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Short Communication

Effect of an acute bout strength training on executive function among college students: a pilot study

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ABSTRACT

Executive functions are built such as reasoning, problem solving and planning. Even mild form of executive dysfunction might hamper everyday activities depending on the work and situation, which requires various cognitive domains. Strength exercises are able to increase the anti-inflammatory balance with an increase in cognition and better physical performance. Aim of the study was to evaluate the acute bout effect of strength training on executive function among college students. 10 participants were divided into control and intervention group for experimental study performed at SPB physiotherapy college. Consent was taken from the participants. Only one session of 30 minutes was performed by intervention group. Intervention group performed 10 repetitions of 12 exercise per set and 2 sets per session. Warm up and cool down was performed by participants. Pre and post measures of trail making test B was recorded as outcome measure for executive function. Trail making test score was significantly improved immediately after strength training with p value <0.05 suggesting improvement in executive function. The study concluded that Strength training has greater immediate impact on executive function among college students

Keywords: Executive function, Strength training, Cognition, Exercise

INTRODUCTION

Executive function (EF) skills are the attention-regulation skills that are responsible for sustaining attention, keeping goals and information in mind, refraining from responding immediately, resisting distraction, tolerating frustration, different behaviours and consequences, reflecting on past experiences, and planning future tasks.[1] Core executive functions are inhibition and interference control, working memory, and cognitive flexibility. Inhibition means response inhibition which is self-control. Inhibition can be defined as resisting temptations and resisting acting impulsively. Selective attention and cognitive inhibition together defined interference control. Cognitive flexibility means seeing anything from different perspectives, and quickly and flexibly adapting to changed circumstances.[2]

Strength training has a positive relation with executive functions as it focuses on the core.[3] Physical exercise can directly influence the expression of neurotransmitter and neurotrophic factors, synaptic plasticity, and nerve cell proliferation and influence brain health by modifying inflammatory pathways or cerebral vasculatures. Chang et al stated in their review that resistance exercise training had a potential positive benefit in improving cognitive performance, including memory, attention and execution dimensions of cognitive function, in healthy older adults.[4]

Certain research suggests that some differences in academic performance could arise from interindividual variations in self-regulation mechanisms such as executive function.[5] As academic performance is basically depending on the memory concentration, attention and executive functions.

Aim of the study

The aim of the study was to evaluate the acute bout effect of strength training on executive function among college students.

METHODS

A pilot study was conducted from October 2023 to December 2023 at SPB Physiotherapy College, Surat, Gujarat. Sample was selected on the basis of following inclusion and exclusion criteria. Subject with MMSE score ≥24, age 18 to 25 and willing to do exercise were included in the study. Subjects with neurological or psychological disorders, any musculoskeletal injuries, surgical history within last 6 months and performing any kind of physical activity for more than 30 minutes were excluded from the study. Purposive sampling technique was used to select the sample. Total of 10 samples were divided into 2 groups randomly. There were 5 subjects in each group.

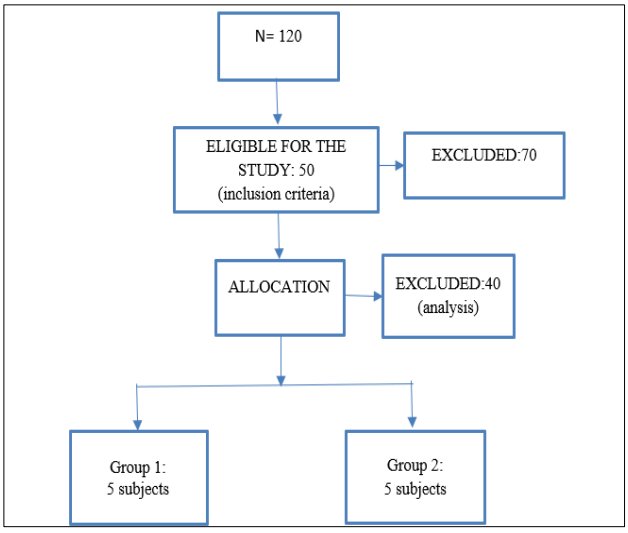

Figure 1: Flowchart of methodology.

Group 1 only performed conventional exercise whereas Group 2 performed conventional and strength training exercises. Only one session of exercise was performed by subjects of both groups. Pre and post measures of trail making test B (TMT B) was performed as an outcome measure of executive function in each group.

Conventional exercises consisted of warm up of neck rotation, arm rotation and spot marching. Session of walk on toes, walk on heels, sideward walking, backward walking, one leg standing and sit to stand exercises.[6] Cool down was performed by stretching of biceps, triceps, hamstring, calf, and quadriceps muscle with 30 seconds hold for 3 repetitions.

Strength training exercises consisted of chest press, pectoral deck, lateral pull, knee extension, crunches, obliques, elbow flexion, lateral lift, hip extension, hip abduction, horizontal led press and Squats.[7] 2 sets of all 12 exercises with 10 repetitions in each set were performed by the subjects.

Statistical analysis

The statistical analysis was performed by Jamovi 2.3.28 software. Normality of the data was checked by Shapiro wilk test. The data was normally distributed so we did parametric test. For within group analysis paired t test was done and Homogeneity of the data was checked. Independent t test was performed for between group analysis.

RESULTS

Demographic details of subjects

There were 10 participants in the study. In group A, 3 females and 2 males were there. In group B, 2 females and 3 males were there. The mean age for group A was 20.6±1.67 and for group B mean score of age was 20.2±1.64.

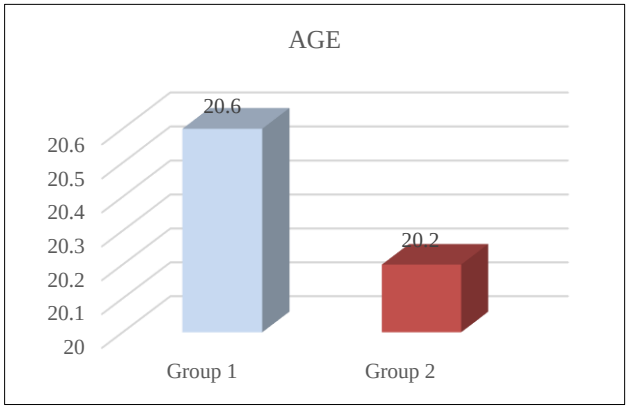

Figure 2: Baseline characteristics of the data.

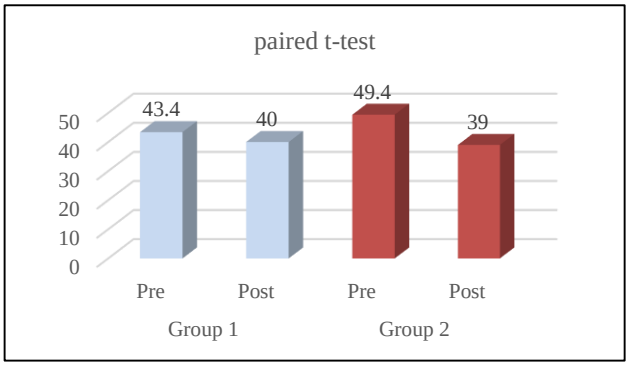

Figure 3: Paired t-test for intragroup comparison between two groups.

The normality of the data was checked by Shapiro Wilk test. Data of the age group followed normality with p value >0.05. The normality of the quantitative data has p value >0.05 which shows that the data is normal.

Intragroup comparison of TMT B in both groups

Paired t test was done to check the intragroup significance of the data. There was significant difference between pre and post-value of group 2 in the score of TMT B with p value of <0.05.

Analysis of intergroup comparison of TMT B in both groups was done by independent t test.

Intergroup comparison of TMT B score between both groups showed a significant difference by p value <0.05.

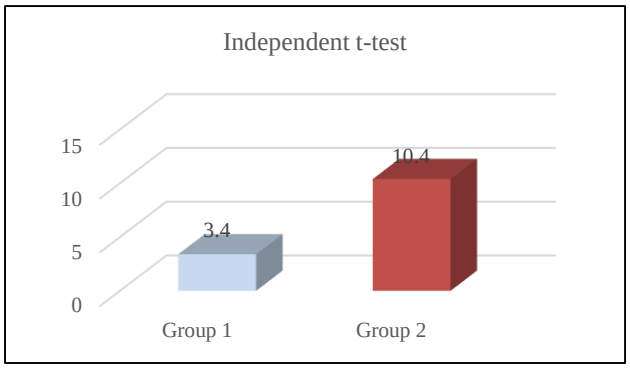

Figure 4: Independent t test for intergroup comparison between two groups.

The result of the paired sample t test showed significant improvement in group 2 (intervention group) pre-post data (p<0.05). The result of the independent t test also showed significant improvement between groups with p=0.009 which is <0.05. So, we can say that there is significant improvement after Strength training in the interventional group as compared to a control group who performed only conventional exercises.

DISCUSSION

There is a significant difference in the score between two groups after strength training program. It shows there is an improvement in the executive function after a single session of strength training among young college students. There can be various physiological theories behind it.

The present study concluded a positive effect of strength training on executive function among college students. The strength training focused on all the major muscles of the body, which may lead to increased blood circulation towards the brain from the periphery, can be the mediator to improve the score of the executive function test. An increase in blood circulation can lead to an increase in brain-derived neuro factors (BDNFs), which are responsible for neural growth stimulation and it can lead to increase cognitive domains of the person.

Study by Kliszczewicz et al. concluded that lower levels of exercise intensity are sufficient enough to elicit a moderate elevation of epinephrine (E) and norepinephrine (NE) in plasma. While maximal exercise intensities elicited a 5-10 time increase in catecholamine levels. It can also stimulate ANS response can lead to improvement in executive functions.[8]

Tsuk et al concluded the improvement in executive function and attention after strength training were previously shown to increase plasma cortisol and noradrenalin levels. The effects of the increased sympathetic system may explain the positive effects of this exercise mode.[9]

Formenti et. al conducted a study to check the effect of acute resistance training on cognitive performance in middle-aged adult. They concluded a positive effect of acute exercises like balance and aerobic training on cognitive performance.[10]

In 2021, Chow concluded that resistance exercise, even when performed acutely, can lead to neuroplastic changes within the central nervous system (CNS) and improve cognitive functioning. Resistance training alone or combined with aerobic exercise is beneficial for improving cognitive function.[11]

The result of a meta-analysis concluded the effect of one session of exercise training on BDNF which explains the improvement regardless of type of exercise but may vary with study duration and across genders.[12]

Limitation

The limitation of the study was that it had small sample size.

CONCLUSION

After analyzing the data of the pilot study and concluded that a single session of strength training is also significantly effective in improving the executive function among young college students. Through this study, a conclusion can be made about the improvement of executive function after acute bout strength training sessions among college students.

Recommendations

An experimental study can be performed with a large sample size. Patients with neurological and psychological diseases may have executive dysfunction compared to normal individuals. We can conduct a study among them to see the effect of an acute bout of strength training. Other age group students can be targeted to see the effect of an acute bout of strength training.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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