autonomy, personal mastery, and intrinsic motivation is critical to their long-term success in the game [Greenwald 2009]. Interest in behavioral sport psychology has grown [Luiselli, Reed 2011; Martin 2011], producing refined methods and an expanded research focus. Behavior analysts continue to examine the merits of applying basic learning principles to evaluate and predict competitive sports outcomes.

Gucciardi *et al.* [2015] stated that the consistent demonstration of salient behaviors across various situations is one way of operationalizing the reputation of an athlete being mentally tough. In their study, tennis coaches and players were asked to generate mentally tough behaviors and the results showed that working hard no matter which setbacks are encountered, perform the best of their ability no matter how the athlete is feeling, refusing to give up when things get tough, fighting for every point, and being a good decision-maker were some of behaviors indicated by coaches and players that reflect mental toughness [Gucciardi *et al.* 2015]. Based on the previous literature that silat is a martial art sport that has the characteristic of aggressiveness which also supports the development of psychological aspects such as character building of an athlete and considering the impact of training routines in enhancing mental toughness, the study on silat practice among junior tennis players is a significant option to determine its effects on their psychological performance.

The purpose of the study is to investigate the effectiveness of silat practice as a cross-training intervention in enhancing the psychological attributes of existing national elite junior tennis players aged between 12 to 16 years and to provide evidence-based recommendations that can be adopted by players, parents, coaches, and national associations in the training programs with the objective of upgrading the performance level and achievements of Malaysian junior tennis players. The finding of this study will provide important information, knowledge and guidelines for coaches, parents, and players on a systematic approach to become better players and to reach the maximum potential of the players. Tennis players who are looking forward to reaching their full potential deserve to be trained using the most up-to-date or systematic approaches which have been scientifically proven to enhance their performance. It is the responsibility of the coach to impart the latest information and findings into a successful evidence-based training program to enhance players' performance and to achieve their fullest potential. Thus, the objectives of this study are:

1. To determine the effect of silat practice on the psychological characteristics of junior tennis players.
2. To compare the effect of silat practice on the psychological characteristics of young junior tennis players.

Methods

Research Design

This is an experimental study with a pre-test and post-test treatment design. A group of junior tennis players was recruited and randomly divided into two groups in which the subjects functioned as independent variables. This repeated measure study consists of pre-test prior to an intervention and post-test after eight weeks of intervention to determine the effects on psychological performance of the subjects.

Participants

A total of thirty (N=30) junior tennis players were recruited for this study using the purposive sampling method with the effect size of 0.8 as stated by Sylvia and Terhaar [2014]. The participants were ranked in the National Junior Ranking System and were between the ages of 12 to 16 years old 18 males and 12 females, mean age 14.29 ± 1.65 years). The ranking system was based on the accumulated points collected by the players in various national level tennis tournaments. The points collected determine the ranking achievement of each of the players who participated in national tennis tournaments. All testing and training procedures were fully explained, and written parental consent was obtained for each participant, all of whom agreed to participate in the study.

Measures (Procedures of study)

All subjects were requested to answer the Psychological Performance Inventory (PPI) Questionnaires [Loehr 1986] before the intervention started to determine their psychological profile, which consists of seven psychological determinants. This method correlates with the objective of this study which focuses on the effects of an intervention program on mental toughness. Loehr [1986] suggested that mentally tough athletes have the ability to increase their flow of positive energy in adversities. Although some research findings identified twelve attributes of mental toughness such as Fourie and Potgieter [2001]; Jones *et al.* [2002]; Middleton *et al.* [2005], the seven fundamental attributes of mental toughness suggested by Loehr [1986], show similarities to those identified by recent researchers like Fourie and Potgieter [2001]; Jones *et al.* [2002]; Middleton *et al.* [2005]. Therefore, in this study, the researcher considered the seven fundamental attributes of mental toughness suggested by Loehr [1986]. Specifically, the mental toughness attributes include (1) self-confidence (i.e. belief that one can perform well and be successful), (2) negative energy control (i.e. to cope with negative emotions such as fear, anger, frustration and temper for achieving success), (3) attention control (i.e. stay focused and to perform well), (4) visualization and imagery control (i.e. creating positive mental images), (5) motivation level (i.e. the energy and willingness to persevere), (6)

positive energy control (i.e. energized with fun, joy and satisfaction), and (7) attitude control (i.e. habits of thought and unyielding).

Silat practice drills were developed in the study and employed as an intervention as shown in Figure 1. The participants were divided into two groups namely the Experimental Group and Control Group. The Experimental Group was inducted into the silat practice which was employed for eight weeks in addition to their normal tennis training while the Control Group only engaged in a normal individual tennis training.

No.	Task	Sets	Reps	Rest
1.	Punch drills	1	10 reps	30 sec
2.	Combine Block and Punch drill	1	10 reps	30 sec
3.	Fake Punch	1	10 reps	30 sec
4.	Kicking drills	1	10 reps	30 sec
5.	Combine kicking drills	1	10 reps	30 sec
6.	Combine Block and kicking drills	1	10 reps	30 sec
7.	Dodge and kicking drills	1	10 reps	30 sec
8.	Sweeps drills (front and back drills)	1	10 reps	30 sec
9.	Combine punch and sweep drills skills	1	10 reps	30 sec
10.	Combine and kicking and sweep	1	10 reps	30 sec



Fig. 1. Silat Practice as cross-training activities.



Fig. 2. Junior tennis players are undergoing the cross-training session using silat practice.

The Experimental group was engaged in the silat practice for thirty minutes as part of their dynamic warm-up

session prior to their normal tennis training routines as shown in Figure 2. All participants were tested on their psychological profiles before and after the completion of the intervention training program. During the pre and post-test sessions, all participants were asked to complete PPI Questionnaires [Loehr 1986]. A 42 items self-report inventory with seven subscales, designed to measure factors that reflect mental toughness in an athlete.

Statistical Analysis

Mean scores and standard deviation were calculated for each attribute of psychological profiles. An independent t-test was carried out to examine the significant effect of the cross- training and paired t-test was conducted to determine the significant difference between both groups after the intervention. The statistical techniques provide the comparison of the two groups over time. An interaction effect between the performance level and measurement reveals differences between the experimental group and control group that changed as a function of time. An alpha of 0.05 was adopted for all the tests of significance.

Results

After running the independent t-test, the results in Table 1 show that all psychological attributes of self-confidence, negative energy, attention control, visual and imagery control, motivation level, positive energy, and attitude control have shown significant improvement after eight weeks of silat practice cross training with p-value in all variables recorded below than 0.05. Table 2 shows that self-confidence, attention control, visual and imagery control, motivation level, positive energy, and attitude control proved to be significantly difference between the experimental and control group after the intervention. The results show that the Experimental Group scores mean= 21.08 while the Control Group has mean=17.75 in self-confidence and statistically it is $t=4.82$, $p<0.001$, meaning that the 15 players who participated in silat practice has developed higher self-confidence as compared to the players who did not participate in the cross-training. The Experimental Group showed higher results in attention control with mean=19.50 while Control Group showed mean= 17.25 where it is statistically proven to have significant difference at $t=3.84$, $p<0.001$, which shows that the Experimental group possess a good attention control. The results in other psychological attributes also showed that visual and imagery control with $t=2.77$, $p<0.05$, motivational level $t=6.20$, $p<0.001$, positive energy $t=3.71$, $p<0.001$ and attitude control $t=3.61$, $p<0.01$. In short, all psychological profiles have shown significant difference effects, except for negative energy.

Table 1. Effects of Silat Practice on Experimental Group

Psychological Profiles	Group	Mean	t	Sig. t-test
Self-Confidence	Experimental	21.08	-4.82***	0.00
	Control	17.75		
Negative Energy	Experimental	17.92	-0.62	0.54
	Control	17.42		
Attention Control	Experimental	19.50	-3.84***	0.00
	Control	17.25		
Visual & Imagery Control	Experimental	20.83	-2.77**	0.01
	Control	19.08		
Motivational Level	Experimental	23.17	-6.20***	0.00
	Control	19.00		
Positive Energy	Experimental	19.67	-3.71***	0.00
	Control	18.00		
Attitude Control	Experimental	19.75	-3.61***	0.00
	Control	17.75		

*p < 0.05

Table 2. Comparison of Experimental Group and Control Group after Intervention.**Psychological Profiles (Experimental Group)**

Variables	Pre-test	Post-test	Diff.	t-test	p-value
Self-Confidence	18.33	21.08	2.75	-9.87	0.00
Negative Energy	17.00	17.92	0.92	-4.01	0.00
Attention Control	17.17	19.50	2.33	-9.11	0.00
Visual & Imagery Control	18.33	20.83	2.50	-9.57	0.00
Motivational Control	20.67	23.17	2.50	-10.86	0.00
Positive Energy	17.42	19.67	2.25	-8.07	0.00
Attitude Control	18.83	19.75	0.92	-3.53	0.01

*(p<0.1), **(p<0.05), ***(p<0.001)

Discussion

The results of this study indicate that the Experimental group which engaged in the silat practice as cross-training has shown positive significant differences from the control group in Self-Confidence, Attention Control, Visual & Imagery Control, Motivational Level, Positive Energy and Attitude Control except in Negative Energy. However, the Experimental Group still showed a higher mean in Negative Energy as compared to the control group. The evidence from the outcome of this study has indicated that using silat practice as a cross-training is one of the appropriate training methods that has a significant contribution to the psychological performance enhancement of junior tennis players. Silat practice is a training structure that can be applied to accelerate the athletes' progress toward achieving peak performance and was developed in this study based on previous research findings.

These results are consistent with the study by Ibrahim and Badr al-Din [2001] and the study by Shawky [2015] that psychological skills can be developed through sports training. Al-Sayed and Ashraf [2003] point out

that the use of cross-training affects the psychological aspect by getting rid of routine when training for only one activity, removing the feeling of boredom and monotony, and having some kind of psychological adaptation and increasing the effectiveness of training. Evidence from this study shows that silat practice made a significant impact on the psychological skills of young tennis players was also supported by the study of Rogowska and Kusnierz [2013] which found that those who engaged in martial arts and combat sports improved in terms of attitude, especially in terms of the cognitive component. Sibley and Bergman [2018] affirm that the adherence and motivation to practice the cross-training modality include individuals from different groups such as obese, healthy, and athletes, and the number of people as a limitation to the practice of this modality for each group compared.

Conclusions

In conclusion, the practicality of the information gathered from this study can be applied in designing training programs for elite tennis players. The findings of this study offer some key prospective directions for mental toughness and cross-training research among the young tennis players. It also revealed that the cross-training

plays a significant role in enhancing the psychological profiles of tennis players. The proposed cross-training program using silat practice has shown a positive effect in improving the determinants of mental toughness, represented by self-confidence, negative energy, attention control, visual perception control, motivation level, positive energy and attitude control of the experimental group in this study. Therefore, coaches shall consider including silat practice as part of warm-up activities when designing a training program for young junior tennis players as an alternative method of cross-training to improve their psychological skills.

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Wpływ treningu przekrojowego z wykorzystaniem praktyki silat na profile psychologiczne młodych tenisistów

Słowa kluczowe: odporność psychiczna, sprawność, praktyka silat, tenis, trening

Streszczenie

Tło. Stwierdzono, że *silat* wspiera rozwój aspektów psychologicznych w zwiększaniu odporności psychicznej sportowca. By osiągnąć sukces w tenisie, umiejętności psychologiczne są bardzo ważne i należy je włączyć do rutynowych treningów. Problem i cel. Trenerzy zidentyfikowali czynniki psychologiczne, które mogą mieć wpływ na wyniki osiągnięte przez młodych tenisistów. Atrybuty psychologiczne, które można rozwinąć poprzez praktykę silatu, mogą pomóc młodym tenisistom w zwiększeniu ich wydajności psychologicznej. W związku z tym, w niniejszej pracy zbadano wpływ praktyki silat jako programu treningu przekrojowego na odporność psychiczną młodych tenisistów w Malezji. Materiał i metody. Trzydziestu ($n=30$) tenisistów juniorów w wieku od 12 do 16 lat (18 mężczyzn i 12 kobiet, średnia wieku $14,29 \pm 1,65$ lat) zostało wybranych metodą doboru celowego i równo podzielonych

na grupę eksperymentalną i kontrolną. Obie grupy uczestniczyły w tych samych sesjach treningowych każdego dnia przez osiem tygodni. Grupa eksperymentalna wykonywała jednak 30-minutowy trening silat przed normalnymi sesjami treningowymi. Wszyscy uczestnicy wypełnili Kwestionariusz 42 pozycji Inwentarza Profili Psychologicznych (PPI) dzień przed i po badaniem.

Wyniki. Grupa eksperymentalna ($n=15$) wykazała znaczącą poprawę po interwencji, a wyniki analizy sparowanych testów t wskazały, że wszystkie profile psychologiczne z wyjątkiem negatywnej energii wykazały znaczącą różnicę pomiędzy grupą eksperymentalną ($n=15$) a grupą kontrolną ($n=15$) po 8 tygodniach programu interwencyjnego.

Wnioski. Wyniki tego badania potwierdzają pozytywny wpływ treningu silat na odporność psychiczną młodych tenisistów.