ATLANTIS PRESS

Advances in Social Science, Education and Humanities Research, volume 362

5th International Conference on Physical Education, Sport, and Health (ACPES 2019)

The Effects of 2 Type SAQ Training on Primary School Students' Physical Fitness and Cognitive Function

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***Abstract*—The aim of this research was to evaluate two kinds of SAQ training for elementary school children on physical fitness and cognitive function. One hundred and twenty children were allocated equally to three groups: a control group (C), the SAQ of hand (SAQ-H), and the SAQ of leg (SAQ-L) groups. All participants were measured Trail Making Test A and B (TMT A & B), run 20-meter dash, Shuttle and Zig-Zag Run, Zig-Zag Run, a reaction time of hand and leg, and coordination. The C and SAQ-H groups had a significant difference in hand reaction time and coordination. The C and SAQ-L groups had a significant difference in coordination. There was no significant difference between groups for TMT A&B, run 20-meter dash, Shuttle and Zig-Zag Run, and Zig-Zag Run. The C group had increased significantly in some dependent variables after training. The SAQ-H and the SAQ-L groups had significantly increased in almost dependent variables after training. In conclusion, there was no important distinction between SAQ-H and SAQ-L in the enhanced physical fitness and cognitive function of elementary school students. However, the SAQ-H and SAQ-L could improve primary school students ' physical fitness and cognitive function.**

Keywords— SAQ, physical fitness, cognitive function

I. INTRODUCTION

A study found that participation in sports and exercise of children and youth in Thailand has a number less than it should be, only 26.1 percent [1]. Children is a childhood that is appropriate to the activity learning about the different forms of movement and development of physical fitness that should help develop children's intelligence at the same time. Studies have shown that exercise is an activity that benefits the body and mind by exercising leads to a better mood, increases cognitive function includes memory, concentration, perception, behavior, and expression, including the high level of brain function [2]. Executive Function is to think, solve a problem, decision making and better planning [3]-[5]. The exercise also led to an improvement of the brain function [5]. The study found that athletes who are exercised for more than 20 minutes increased the working memory, both easy workouts such as Simple Reaction Time and the complex workouts such as Choice Reaction Time, at the end of the workout until within 1hour after workouts [6]. The enhanced brain mechanism is presumed to be the result of increased blood flow to the brain. It also may be the result of the increased of Catecholamine and Endorphin in some areas of the brain [7]. which automate the process of attention and learning better.

Exercise for developing physical fitness and intelligence to children can be made in many forms; however, the development of physical fitness should be focused on speed, agility, and quickness (SAQ). SAQ training is a method commonly used for physical fitness development in terms of speed, agility and quickness, including nervous system development. This training may cover the entire area of intensity of training, from low to high intensity. It removes mental blocks and thresholds and enables the athlete to exert maximum strength during regulated and balanced patterns of motion [8]. Speed was regarded as a single entity for a lengthy time: how far an object soon gets from point A to B. Agility is strongly linked to equilibrium because athletes need to control changes in the center of gravity of the body while subjecting them to postural deviation. [9]. Quickness relates to velocity of response and velocity of acceleration in the first steps [10]. [11] cites 4 agility aspects such as equilibrium, coordination, programmed and random agility, all of which are used in the SAQ training with adequate volume and intensity in terms of athletes ' age and motor readiness level.

Therefore, researchers are interested in studying the growth of children's physical fitness and cognitive function by using the SAQ training 2 formats to practice the exercises. The first format is SAQ training of hand and the second format is the SAQ training of leg. Students in SAQ practice are hypothesized to have important improvements in all factors relative to those in the control groups.

II. METHODS

A. Participants

The amount of respondents was based on the power analysis of the application factor (3 levels), the pretest factor (2 levels) and the pretest action interaction effect. A medium effect size (Cohen's f=.3) was assumed for the interaction group because intervention and true-control groups were

This research was founded by department of sport science, faculty of physical education, Srinakharinwirot University

compared. Setting a power of 0.80, the effect size of 0.3, and an alpha level of .05 for the main and interaction effects, 36 participants per group were required. One hundred and fourteen male and female primary school children participated were divided into three groups, the SAQ of hand (SAQ-H) group, the SAQ of leg (SAQ-L) group and a control group. The SAQ-H contained 40 male and female participants (10.5±0.5 years; 40.0±10.0 Kg; 144.2±7.2 cm), the SAQ-l included 37 male and female participants (10.7±.5 years; 40.7±10.8 Kg; 146±8.6 cm) while the control group included 37 male and female participants (10.5±0.5 years; 40.37±13.57 Kg; 144.2±7.7 cm). The respondents were allocated to each group on a random basis. A three-group, repeated (pre- and post-test) design was used to explore the impacts of SAQ practice on physical fitness and cognitive function parameters in male and female primary school kids. Physical fitness variables include run 20-meter dash, Shuttle and Zig-Zag Run, and Zig-Zag Run, and cognitive function variables include Trail Making Test A and B (TMT A & B), a reaction time of hand and leg and coordination. At baseline and after the 8-week training intervention, all the parameters were measured.

The SAQ-H and SAQ-L groups carried out 8 weeks of SAQ of hand and leg training, respectively, 3 times a week. The control group did not receive any treatments, but they participated in normal physical education classes one hour a week and were tested on the dependent variables. Before data collection, written informed consent was obtained from all subjects, and the investigation was approved by the university's Institutional Review Board for the Protection of Human Subjects (SWUEC/X-156/2561).

B. Procedure

The participants were divided into 3 groups: the SAQ-H, the SAQ-L intervention, and the Control group. All participants undertook: 1) a TMT A and B tests, 2) reaction time of the hand and leg tests, 3) coordination test, 4) a run 20-meter dash test, 5) Shuttle and Zig-Zag Run test, 6) Zig-Zag Run test. The tests were performed in the above order to enable proper cognitive function and physical fitness evaluation uninfluenced by SAQ tests. Two types of trail making tests, the reaction time of hand and leg, and coordination were used to test cognitive function. Run 20-meter dash, Shuttle and Zig-Zag Run, and Zig-Zag Run were used to evaluate SAQ as indicators of the rise in the physical fitness level of the participants. At baseline and after 8 weeks each test was conducted. All evaluations were conducted simultaneously by the same investigator on the same day.

The SAQ-H and the SAQ-L groups trained three times a week on non-consecutive days using the protocol shown in Table 1, while the control group continued their normal daily routine without any structured training activities, but participated in PE classes one hour a week.

C. Data Analysis

Using SPSS version 21.0 for Windows (SPSS, Inc, Chicago, IL) software, data analysis of the differences between and within groups was performed. The results were provided with means and standard deviations for the measurements of the 2 settings. Test of normality for the data has been performed Shapiro-Wilk Test. In order to assess the effects of training methods (3 levels) and time (2 times) on all dependent variables, multivariate analysis of variance (MANOVA) was used. Significant interaction effects were followed up with one-way ANOVA and dependent samples t-tests. The Bonferroni method of post hoc analyses was used for a comparison between the 3 groups. The level of significance for all statistical analyses was set at $\alpha < .05$.

III. RESULTS

MANOVA presented that there was a significant interaction effect of time by training methods for the Trail Making Test B (TMT B), run 20 meter dash, Shuttle and Zig-Zag Run, Zig-Zag Run, hand and leg reaction time, and coordination (all, $p < .05$); but not for Trail Making Test A (TMT A) ($p > .05$). The main effect of training methods was not significant for TMT A, but the main effect of time periods was significant (Table 2).

To follow up the interaction effect of time by training methods, One-way ANOVA was used for the TMT B, run 20-meter dash, Shuttle and Zig-Zag Run, Zig-Zag Run, reaction time (hand and leg), and coordination; see Table 2. The main effect of training methods was significant for Zig-Zag Run, reaction time (hand), and coordination (all, $p < .05$), but not for TMT B, run 20-meter dash, Shuttle, and Zig-Zag Run, and reaction time (leg); see Table 2. Multiple comparisons presented that the control and the SAQ of leg (SAQ-L) groups and the Control and the SAQ of hand (SAQ-H) groups had a significant difference in Zig-Zag Run (all, $p < .05$), but not for the SAQ-H and SAQ-L groups. The control and SAQ-H groups had a significant difference in reaction time (hand); all, $p < .05$; but not for the control and SAQ-L groups and the SAQ-H and SAQ-L groups. The control and SAQ-H groups and the control and SAQ-L groups had a significant difference in coordination (all, $p < .05$), but not for SAQ-H and SAQ-L groups.

To follow up the interaction effect of time by training methods, paired sample t-tests were used for the TMT B, run 20-meter dash, Shuttle and Zig-Zag Run, Zig-Zag Run, reaction time (hand and leg), and coordination (see Table 3). The control group had TMT B, Shuttle and Zig-Zag Run, Zig-Zag Run, and coordination at posttest better than pretest (all, $p < .01$), but there were no significant difference of run 20-meter dash and reaction time both hand and leg (all, $p > .05$). The Hand group had TMT B, run 20-meter dash, Zig-Zag Run, reaction time (hand), and coordination at posttest better than pretest (all, $p < .01$); but there was no significant difference of Shuttle and Zig-Zag Run and reaction time of leg (all, $p > .05$). The Foot group had TMT B, run 20 meter dash, reaction time (leg), and coordination at post-test higher than pretest (all, $p < .01$); but there was no significant difference for Shuttle and Zig-Zag Run, Zig-Zag Run, and reaction time of hand (all, $p > .05$)

TABLE I. SAQ OF HAND AND LEG TRAINING PROTOCOL

SAQ-H				
	W1-2	***W3-4***	***W5-6***	***W7-8***
Exercise	- Throw the tennis ball flipped over face up hand-picked. - Throw the tennis ball touches the wall, face-up hand-picked. - Throw the tennis ball touches the wall, upside down hand-picked. - Tap 3 bottles.	- Throw the tennis ball, touch the wall with hand, face-up hand-picked. - Throw the tennis ball, touches the wall with both hands, face up hand-picked. - Throw the tennis ball touches the wall with both hands, upside down hand-picked. - Tap 4 bottles.	- Throw the tennis ball, touches 2 bottles with hand, face-up hand-picked. - Throw the tennis ball touches the wall switch hands, face up hand-picked. - Throw the tennis ball touches the wall switch the hands, upside down hand-picked. - Tap 3 bottles of switch hands.	- Throw the tennis ball, touches 3 bottles with hand, face-up hand-picked. - Throw the tennis ball touches the wall switch hands, face up hand-picked. - Throw the tennis ball touches the wall switch the hands, upside down hand-picked. - Tap 3 bottles of switch hands.
	4 set / 45 second	4 set / 45 second	4 set / 45 second	4 set / 45 second
SAQ-L				
	W1-2	***W3-4***	***W5-6***	***W7-8***
Exercise	- Dribbling the soccer ball cross the cone to the front. - Dribbling the soccer ball cross the cone to the side. - Dribbling the soccer ball cross the cone backward. - Jumping with the ankle.	- Dribbling the soccer ball cross the cone forward. - Dribbling the soccer ball cross the cone to the side. - Dribbling the soccer ball zig-zag cross the cone forward. - Dribbling the soccer ball the triangle format forward.	- Dribbling the soccer ball cross the cone to the side. - Dribbling the soccer ball cross the cone backward - Dribbling the soccer ball the triangle format backward. - Dribbling the soccer ball zig-zag cross the cone forward.	- Dribbling the soccer ball the triangle format forward - Dribbling the soccer ball zig-zag cross the cone forward. - Dribbling the soccer ball zig-zag cross the cone to the side. - Dribbling the soccer ball zig-zag cross the cone backward.
	4 set / 45 second	4 set / 45 second	4 set / 45 second	4 set / 45 second

TABLE II. MANOVA RESULTS FOR THE TIME BY TRAINING METHODS FOR DEPENDEN VARIABLES

Variables	**Pretest**				**Posttest**			***p***	***p***	***p***
	Control ***M (S.D.)***	***SAQ-H*** ***M (S.D.)***	***SAQ-L*** ***M (S.D.)***		***Control*** ***M (S.D.)***	***SAQ-H*** ***M (S.D.)***	***SAQ-L*** ***M (S.D.)***	**Time x Training methods**	**Time**	**Training methods**
TMT A	34.16 (12.96)	34.09 (10.30)	33.54 (8.44)		28.16 (8.56)	28.92 (10.65)	28.59 (6.16)	.85	**.00**	.55
TMT B	73.43 (29.86)	70.58 (34.31)	67.80 (24.56)		53.27 (18.06)	54.56 (16.05)	58.09 (23.13)	**.02**	.00	.80
20 meter dash	4.48 (.52)	4.69 (.59)	4.41 (.46)		4.38 (.41)	4.29 (.44)	4.23 (.65)	**.00**	.00	.47
SZZR	9.48 (1.06)	9.02 (.95)	11.71 (14.65)		9.03 (.86)	8.86 (.95)	9.29 (.99)	**.03**	.00	.21
ZZR	23.45 (2.33)	22.78 (2.09)	22.18 (2.07)		21.79 (1.80)	21.62 (1.99)	21.98 (2.14)	**.00**	.00	.44
RT-H	0.70 (.15)	0.74 (.17)	0.70 (.16)		0.71 (.12)	0.60 (.09)	0.66 (.10)	**.00**	.00	.39
RT-L	0.38 (.08)	0.39 (.13)	0.33 (.09)		0.40 (.10)	0.39 (.11)	0.38 (.09)	**.02**	.01	.14
Coordination	20.10(4.28)	22.48 (6.02)	22.51 (5.78)		15.84 (4.83)	9.95 (1.51)	11.07 (2.14)	**.00**	.00	.02

TABLE III. PAIRED-SAMPLE T-TEST AND ONE-WAY ANOVA RESULTS TO FOLLOW-UP THE INTERACTION EFFECT

Variables	**Pretest**				**Posttest**			***p***
	Control ***M (S.D.)***	**SAQ-H** ***M (S.D.)***	**SAQ-L** ***M (S.D.)***		**Control** ***M (S.D.)***	**SAQ-H** ***M (S.D.)***	**SAQ-L** ***M (S.D.)***	**ANOVA**
TMT B	73.43 (29.86)	70.58 (34.31)	67.80 (24.56)		53.27 (18.06)**	54.56 (16.05)**	58.09 (23.13)**	.51
20 MD	4.48 (.52)	4.69 (.59)	4.41 (.46)		4.38 (.41)	4.29 (.44)**	4.23 (.65)*	.68
SZZR	9.48 (1.06)	9.02 (.95)	11.71 (14.65)		9.03 (.86)**	8.86 (.95)	9.29 (.99)	.14
ZZR	23.45 (2.33)	22.78 (2.09)	22.18 (2.07)		21.79 (1.80)**	21.62 (1.99)**	21.98 (2.14)	**.02**
RT-H	0.70 (.15)	0.74 (.17)	0.70 (.16)		0.71 (.12)	0.60 (.09)**	0.66 (.10)	**.01**
RT-L	0.38 (.08)	0.39 (.13)	0.33 (.09)		0.40 (.10)	0.39 (.11)	0.38 (.09)**	.31
C	20.10(4.28)	22.48 (6.02)	22.51 (5.78)		15.84 (4.83)**	9.95 (1.51)**	11.07 (2.14)**	**.00**

* Significant difference pretest-posttest at .05; ** Significant difference pretest-posttest at .01

20 MD = 2o meter dash, SZZR = Shuttle and Zig-Zag Run, ZZR = Zig-Zag Run, RT-H = Reaction time (hand), RT-L = Reaction time (leg), C = Coordination

IV. DISCUSSION

This research showed that there were beneficial impacts on cognitive function and some physical fitness for 8 weeks of SAQ practice. The SAQ-H training had significantly increased in TMT A&B, run 20-meter dash, Zig-Zag Run, the reaction time of the hand, and coordination, excepted Shuttle and Zig-Zag Run, and reaction time of leg. The SAQ-L training had significantly increased in TMT A&B, run 20-meter dash, Zig-Zag Run, and coordination. We also found that the control group had significantly increased in TMT A&B, Shuttle and Zig-Zag Run, and Zig-Zag Run, and coordination after training. To compare between groups, this research showed a better reaction time and coordination of the SAQ-H training compared to the control group. Compared to the control group, SAQ-L training had better

coordination. However, both SAQ training formats and the control group had similarly of TMT A&B, run 20-meter dash, Shuttle and Zig-Zag Run, and Zig-Zag Run.

This study found a significant difference in Zig-Zag run, the reaction time of the hand, and coordination between groups. This outcome was comparable to earlier research that discovered the advantages of physical activity and brain development [12]-[13]. Exercise influences memory and behavior in the classroom positively [14]. However, this study did not find a significant difference in cognitive function between groups and other physical fitness variables after training. We suggest that because the students in the control group received training in physical education classes; therefore, they may increase their physical fitness and cognitive function.

This study showed that SAQ-H training could increase cognitive function (TMT A&B), run 20-meter dash, Zig-Zag Run, the reaction time of the hand, and coordination. The SAQ-L training had significantly increased in cognitive function (TMT A&B), run 20-meter dash, Zig-Zag Run, and coordination. These are comparable to prior research that discovered that SAQ training in athletics could increase speed, agility and quickness in athletics [9][15]. In addition, [16] discovered that SAQ training had an important impact on basketball athletes' velocity, agility and efficiency. Reference [17] found similar results that speed and agility were developed significantly as a result of the SAQ training.

We also found that students in the control group had significantly increased in cognitive function (TMT A&B), Shuttle and Zig-Zag Run, and Zig-Zag Run, and coordination after training. Children in the control group participated in PE classes one hour a week and were not controlled for physical activity. Thus, they may increase physical fitness and cognitive function by those activities. A research conducted by reference [18] discovered that kids were involved in physical exercise for 1-3 hours a week and tended to show greater consciousness. If children participated in regularly physical activity, they tended to have development in memory and physical fitness.

V. Conclusion

The present findings show that the SAQ-H and SAQ-L were not substantially different for elementary school learners in enhanced physical fitness and cognitive function. The SAQ-H and the SAQ-L could improve primary school students ' physical fitness and cognitive function. This finding suggests that SAQ of hand and leg training may be useful for elementary school students who require improved physical fitness and cognitive function.

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