

The Effect of Taekwondo Practice on Anxiety in Adolescents with Attention Deficit Hyperactivity Disorder during Following Taekwondo Taegeuk Poomsae

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ABSTRACT

Research suggests that adolescents with Attention Deficit Hyperactivity Disorder (ADHD) who also suffer from anxiety are in the risk zone of a number of negative outcomes ADHD. These teens have a longer reaction time, do not seem to be overactive and seem inattentive. A clinical study suggests that these adolescents have problems planning their future, perform specific tasks, are less determined and seem to have problems with working memory, including being forgetful and having trouble keeping information for transformation. The combination of ADHD and anxiety is usually detected later in life than earlier in life, as do only the symptoms of ADHD. A 2×4 factorial ANOVA revealed that anxiety was more common in these adolescents with ADHD. Thus, inattention was found to be more closely related to expected outcomes than symptoms of hyperactivity and impulsivity. In this context, the objective of this study was to investigate the effects of one and a half year Taekwondo (TKD) intervention on psychological function in adolescents with ADHD. Comparisons between the TKD and control groups at baseline did not reveal significant differences. These results suggest that adolescents with simultaneous ADHD and anxiety may require different intervention approaches to treatment. There is statistically significant decrease of mean Total posttest Intensive Care Psychological Assessment Tool (IPAT) anxiety scale in experimental group in comparison to control group ($P < 0.05$) (52.550) and (32.400). In conclusion, the movements and techniques of poomsaes (MTP) intervention program can help adolescents with ADHD improve their psychological function the martial art of Taekwondo is finding a niche in the treatment of psychological disorders and will likely prove to be a useful complement to verbal therapy. The martial art of Taekwondo can help develop both better bodies and better minds and may lead to a better, more peaceful society.

Keywords: ADHD; Anxiety; Taekwondo; Martial arts

INTRODUCTION

Anxiety has been recognized to be comorbid with attention-deficit/hyperactivity disorder. A clinical study showed that around 25% of children with ADHD have a comorbid anxiety disorder [1-4]. Anxiety disorders are characterized by consistent and impairing levels of anxiety, worry, and/or avoidance [5]. There are several possible explanations for the comorbidity between ADHD and anxiety; some of them concern heritability, temperament, and family influences [6]. Research suggests that adolescents with ADHD who also experience anxiety are in the risk zone of a number of negative outcomes. For example, children with comorbid ADHD and anxiety perform poor on tasks involving attention compared to

children with ADHD only [1]. These children have longer reaction time, do not appear to display hyperactivity and seem inattentive. A clinical study suggests that these children have problems planning for the future, attain goal-directed tasks, are less determined and seem to have problems with their working memory including being forgetful and have a hard time holding information for processing [2].

According to Schatz DB, et al. [3], the combination of ADHD and anxiety is typically detected later in life rather than earlier in life like ADHD symptoms alone do. The proposed explanation is that symptoms such as impulsivity are easier to detect than anxiety since it is mainly expressed through internalizing emotions. Further, ADHD with comorbid anxiety symptoms have been reported

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Received: August 03, 2021, **Accepted:** August 24, 2021, **Published:** August 31, 2021

Citation: Kadri A, Azaiez F (2021) The Effect of Taekwondo Practice on Anxiety in Adolescents with Attention Deficit Hyperactivity Disorder During Following Taekwondo Taegeuk Poomsae. J Depress Anxiety 10:423.

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to be associated with lower social skills [7], higher psychosocial impairment [8] and suicidal attempt [9]. These findings suggest that children and adolescents with concurrent symptoms of ADHD and anxiety are an unique group that is associated with differential negative outcomes than ADHD-only children and adolescents. Gender and ADHD subtypes (e.g., ADHD-combined, ADHD-hyperactive/impulsive and ADHD-inattentive) have been found to be associated with different outcomes implicates that there is a two to three time's higher prevalence among boys than girls to receive a clinical diagnosis of ADHD [10]. Thus, the criteria for the disorder are very bound to the "boyish" norm, which complicates diagnostic criteria for girls. Kadesjo states that symptoms of hyperactivity is found more rarely in girls than in boys, and that girls tend to be more introvert and have lower self-esteem than boys [11]. Girls with ADHD are therefore proposed to show patterns of lower activity in regards to hyperactivity in childhood. Another difference is that girls show a higher rate of somatization (e.g. symptoms such as fatigue, stomach ache and panic attacks), which is also the main reason for seeking help. Boys on the other hand show higher rates of developing delinquent behaviors and substance abuse [11]. In terms of the propensity of developing ADHD, research suggests that boys are more likely to develop comorbid ADHD with anxiety [12]. They also found that boys are more likely to develop the more severe type of ADHD in which is called combined type, that is, expressed through hyperactive, impulsive and inattentive characteristics.

The combined type is in other words the fully developed type of ADHD with both attention and hyperactivity problems. Further, girls are more likely to develop anxiety in the predominantly inattentive subtype which explains why some youths struggle with attention more than hyperactivity [12]. Research also suggests that girls with this subtype have a greater likelihood for having comorbid anxiety disorder than boys with the same inattentive type of ADHD. This suggests that gender is not the only factor that predicts behavioral issues in ADHD and that the subtypes of the disorder, is of high value in research and intervention in psychosocial well-being in adolescents with ADHD [12]. The formation of martial arts, including the variety of specified techniques and exercises that are each martial art and each class of martial art. The teenager must focus on a specific task for a short time only. The task or technique to be attained is mainly transformed quickly into another. During the time of hour, the child is engaged in various repetitive tasks, but so does the interest being sustained. One learns to develop concentration skills, but in very courteous conditions [13].

The hierarchical and progressive structure of martial arts training also helps to channel it positively as well as distractibility and courtesies of attention, and to compensate for frustration. Students' progress through a series of progressive stages and acquire complex skills, such as a long form, a difficult kick or a grappling exit by mastering smaller exercises festivals much more digestible. The form of the complex of digital movements, which have been learned by a complex grappling technique, for example, involves several steps. The benefits of this approach go far beyond learning the specific task in question, in an approach to life that can help the adolescent with ADHD. Recreational and fitness activities have been shown to be helpful for various special needs populations [14]. Since martial arts practice can have beneficial outcomes, a number of people are looking to the martial arts as a means to treat psychological function. For instance, Guthrie found

that women recovering from psycho-sexual abuse, eating disorders, substance abuse and growing up in dysfunctional families reported that karate training was helpful in their recovery [15]. In a case study, Weiser claim that Shotokan Karate helped a client achieve quicker results in verbal therapy [16]. One of the most cited studies in this area was conducted by Trulson [17].

Adolescents identified as juvenile delinquents were assigned to one of three groups. The first group received traditional taekwon do training (involving meditation, warm-up exercises, brief lecture about Tae kwon do, and the physical techniques of Tae kwon do); the second group received Tae kwon do training (only the physical techniques were taught); and the third received a program of increased physical activity not involving the martial arts. All groups were taught by the same instructor for the same amount of time and in the same room. At the end of six months, the students in the traditional Taekwondo group showed a decrease in aggressiveness and anxiety and an increase in self-esteem. In contrast, the modern Taekwondo group showed an increased tendency towards delinquency and an increase in aggressiveness. Students in the exercise group showed an increase in self-esteem, but no other significant changes. Several groups have used other martial arts as a means of psychological treatment. Judo training, but not the control activities, led to an increase in the social adjustment scores for developmentally disabled subjects and modified judo training increased the psychosocial skills for blind, developmentally disabled children [18,19]. Aikido training for adolescents with behavioral problems led to larger increases in self-esteem than traditional treatment [20]. Both judo [21] and karate [22] have been useful in reducing dysfunctional behaviors in male, behaviorally disordered adolescents. Judo has also been found to be a useful adjunct to community programs for the treatment of pre-delinquent children [23].

Aikido has been successfully used as an intervention strategy for middle and high school students with severe emotional disturbances and other research indicates that martial arts may help reduce behavioral problems in adolescence [24,25]. One of the central goals of both psychotherapy and many martial arts is knowing oneself and the world around us. As Master Sun says, "know the enemy and know yourself; in a hundred battles you will never be in peril". These battles can be waged both inside and outside of ourselves [26]. Within this theoretical framework, Taekwondo (TKD) is a Korean martial art refined over generations that engages students in a range of cognitive, physical, emotional, social and educational processes [27]. TKD favors the integration of different skills and mental faculties, and represents a mature behavioral philosophy that emphasizes self-control, respect, integrity, perseverance, goal setting and concentration [28]. At the heart of TKD, there is an exercise-based approach to a complex physical activity that involves planning, problem-solving and changing positions [29].

The cognitive complexity of physical activity in TKD practice is illustrated by the so-called *poomsae*, meaning "forms". *Poomsae* is a composite word that combines " *poom* ", which means " movement", and " *sae* ", which means "identity, style". *Poomsae* are not only technical schemes or a mere series of choreographic physical movements performed with high-level precision in a particular order [30]. The *poomsae* principle does not refer exclusively to technical rules and movements, but enhances cognitive functions and skills. In particular, our investigation is based on the "Movement and Technique of *Poomsae* " (MTP), which represents

the working core of our intervention among adolescents with ADHD. Recently, TKD has received attention from scholars and researchers, who have investigated the benefits of TKD training among children and adolescents, in terms of psychological and behavioral improvements, even though the possible therapeutic implication of TKD practice still remains overlooked in the extant scholarly literature [31,32].

Poomsae is consecutive motions with which offense and defense techniques can be trained for improvement of Kyorugi technique and motion application capacity. It is effective in improving physical activity fitness and health such as muscular strength, cardiovascular and respiratory endurance, flexibility, and agility [33]. But compared to Kyorugi for which various studies are under progress, study for Poomsae is very poor. So, systematic development and application of Poomsae is needed. And LEE Gyuhyeong (29) suggested that as present Poomsae is simply formal process for promotion and composed of simple motions, it should be recomposed so that actual application can be available (Figure 1).

Taegeuk Poomsae (forms: a series of movement sequences) was based on the profound philosophy of Taegeuk to be trained by the Taekwondo (TKD) practitioners. Taegeuk Poomsae vary a great deal in both, upper and lower body techniques with total 167 movement sequences consisting of blocking, punching, and kicking techniques as well as turning, leaping and jumping movements in a range from Taegeuk I-Jang to Tae-geuk 8-Jang. Kim suggests that Taegeuk Poomsae serve to increase anxiety [34]. Therefore, the research on Tae-geuk Poomsae should provide precise information about anxiety responses as well as psychological function of adolescent with ADHD responses. As such, the main objective of this study was to evaluate the effectiveness of one and a half year TKD training program on psychological function in young adolescents with ADHD. Taekwondo is Korean unique martial arts sports.

EXPERIMENTAL SECTION

Physical characteristics of the subjects at baseline

Data on the socio-demographic profile of participants are presented in Table 1. The groups are equivalent in age. The distribution by sex is also proportionally respected. The composition of the groups does not respect the matching according to the field of study. The recruitment of the control subjects was carried out accordingly.

Population selection: inclusion/exclusion criteria

Forty young patients with ADHD (36 males and 4 females) were recruited. They were randomly allocated to a TKD practice group (TKDPG, n=20, age=14.5±3.5 years) or a control group (CG, n=20, age=14.2±3 years) without any physical training. To be eligible to participate in the study, participants were required to meet the following criteria: (a) no consumption of any supplements or drugs; (b) no history of use of medications that could alter the hypothalamic-pituitary-gonadal (HPG) axis, such as anabolic steroids; (c) no history of chronic disease, bronchospasm or atopy; (d) regular eating patterns; (e) no respiratory infection during the previous month; (f) abstinence from strenuous exercise in the 48 h before testing and (g) not being color blind or vision-impaired. Local institutional ethical approval was provided for this study, which was conducted in accordance with the 1964 Helsinki declaration and its subsequent amendments. Written



Figure 1: Taegeuk poomsae.

Table 1: Physical characteristics of the subjects at baseline.

Variables		Groupe de contrôle (n=20)	Groupe TKD (n=20)
Genre (garçons/filles)		18/2	18/2
Âge (ans)		14.2 ± 3	14.5 ± 3.5
Niveau scolaire	Secondaire	7	7
	Collège	13	13
Taille (cm)		154.1 ± 7.7	154.3 ± 7.6
Poids (kg)		46.9 ± 11.5	46.5 ± 11.8

informed consent was obtained from the participants and their parents following verbal description of all experimental details, prior to experimental data collection. The study was conducted from September 2015 to January 2017. Participants visited the laboratory on three separate occasions at the same time of day (2 p.m.), each separated by 1 week. The participants were familiarized with the testing procedures at visit 1 and, thereafter, were randomly allocated to one of the two conditions. The first visit consisted of the collection of anthropometric data. Furthermore, participants were familiarized with the IPAT scale of anxiety. During the second visit, participants were asked to perform the above mentioned tests, before completing one of two conditions. A rest interval of at least 5-min was provided between tests. The same tests were also performed after each condition. The participants of the taekwondo practice (TKDP) group performed various specific TKD techniques and poomsaes. The participants of the control group performed other activities such physical educational. Participants were advised to avoid cognitive exercise, caffeine, and alcohol 48 h before each laboratory visit. Food and fluid intake was registered 48 h prior to the first study visit, and subjects were asked to avoid such intake 3 h before the second visit.

INSTRUMENTS

Intensive Care Psychological Assessment Tool (IPAT) anxiety scale

The IPAT Anxiety Scale consists of 40 items formulated to ensure

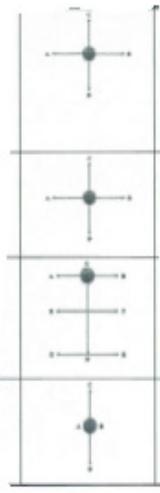
cooperation and openness while minimizing the influence of suggestion [35]. It lends itself to individual and collective administration and is corrected quickly by means of a grid. The duration of handover is 10 to 15 minutes. This scale was designed to be applicable to both sexes and can be administered to subjects 12 years and older.

Taekwondo intervention

Taekwondo practice (TKDP) group practiced specific exercises for

50-min twice weekly for a year and a half. Training sessions took place between 3 and 7pm. The intervention took place in a private martial arts *Dojang* (researcher). The TKD intervention program consisted of the development technical aspect (e.g. blocking, punching and kicking) of the sport and *poomsae* (forms) for 30-min. Before each training session, participants completed a 10-min general warm-up and recovery, respectively. An example of a TKD intervention scheme is provided in Table 2. The TKD intervention was conducted by qualified TKD instructors.

Table 2: MTP intervention program (movements and techniques of poomsaes).

Program	Static Activity	Dynamic Activity	Psychological And Cognitive Functions Targeted	Time (min)
Echauffement	Stretching, jogging and strengthening (sit-up and push-up)			Ten
Blocks and body punch	Defense position	Walk forwards/backwards	Visual selective attention Focused attention	Five
Upper				
Down	Large position	Walking back ward/forward		
Inside				
Outside				
Kicking				Five
Front				
Lateral	Fighting position	Walking forward/backward	Visual Sustained Attention	
On the back				
Tour yourself		Jump		
Side				
Objective of MTP				
Poomsae	Movement	Forward/backward Left right Turn in yourself Down To the top No foot wide/short	Alternation/attentional self-confidence	Thirty
Technical				
Poomsae position			Looking forward Efficiency Coordination Attention Target Balanced Agility Vigilance Confirmation	Learning Auditory work memory Verbal working memory Visual work memory Self Esteem
Relaxation	Placement	Softness Flexible Stretching group game	Self-regulation Concentration calm	Ten

STATISTICAL ANALYSIS

Concerning the statistical analysis, data were visually inspected for potential outliers, before proceeding with their manipulation. They were represented as group mean values and standard deviations (SD). Range values were also reported where appropriate. After verifying data normality assumption with the Shapiro-Wilk test (which was preferred to other normality tests due to the small sample size used in the present investigation), exploratory paired Student's *t*-test were used to detect baseline between group differences and training effects over time, using Bonferroni correction to ensure protection against multiple testing. Dependent variables were analyzed in separate 2 (Groups: TKPG - CG) × 2 (Time: pre, post) Then, analysis of variance (ANOVA) with repeated measures on time was performed. The Mauchly's Sphericity Test was applied in order to control data for the sphericity assumption, that is to verify whether the variances of the differences between all possible combinations or pairs of groups (or said otherwise all the possible levels of the independent variable) were equal. In case of sphericity violation, data were corrected using the Greenhouse-Geisser correction or the Huynh-Feldt correction, based on the value of the epsilon. More in detail, if the epsilon was less than 0.75, the first approach was used, otherwise the second was preferred. Effect sizes (ES) were determined by calculating Cohen's *d* values with their 95% confidence interval or CI. Cohen's *d* values were classified as small ($0.00 \leq d \leq 0.49$), medium ($0.50 \leq d \leq 0.79$), and large effects ($d \geq 0.80$) according to the Cohen's rule of thumb [36]. A significance level of $p \leq 0.05$ was set for all analyses. All statistical analyses were carried out using the commercial software "Statistical Package for Social Science" for Windows [37].

RESULTS

The results obtained at the IPAT anxiety measurement scale are presented in Table 3. The qualitative analysis of the data makes it possible to identify certain differences. Despite similar results during the first test, the groups differ in the second evaluation. The total results obtained by subjects in the experimental group remain relatively from one transfer to another, while those of controls increase. The statistical analysis of these data confirms the presence of significant differences according to the group of membership ($F=5.873$, $P=0.041$) and measurement times ($F=4.908$, $P=0.041$). An interaction effect is also noted ($F=21.665$, $P<0.001$). The analysis of the results obtained the veiled anxiety subscale reveals the presence of differences according to the group of affiliation ($F=9.629$, $P=0.01$). The interaction effect is also significant ($F=19.159$, $P=0.001$). The groups are comparable with respect to overt anxiety.

DISCUSSION

The results obtained in this research validate the existence of a link between Taekwondo practice and psychological functions. The analysis of the results proposes the existence of an effect of the Taekwondo MTP intervention program beneficial to participants' mental health. It also has a positive influence on many psychological processes such as self-esteem, stress and anxiety. Numerous studies have demonstrated the importance of this psychological variable [37]. These variables indirectly affect their influence on self-image, integration into the learning environment and peer relationships. Analysis of the mental health outcome of the experimental group suggests a beneficial effect of the Taekwondo MTP intervention program on psychological function impulse and flexibility. These results are not surprising because the relationship between the regular practice of a physical activity and the level of fitness is known for a long time. Throughout a year and a half of experimentation, the subjects showed discipline and respected the training parameters. Participation in this Taekwondo MTP intervention program can have many positive effects on the integration of adolescents with ADHD is likely to decrease anxiety [38]. As the training takes place directly in the Dojang, participants can tame their new environment in a positive atmosphere. Participation in this type of intervention also allows adolescents with ADHD to experience pleasant, stimulating and rewarding situations. This can be important for psychological development. Being able to rub shoulders with these people in an informal setting encourages exchanges, confidences and questions. All of these factors can indirectly influence the integration of adolescents with ADHD. The data obtained during the psychological evaluation of the subjects show that the Taekwondo MTP intervention program has had a favorable influence on school motivation, anxiety, stress and self-esteem [39]. The importance of these variables in relation to academic success is well demonstrated. Some studies suggest that influencing these variables promotes classroom concentration and positively influences academic achievement [40]. Past researchs agree on the comorbidity between ADHD and anxiety [6]. These findings suggest that anxiety when accompanied by ADHD-symptoms in an adolescent is not a protective factor. It is also suggested that anxiety is more common among adolescent boys than girls in the combined type of ADHD. These findings are partly supported by the findings in our study and since past research have used clinical measures; our findings are valuable in the aspect that we have used measures that capture symptoms that is not necessarily clinical.

The uniqueness in our findings are that our study support previous research on clinical measures which shows that there are adolescents with non-clinical symptoms that show similar problematic behaviors

Table 3: Impact of taekwondo practice (TKD) on the IPAT test between the experimental and control groups.

Variables	Control Group			TKD group			TKD vs. Control Group departing	Global Effect Size
	Pré-test	Post-test	Sig Statistical	Pré-test	Post-test	Sig Statistical		
IPAT Test								
Manifest anxiety	22.1 ± 4.9	27.7 ± 4.3	<0.041	23.7 ± 5.1	15.8 ± 3.4	<0.001	0.168	-0.047
Veiled anxiety	20.25 ± 3.3	25.3 ± 4.1	<0.003	21.55 ± 4.07	16.5 ± 2.8	<0.001	0.159	0.203
totals	42.3 ± 8.2	52.55 ± 8.4	<0.001	45.2 ± 9.1	32.3 ± 6.2	<0.001	0.093	4.63

Mean values and standard deviations (S.D) of psychological test (IPAT test) before and after the intervention, their statistical significance and the overall size of their effects (ES)

comparable to clinically diagnosed adolescents. Limitations with the present study is the cross sectional design which means that no implications about causation and future prediction can be made [41]. Further, since the data are collected in a community-based sample with self- and parent-reported measures, we can only talk about symptoms of ADHD and anxiety. The results can therefore not be generalized and used in clinical settings. Thus, since we have used a normative sample, the results are valuable in the sense that it gives information about how it might look in reality. Lastly, since the anxiety measure is a parent-reported measure and feelings of anxiety are internalized feelings, the results may not reflect the adolescents' feelings of anxiety fairly [42]. Thus, in future research, validation with self-report measures are needed. Strengths with this study are that it was conducted in a normative community-based sample. The sample further consisted of forty adolescents, including both boys and girls in ages 14-18.

The gist of this sample is that it is a representative sample of adolescents. The conclusions made in this study may therefore be applied and generalized to normal populations of adolescents and in Tunisian context. Another strength with this study is that previous research on adolescents with concurrent ADHD and anxiety are rather unexplored, meaning that our study adds valuable information which can be used in future research, and in intervention and treatment. Further, no study examining this unique group on outcomes like ADHD and anxiety has been done in a Tunisian context before. Therefore, strengths with the present study are that our findings support that this group do exist. Future research examining alternative interventions and treatment for adolescents with ADHD and anxiety is needed. That group of youth may worsen the treatment outcome [43].

Psychotherapy has been found to be a successful treatment for adolescents with ADHD since the ability to self-reflect develops during adolescence [44]. Further, treating youth with symptoms of ADHD and anxiety have been suggested to depend greatly on habituation. The habituation is suggested to require uninterrupted contact with the identified "anxiety-source" to successfully reduce anxiety symptoms [45]. Based on these findings we can assume that anxious adolescents with ADHD may be in need of different treatment approaches. Also, research conducted using a longitudinal study design would be essential in the development of prevention and treatment since it gives information about direction and causation on external variables [26]. Hence, symptoms in adolescents with ADHD should be considered in intervention and treatment that is based on individual differences in the disorder.

CONCLUSION

In summary, it appears that Taekwondo's MTP intervention program can help ADHD adolescents improve their overall behavior and improve their academic performance. ADHD is manifested by short periods of attention, excessive energy and an inability to control impulsive behavior. Together, these symptoms negatively affect the performance of adolescents with ADHD. Their inability to adequately focus on school tasks results in poor academic performance and anxiety, which leads to frustration among adolescents, parents, and educators, compounding the initial problem. Taekwondo training focuses on concentration in a number of ways, including the need to practice a technique or a set of techniques over and over again to perfect it. This

increased ability to focus is gradually being developed, just as young practitioners learn to learn in small steps and look forward to small achievements. These "mental" benefits are the "cherry" on the broader benefits of Taekwondo's MTP intervention program, which help teens and thus improve their mood, health and oxygenated brain. Research is also underway on the impact of Taekwondo practice on the treatment and reduction of anxiety and violence in adolescents with ADHD. Taken together, the physical and mental benefits of Taekwondo has the potential to treat the symptoms of ADHD, anxiety, and other behavioral problems, without resorting to medications and its harmful side effects.

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