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Original article:

Stretching Exercise Enhance Cognitive Function

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ABSTRACT

BACKGROUND: Cognation is very important mental function. Scientists are trying to improve cognation by different ways. Exercise Scientist also started experimenting with the use of different exercises.

AIM: To observed the changes of Cognitive Function after Stretching Exercise.

METHOD: Male adolescence Twenty one(N-21) subjects were collected from nearby areas. The age range was 12 to 19 years(Mean age 16 years) and all are reported healthy. Before collecting their data their parents had been informed and subjects were oriented about the stretching exercises and the neuro cognitive test procedure. Then after only the willing subject was accommodated in the final study. This study was approved by the Institutional Research Board and University Grant Commission Government of India. Three separate rooms were used for this study. In room number- one subject was taking rest before their data collection. Room number-two laboratory setup was organized for the authentic and accurate data. Room number- three was used for stretching exercise purpose. Then the CNS Vital Sign test was conducted and cognitive flexibility, motor speed, executive function, processing speed, neurocognative index was measured. For stretching exercise standard exercise procedure was followed. Statistical analysis was performed by using Microsoft Office Excel Worksheet (version2010). To analysis those data, Mean, SD and Dependent t-test were calculated.

RESULTs: Before stretching exercise the Cognitive Flexibility was 62.9 and after stretching exercises it was 80.1(27.3%). Motor Speed Before stretching exercise the motor speed was 97.4 and after stretching exercises it was increased in 101(3.27%). Executive Function Before stretching exercise the executive function was 65.6 and after stretching exercises it was increased in 81.6(10.3%). Processing Speed Before stretching exercise the processing speed was 76.5 and after stretching exercises it was increased in 84(10.3%). Neurocognitive index Before stretching exercise the neurocognitive index was 70.7 and after 40 exercises it was increased 79.5(12.4%).

All five tests were significantly improved.

CONCLUSION: Acute stretching exercise enhance cognitive function in adolescence period, may be due to enhancement of DMN, Hippocampus activity, dopamine activity and gyrus activity in brain.

KEY WORD: Stretching Exercise; Neurocognitive Index; Adolescence.

INTRODUCTION

World Health organization identified ten to nineteen years as an adolescences period. Many schools also supported the same length of period of adolescence[12,13]. This are also called as schooling age and cognitive development age. However the

different social factors in this modern era disturb the cognitive function. It has been reported that 12.8% below 16 years Indian young people suffering from mental disorders. In the same age other developed and under developed countries reported similar tradition i.e. Japan 15%; Germany 20.7%;USA21%; Spain21.7%; Switzerland, 22.5% ; Ethiopia, 17.7% [22]. Majority of the mental disorder related with cognitive function as identified by the researcher. All over the world a group of scientist are engaged themselves to search some method for the improvement of mental disorders and specially the cognitive function.Regular physical exercise can restrict mental disorder. Exercise has the ability to enhance brain Plasticity (Functional Flexibility) and encoding in a manner that may translate directly in to structural change of neurons and synapses [23]. Exercise increased neurogenesis (Increase of new nerve cell) and this is one of the function (21). Exercise also increased Synaptogenesis (Increase of synaptic function) and Angiogenesis (formation of new blood vessels) [15,16,5,2]. Brain derived neurotrophic factor (BDNF) [3,11], Dopamine, Galanin are increased after regular exercise[3,11]. All this mechanisms supported the structural changes of brain which improve the functional quality of brain. The aim of the present study was to observe the cognitive changes after a single bout stretching exercise protocol in a healthy male adolescence group.

METHOD

SUBJECT: This research work was conducted in the Exercise and Sports Physiology Laboratory, Department of Physical Education, Visva-Bharati University, Santiniketan, Birbhum- 731235, West Bengal, India. Male adolescence subjects (N-21) were collected from nearby areas. The age range was 12 to 19 years and all are reported healthy. Before collecting their data their parents had been informed and subject was oriented about the stretching exercises and the neuro cognitive test procedure. Then after only the willing subject was accommodated in the final study. This study as approved by the institutional research board and university grant commission government of India.

LABORATORY SETUP:

In the present study three separate rooms were used. In room number, one subject was taking rest before their data collection. Room number two laboratory setup was organized for the authentic and accurate data. Dim light and moral less sound proof room was used to collect the cognitive function data. At a time one subject was allowed in the laboratory room. Room number three was used for stretching exercise purpose. This room also a noise free medium lighted temperature controlled (25°C - 30°C).

MEASURES:

To measure the cognitive function computerized neuro psychological test (CNS Vital Sign). This test was recommended by the scientist all over the world for the measurement of cognitive functions. In this test battery total 16(sixteen) parameters can be measured and it will take at least 40 minutes time to complete one round of test. Subjects were performed the test before the stretching exercise and immediately after the exercise.

TEST PROCEDURE:

After entering into the laboratory the subject was sited quietly and the qualified tester explain the procedure of the test in detail. Then the CNS Vital Sign test was conducted according to their standard procedure explain in the company manual and other

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research papers. The tester also learned this test procedure from qualified bio medical engineer provided by the company. In the following, the detail procedure of five identified cognitive function areas- cognitive flexibility motor speed, Executive Function, Processing speed and Neuro cognitive Index(NCI) was mentioned for ready references.

Cognitive Flexibility: Cognitive flexibility was measured by 'Stroop Test'. Stroop test has three parts. In the first part, the words RED, YELLOW, BLUE, and GREEN (printed in black) appear at random on the screen, and the subjects presses the space bar as soon as sees the word. In the second part, the words RED, YELLOW, BLUE, and GREEN appear on the screen, printed in color. The subjects presses the space bar when the color of the word matches with the word. In the third part, the words RED, YELLOW, BLUE, and GREEN appear on the screen, printed in color. The subjects presses the space bar when the color of the word does not match with the word.

Motor Speed: Motor Speed was measured by 'Finger Tapping Test' (FTT). FTT test requires subjects to press the Space Bar with their right index finger as many times as they can in 10 seconds. They do this once for practice, and then there are three test trials. The test was repeated in the left hand too.

Executive Function: Executive Function was measured by 'Shifting Attention Test'(SAT)**.** SAT test was a measure of ability to shift from one instruction set to another quickly and accurately. Subjects are instructed to match geometric objects either by shape or by color. Three figures appear on the screen, one on top and two on the bottom. The top figure is either a square or a circle. The bottom figures were a square and a circle. The figures were either red or blue (mixed randomly). The participant was asked to match one of the bottom figures to the top figure. The rules change at random (i.e., match the figures by shape, for another, by color).

Processing Speed: Processing Speed was measured by 'Symbol Digit Coding test'(SDC). SDC test consists of serial presentations of screens, each of which contains a bank of eight symbols above and eight empty boxes below. The subjects types in the number that corresponds to the symbol that is highlighted. Only the digits from 2 through 9 are used; that was to avoid the confusion between "1" and "I" on the keyboard. The computer program does not allow a person to use a numerical pad preventing a distinct advantage for those who are skilled at using the numerical pad or for those that are right- versus left-handed.

Neurocognition Index (NCI): The NCI was measured by taking all CNS vital sign,2016 parameters means score.

EXERCISE PROTOCOL:

Stretching exercise protocol was selected from a internationally recognized authentic scientific sources (1). The scholar himself an exercise expert, practice these selected protocol and trained two other junior research scholars for smoothly conducting the whole program. For stretching exercise one special room was utilized with an ambient fresh atmosphere. The subjects were performed stretching exercise protocol (Table number-1) after completing the CNS vital sign test for neuro cognitive parameter measures. Some test were conducted in the morning session (7.30am to 8.30 am) and other test were perform in the evening (4.30pm to 5.30pm). Total 20 exercises were performed within 40 minutes of time following all the rules of scientific exercise schedule.

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Table- 1: Stretching Exercise Protocol

Training Schedule of static stretching Exercise:

SL. NO.	**Exercise Name./ Position**	**Zero to final Position/ Execution Time**	**Holding Time/ Intensity**	**Final Position to Zero Position**	**Recovery Time**	**Repetition/ Frequency**	**Total Time/ Duration**
01	Forearm Flexors(Right hand)	5 Sec	10 Sec	5 sec	10 Sec	4 Times	2 Minute
02	Forearm Flexors(Left hand)	5 Sec	10 Sec	5 sec	10 Sec	4 Times	2 Minute
03	Lateral Shoulder(Right hand)	5 Sec	10 Sec	5 sec	10 Sec	4 Times	2 Minute
04	Lateral Shoulder(Left hand)	5 Sec	10 Sec	5 sec	10 Sec	4 Times	2 Minute
05	Triceps Brachii(Right hand)	5 Sec	10 Sec	5 sec	10 Sec	4 Times	2 Minute
06	Triceps Brachii(Left hand)	5 Sec	10 Sec	5 sec	10 Sec	4 Times	2 Minute
07	Hip Flexors(Right leg)	5 Sec	10 Sec	5 sec	10 Sec	4 Times	2 Minute
08	Hip Flexors(Left leg)	5 Sec	10 Sec	5 sec	10 Sec	4 Times	2 Minute
09	Back of the Knee(Right leg)	5 Sec	10 Sec	5 sec	10 Sec	4 Times	2 Minute
10	Back of the Knee(Left leg)	5 Sec	10 Sec	5 sec	10 Sec	4 Times	2 Minute
11	Hamstrings(Right leg)	5 Sec	10 Sec	5 sec	10 Sec	4 Times	2 Minute
12	Hamstrings(Left leg)	5 Sec	10 Sec	5 sec	10 Sec	4 Times	2 Minute
13	Buttocks and Hip(Right leg)	5 Sec	10 Sec	5 sec	10 Sec	4 Times	2 Minute
14	Buttocks and Hip(Left leg)	5 Sec	10 Sec	5 sec	10 Sec	4 Times	2 Minute
15	Achilles Tendon and Posterior Lower	5 Sec	10 Sec	5 sec	10 Sec	4 Times	2 Minute
16	Achilles Tendon and Posterior Lower	5 Sec	10 Sec	5 sec	10 Sec	4 Times	2 Minute
17	Buttocks, Hips, and Trunk(Both leg	5 Sec	10 Sec	5 sec	10 Sec	4 Times	2 Minute
18	Buttocks, Hips, and Trunk(Both leg left	5 Sec	10 Sec	5 sec	10 Sec	4 Times	2 Minute
19	Buttocks, Hips, and Trunk(Both leg	5 Sec	10 Sec	5 sec	10 Sec	4 Times	2 Minute
20	Buttocks, Hips, and Trunk(Both leg left	5 Sec	10 Sec	5 sec	10 Sec	4 Times	2 Minute

Total time= 2 minutes x 20 exercises = 40 minutes

Statistical Analysis:

Statistical analysis was performed by using Microsoft Office Excel Worksheet (version2010). To analysis those data, Mean, SD and Dependent t-test were calculated.

Results and Discussion:

Cognitive Flexibility:

The result of the cognitive flexibility was presented in the Table and Figure number-1. Before stretching exercise the cognitive flexibility was 62.9 and after stretching exercises it was 80.1.

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Table – 1: Cognitive Flexibility

Group		Mean(Score)	SD	P- value	% Difference
Adolescence Group	Pre test	62.9	±25.2	0.000213*	27.3%
	Post test	80.1	±20.9		

*Significant at .05 level

Figure-1

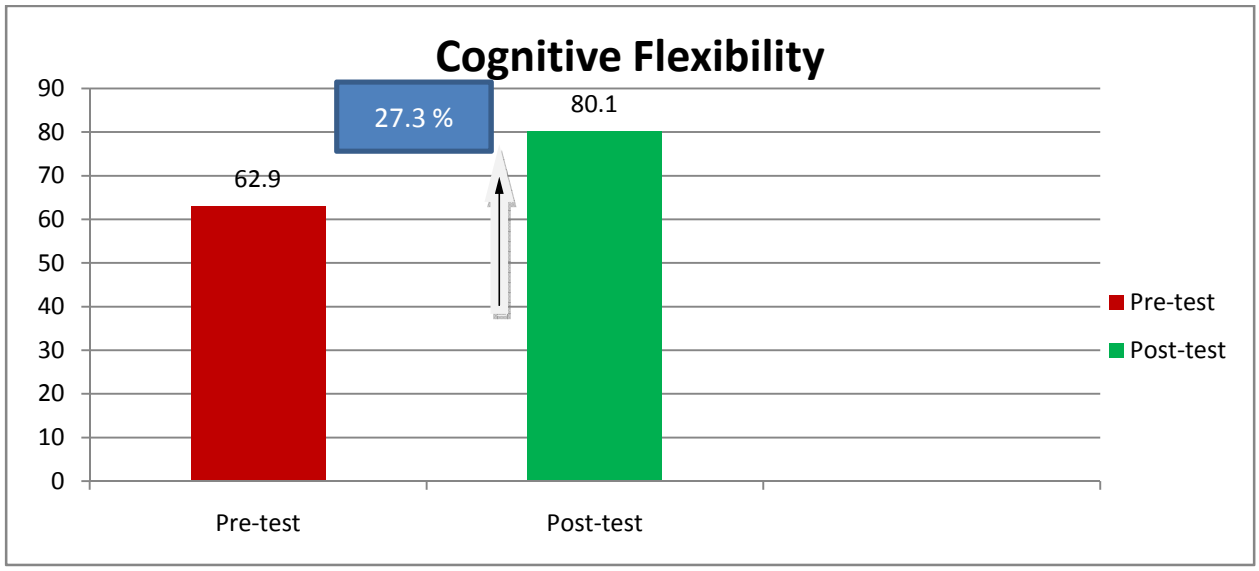

Table & Figure 1 shows Dopamine modulates frontal activity during the performance tasks which can be measures through Stroop Color-Word Test [6]. Increase in cognitive flexibility after stretching exercise. Dopamine activity in frontal lobe may increase cognitive flexibility [6].. Dopamine can measure and perform on behavioral measures of frontal lobe, more specifically on mental flexibility.

Motor Speed:

The result of motor speed was presented in the Table and Figure no -2. Before stretching exercise the motor speed was 97.4 and after stretching exercises it was increased in 101.

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Table – 2: Motor Speed

Group		Mean(Score)	SD	P- value	% Difference
Adolescence Group	Pre test	97.4	±6.24	0.021132*	3.27
	Post test	101	±8.71		

*Significant at .05 level

Figure-2

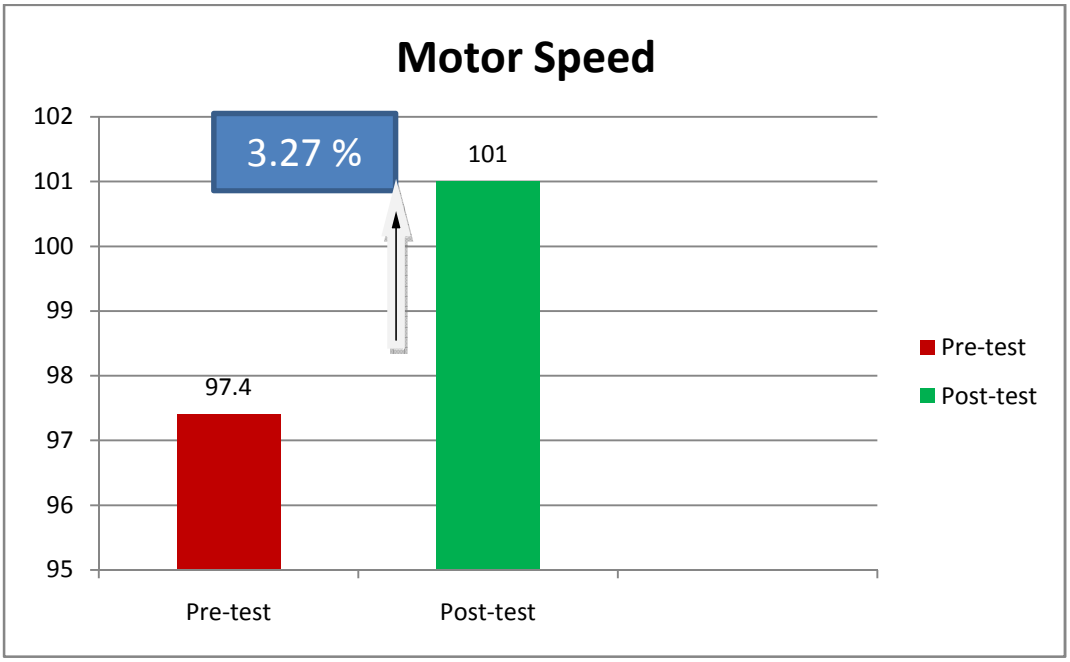

Table & Figure 2 shows increase in motor task after stretching exercise D2 (Dopamine2) receptors associated with the motor task (Finger Tapping Test), which is dependable with the role of dopamine in motor control and regulation [14].

Executive Function:

The result of executive function was presented in the Table and Figure number-3. Before stretching exercise the executive function was 65.6 and after stretching exercises it was increased in 81.6.

Table – 3: Executive Function

Group		Mean(Score)	SD	P- value	% Difference
Adolescence Group	Pre test	65.6	±12.1	0.001194*	10.3
	Post test	81.6	±10.5		

*Significant at .05 level

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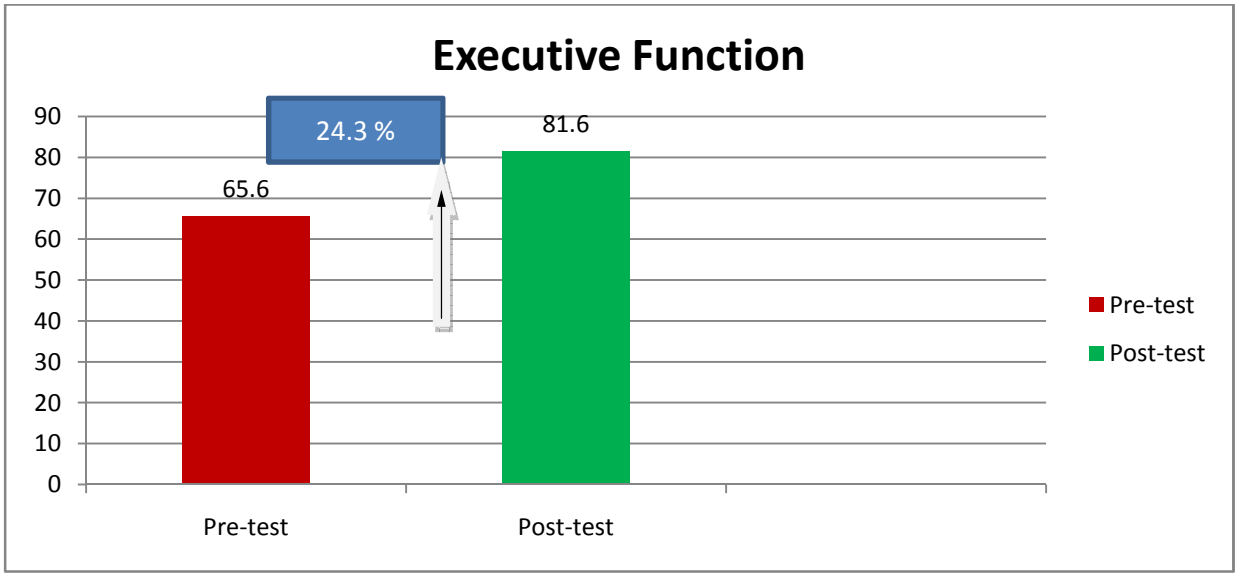
Figure-3



In a combined exercise study, it is stated that aerobic, strength and stretching exercise training together can improve executive function [17].

Table & Figure 3 illustrated an increase in executive function after stretching exercise. The activity of middle frontal gyrus and dopamine in brain regions increases executive function DMN (Default Mode Network) is also associated with increase in executive function. On the basis of these facts, the researcher can predict greater activity in middle frontal gyrus, dopamine and DMN might increase due to stretching exercise. Which was reflected by the increase of executive function.

Processing Speed:

The result of processing speed was presented in the Table and Figure no -4. Before stretching exercise the processing speed was 76.5 and after stretching exercises it was increased in 84.

Table – 4: Processing Speed

Group		Mean(Score)	SD	P- value	% Difference
Adolescence Group	Pre test	76.5	±12.1	0.001194*	10.3
	Post test	84.4	±10.5		

*Significant at .05 level

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Figure-4

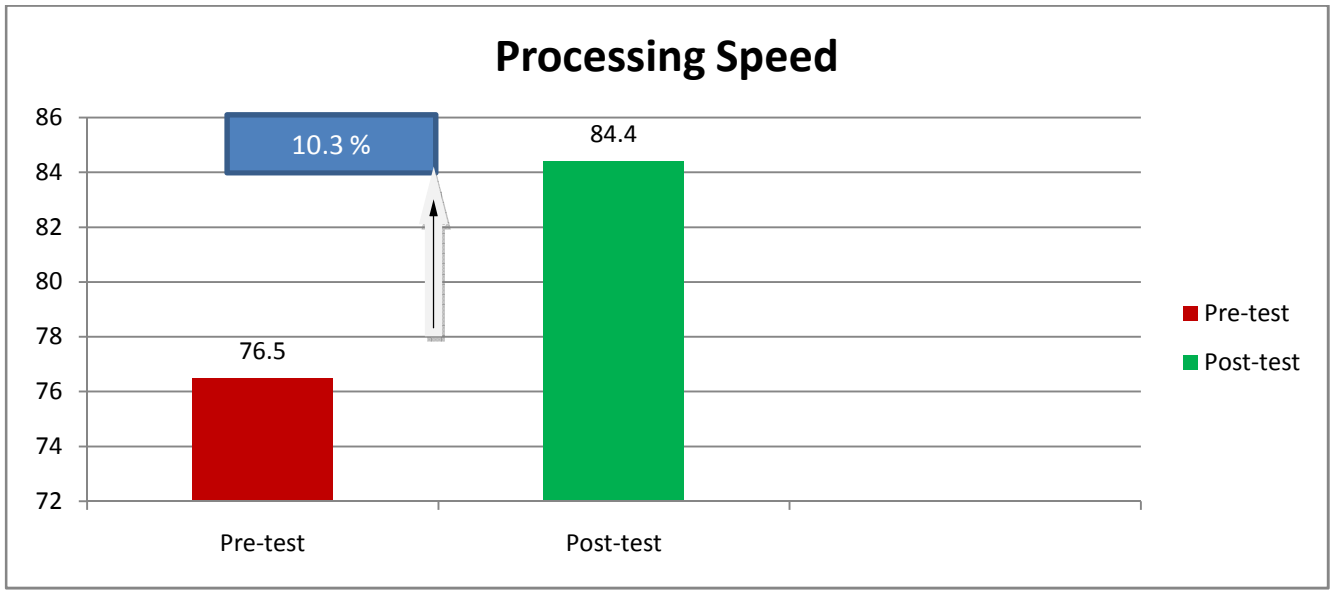


Table & Figure 4 shows improvement of processing speed after stretching exercise. Middle frontal gyrus in the frontal brain region is associated with processing speed. Stretching exercises may increase the activity in the middle frontal gyrus.

Neurocognition Index (NCI):

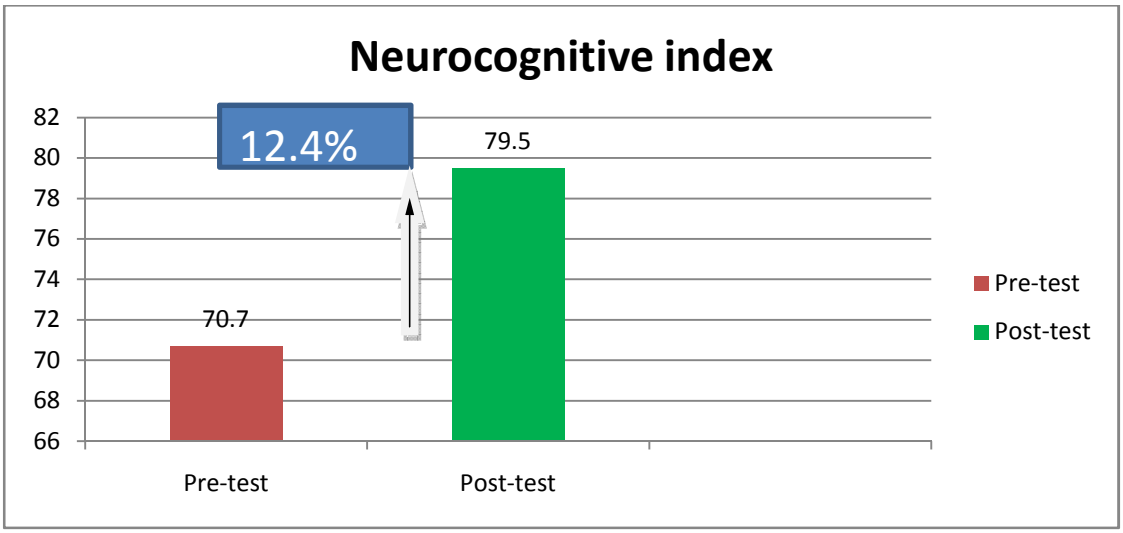
The result of neurocognitive index was presented in the Table and Figure no -5. Before stretching exercise the neurocognitive index was 70.7 and after 40 exercises it was increased 79.5.

Table – 5: Neurocognition Index (NCI)

Group		Mean(Score)	SD	P- value	% Difference
Adolescence Group	Pre test	70.7	±14.5	0.00037*	12.4
	Post test	79.5	±13.6		

*Significant at .05 level

Figure-5



Physical activity was related to cognitive performance ,some experimental studys found that there was a positive relationship between physical activity and cognition or academic achievement of school going children[19].. Exercise may improve neurocognitive performance [4,7,8,9,10].

Table & Figure 5 shows an increase of neurocognition index from pre to post stretching exercise. Improvement of dopamine activity, DMN, Hippocampus activity, and gyrus activity in brain improves Cognitive function after stretching exercise.

Conclusion:

With the limitation of the study the researcher found that acute stretching exercise can enhance cognitive function in adolescence period, may be due to enhancement of DMN, Hippocampus activity, dopamine activity and gyrus activity in brain.

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