

# Effect of step up exercise on cognitive attention with stroop test in Bengali male college students

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## ABSTRACT

**Introduction:** A beneficial influence of exercise on cognitive and brain functions has been established. Exercise is drawing increasing research attention for improving neurocognitive functions. **Aim:** The aim of the present study is to examine the effect of step up exercise on mental attention with stroop test in Bengali male college students. **Methodology:** Twenty eight (28) apparently healthy male sedentary college students from the same socio-economic background, having mean age of  $22.4 \pm 1.02$  years, body height of  $165.3 \pm 6.34$  cm and body weight of  $55.5 \pm 9.01$  kg were recruited for the present study on the basis of random sampling from the undergraduate students of the NS Mahavidyalaya of Tripura. A computer based modified 'Stroop color word' test based on the original Stroop test (Stroop, 1935) to identify cognitive performance. After completion of stroop test in resting sitting condition participants were asked to complete Queen College Step Test to measure  $VO_2$  max. After completion of 3 mins step up exercise a recovery time of 5-15 seconds were taken for  $VO_2$  measurement and immediately after taking recovery pulse participants were asked to perform stroop III subtask to see the effect of exercise on the cognitive performance of the college students of Tripura. **Results:** The mean  $VO_2$  max to be found  $49.1 \pm 6.25$  ml.kg<sup>-1</sup>.min<sup>-1</sup>. The mean time to complete Stroop sub task Tasks III was found  $194.3 (\pm 46.34)$  sec. After 3 minutes step-up exercise it has been shown that the mean stroop III score was improved from  $194.3 (\pm 46.34)$  to  $160.4 (\pm 31.42)$  sec. **Conclusion:** It is observed in the present study that the speed of performance (i.e., stroop tasks) is improved after short term moderate exercise.

**Key words:** Stroop test, Cognitive attention, Step up exercise,  $VO_2$  max, Young adult

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## INTRODUCTION

Many animal studies have reported the beneficial influence of exercise on cognitive and brain functions. Accordingly, exercise is drawing increasing research attention as a possible lifestyle factor for improving neurocognitive functions, and preventing or delaying dementia.<sup>1,2</sup>

So far, the majority of studies have focused on the chronic effects of exercise, while studies on acute exercise effects on cognition have only started to draw growing attention.<sup>3</sup> Recent studies provide evidence that an acute bout of

moderate aerobic exercise improves cognitive performance in a choice reaction task,<sup>4</sup> a simple reaction time task,<sup>5</sup> as well as confliction tasks such as Erikson flanker and Stroop tasks.<sup>6-8</sup>

However, question still arises regarding type of exercise, intensity of exercise and also cognitive tasks assessment during and after exercise.<sup>9,10</sup> Therefore, the aim of the present study was to estimate aerobic power by step up exercise used in Queens's college step test and find out the effect of step up exercise on cognitive attention with stroop test. Queens's college step test is submaximal test by which  $VO_2$  max can be predicted indirectly. It is a widely used test for young adults.

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## MATERIALS AND METHODS

### Participants

Twenty eight (28) apparently healthy male sedentary college students from the same socio-economic background, having mean age of  $22.4 \pm 1.02$  years, body height of  $165.3 \pm 6.34$  cm and body weight of  $55.5 \pm 9.01$  kg were recruited for the present study on the basis of random sampling from the undergraduate students of the NS Mahavidyalaya of Tripura. Prior to initial testing an informed consent were taken after giving a complete explanation of the purposes, procedures and potential risks and benefits involved in the present study. They had a light breakfast 2-3 hours before the test and refrained from any energetic physical and mental activity. The participants had no history of any major diseases like asthma, cardiovascular diseases, neurological disorders, color blindness, etc and did not follow any physical conditioning programme, apart from some recreational sports.

### Experimental design

Age was computed from the date of birth and date of tests. Body weight was taken using a weighing machine when boys were without shoes and wearing minimum clothes. Height was measured by an anthropometric rod. Body Mass Index (BMI) was calculated from height and weight by the following formula:

$BMI = \text{Weight in kilograms divided by the square of the height in meters (kg/m}^2\text{)}$ .

After taking height and weight all participants were tested individually a computer based modified 'Stroop color word' test based on the original Stroop test<sup>11</sup> to identify cognitive performance of mental attention. Actually three subtasks (Task I, Task II & Task III) of Stroop tests were executed. However for comparison only Sub Tasks III was considered. After completion of stroop test in resting sitting condition participants were asked to complete Queen College Step Test<sup>12</sup> to measure  $VO_2$  max. After completion of 3 mins step up exercise a recovery of 5-15 seconds were taken for  $VO_2$  measurement and immediately after taking recovery pulse participants were asked to perform the stroop III subtask to see the effect of exercise on the cognitive performance of the college students of Tripura. All the tests were performed in the Department of the Human Physiology, NS Mahavidyalaya.

### Stroop test

A computer based modified 'Stroop color word' test based on the original Stroop test<sup>11</sup> were used to check the cognitive performance. This Stroop test version consists of three subtasks (Sub Tasks I, II, III) on three slides made

in the Microsoft PowerPoint 2010 version. The stimulus material for each of these subtasks is shown on a white sheet of paper that is landscape oriented with a 14 size Georgia Font). Screen was set in a normal view.

The 112 stimuli for each subtask are distributed evenly in a 14 X 8 matrix on each power point slide. The first subtask shows color words in random order (red, blue, yellow, green) printed in black ink (noncapital letters). Participants read the all words written in the slides (i.e., 112 nos) correctly as soon as possible. Participants read loudly and if any mistakes occur then he corrects himself and continues without interrupting the test. The examiner closely observed the performance of the participant and time was taken by stop watch. The Subtask II contains color words printed in an incongruous color (noncapital letters), for example, the word Red printed in blue color. Participants were asked to name the colors in which the words are written. In the Subtask III also contains color words printed in an incongruous color (noncapital letters) like subtask II, but participants were asked to read the words first and then name the colors in which the words are written.

The procedure of the tests adopted in the present study was described to all participants. However, they were not allowed to practice it before actual examination. They were seated in a adjustable computer chair and computer screen were set according to their comfortable reading distance.

### Prediction of maximum oxygen uptake capacity ( $VO_2$ max) by the queens college step test (QCT)

The step test was performed on a stool of 16.25 inches (or 41.3 cm) height for a total duration of 3 min at the rate of 24 cycles/min which was set by a metronome. After completion of the exercise, the participants were asked to remain standing and the carotid pulse rate was measured by placing thumb on right side of carotid artery near Thyroid notch from 5 to 20 seconds of the recovery period. This 15 second pulse rate was converted into beats/min and the following equation was used to predict the maximum oxygen uptake capacity.<sup>12</sup>

$$VO_2 \text{ max (ml/kg/min)} = 111.33 - 0.42 \times \text{Heart rate}$$

### Data analysis

The collected data were stored and analyzed by the statistical software (IBM SPSS Statistics for Windows, Version 21). Mean, standard deviation, minimum and maximum value were calculated. For parametric data a student 't' test for paired observations was used to determine whether there is a significant difference between Stroop scores of before and after exercise. The level of significance was set at less than or equal to 0.05 in each analysis.

## RESULTS

Physical variables including VO<sub>2</sub> max performances scores of the participants are given in the Table 1. The mean BMI of the participants are found to have 20.47 ± 2.47. On the other hand mean VO<sub>2</sub> max was found 49.1 ± 6.25 ml.kg<sup>-1</sup>.min<sup>-1</sup>. It has been shown that in the present study the mean time to complete Stroop sub task III was found 194.3 (±46.34) sec.

Comparisons of the effects of exercise on the Stroop III performance score are tabulated (Table 2). After 3 minutes step-up exercise it has been shown that the mean time required for completion stroop task was reduced from 194.3 (±46.34) to 160.4 (± 31.42) sec i.e., about 17 percentage reduction.

## DISCUSSION

The mean BMI of the participants are found to have 20.47 ± 2.47 which is found within normal range as per the WHO criteria i.e. within 18 -25 kg.m<sup>2</sup>.<sup>13</sup> On the other hand mean VO<sub>2</sub> max was found 49.1 ± 6.25 ml.kg<sup>-1</sup>.min<sup>-1</sup> which are found to some extent more as compared to another study done on the Bengali male adults,<sup>14</sup> where it was found 39.3 ml.kg<sup>-1</sup>.min<sup>-1</sup>. As in the present study the VO<sub>2</sub> was measured by indirect way through the submaximal test of queen's college step test. On the other hand Chatterjee et al (2004)<sup>14</sup> measured VO<sub>2</sub> by direct method. This may be the cause of higher VO<sub>2</sub> of the present subject.

It is observed that stroop tasks were getting difficult from Task I to Task III. However, speed of performance

is improved after short term moderate exercise. Recent studies provide evidence that an acute bout of moderate aerobic exercise improves cognitive performance in a Stroop tasks.<sup>6-8,15</sup>

Kashihara et al, 2009<sup>10</sup> pointed out the reasons for improved cognitive function by the exercise seem to be not only the facilitated regional cerebral blood flow and neurotransmitters in the central nervous system (CNS) but also psychological factors. However, the psycho-physiological mechanism causing inverted U relationship between incremental exercise and cognitive performance remains unclear. However, Yanagisawa et al., 2010<sup>15</sup> reported a study on adult human and observed acute moderate exercise elicits increased dorso-lateral prefrontal cortex activation and improves cognitive performance with stroop test.

## CONCLUSION

It is observed in the present study that cognitive attention with stoop test is improved after short term sub maximal step-up exercise in young adults.

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**Table 1: Physical variables including VO<sub>2</sub> max variables of the male young college students (n, 28)**

Measures	Mean±SD (minimum value- maximum value)
Age (yrs)	20.4±1.02 (18.0 – 22.0)
Height (cm)	165.3±6.34 (148.0 – 175.8)
Weight (kg)	55.5±9.01 (43.0 – 90.0)
BMI (kg.m <sup>2</sup> )	20.47±2.47 (18 – 29.2)
VO <sub>2</sub> max (ml.kg <sup>-1</sup> .min <sup>-1</sup> )	49.1±6.25 ( 37.4 – 57.6)

Values are mean±SD (minimum value- maximum value)

**Table 2: Comparisons of the effect of the exercise on the stroop performance scores**

Variables	Before exercise	After exercise
Stroop III (sec)	194.3±46.34 (134.0 – 319.0)	160.4±31.42** (99.0 – 240.0)

Values are mean±SD (minimum value- maximum value); level of significance was done by the t test, for paired observations; \*\*p<0.001, Stroop III- word & color-word score

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**Authors Contribution:**

**PD** – Contributed to the original idea, designed the study, enrolled the subjects, collected the data and analysed, prepared the manuscript and reviewed the manuscript; **SB** and **PB** and **TS** – Contributed to patient enrolment and data collection, data analysis, preparing of manuscript and reviewing the manuscript; **MM** – Contributed to the study design, data analysis, preparing of manuscript and reviewing the manuscript.

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