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Efficacy of yoga package on cognitive flexibility and attention in university girls: A single group pilot study

Sandeep Singh[1], **Yashi Tyagi**[1]*

[1] *University of Patanjali, Haridwar, Uttarakhand, India*

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ABSTRACT

Background: Executive functions and attention are key indicator of cognitive health. Cognitive flexibility, the ability to flexibly switch between tasks, is a core dimension of executive functions. Yoga helps to improve mental wellness, which consequently provides cognitive flexibility.
Aim: This study aimed to determine the effect of yoga on cognitive flexibility and attention in university girls.
Materials and Methods: Thirty healthy university girls (group mean ± SD; 18.27 ± 1.44) were enrolled as participants in the study. Trail Making Test (TMT) parts A and B were used to assess their cognitive flexibility whereas sustained attention was determined using Six Letter Cancellation Test (SLCT). The assessments were taken at baseline and after three months of yogic practices. Statistical analysis was performed by paired t-test to examine the effect of yoga on cognitive flexibility and attention in university girls.
Results: There was a significant decrease in time taken to complete TMT part A (t= 4.33; P<0.05) and a significant increase in total attempts (t= -2.75; P<0.05) and net attempts (t=-2.80; P<0.01) in six letter cancellation test after three months of yoga practice.
Conclusion: The results suggest that yoga improves visual search ability and motor speed skills and hence cognitive flexibility and attention in university girls.

1. Introduction

All organisms must adapt to dynamic environmental conditions in order to survive, and the ability to switch thought and/or response patterns characterizes cognitive flexibility.[1] Cognitive flexibility is a core executive function that allows a person to adapt the cognitive processing strategies in response to a changing environment. This definition describes that cognitive flexibility is an ability which could be acquired with experience and involves the adaptation of cognitive processing strategies.[2] A person with cognitive flexibility can work effectively to disengage from a previous activity, reconfigure a new response set, and implement this new response set to the current situation. Greater cognitive flexibility is linked to positive outcomes across the lifespan including improved reading skills in adolescents, greater resilience to adversity and stress in adult's higher levels of creativity in adulthood, and better quality of life in older people. Given the variety of ways it has been defined in the literature, cognitive flexibility can be particularly difficult to examine.

The behaviour of a person must be adjusted to the circumstances around the activity during performing a complex task. However, these factors keep altering as the activity progresses, therefore in order to be flexible, a person must regularly pay attention to these conditions. Additionally, the individual must reorganise their knowledge in order to correctly perceive the new

* *Corresponding author*.
E-mail address: drsandeep.singh@uop.edu.in (Y. Tyagi).

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scenario and the new task requirements in order to adjust their behaviour to the new circumstances. As a result, cognitive flexibility is dependent on attentional processes and knowledge representation.[2] In some cases, the cognitive flexibility is brought up in relation to activities requiring attentional changes (e.g., attentional flexibility, attention switching, attentional set shifting). The behavioural and cognitive activity of selecting focus on a particular piece of information, whether it is considered subjective or objective, while ignoring other perceivable information, is called attention.

When a person is not cognitively flexible, they behave in a non-functional way in dealing with situational demands, therefore they would often perform erroneously. Numerous research on adult populations have established the significance of yoga, which is more effective than exercise at enhancing psychological outcomes.[3] Yoga is the best lifestyle change, which uses asana (physical postures), pranayama (breathing exercises), and meditation to achieve the unity of the mind, body, and spirit.[4] Yogic practices like asana, pranayama, vedic chanting, and meditation reduces stress,[5] enhances attention,[6] self-esteem (SE)[7] improves self-efficacy[8] and processing speed with fine motor coordination, visual–motor integration, visual perception, planning ability, and cognitive performance.[9]

In the present study the trial making test (TMT) was used to assess cognitive flexibility which is a short and convenient method to estimate cognitive functions, primarily memory and attention. Part A is primarily dependent on the efficiency of visual scanning and psychomotor speed. On the other hand, Part B interprets as an executive task. The six-letter cancellation test was used to determine sustained attention in university students.

2. Literature Review

Sheela et al., (2013) conducted a single group pre-post study on 66 students and the study suggests that a systematic practice of the yoga may enhance SA which can further lead to academic excellence.[10] The data analysis showed 11.6% decrease (P<0.001) in total time taken and 31.90% decrease (P<0.001) in error scores for DVT. A Research done in the year 2018 on the medical students in the duration of 3 months in which comparison was done between yoga group and control group using PGMI memory scale. The results suggest statistically significant improvement in attention, concentration, and memory of yoga group (P<0.001) when compared to the control group.[11] Schmalzl L et al., (2018) researched that 8-weeks of yoga-based practices can lead to measurable changes in perceived stress, salivary cortisol and sustained attention in novice practitioners.[12] A Research done in the year 2018 on 60 healthy volunteers showed that yoga therapy enhances sustained attention. The yoga therapy group showed 15.06% significant increase (P<0.01), paired sample t-test) in total score on six letter cancellation tests. Similarly, there was 19.03% increase significant increase (P=0.008), paired sample t-test). However, there was 26.32% significant decrease in wrong attempts which was statistically not significant (P=0.637).[13] Telles et al., (2019) researched that 61 pre-teen children showed an immediate response to 18 minutes of high frequency yoga breathing, breath awareness and quiet sitting.[14] Following, high frequency yoga breathing they obtained better scores in attention based on six letter cancellation tests. Data analysis showed an increase in total attempts and net scores after high frequency yoga breathing (P<0.005). Sreenivas et al., (2022) researched that yoga can be an effective measure in improving attention of medical students.[15] There was a significant reduction in the completion timings of all attention tests. A reduction in the number of errors in Digit Vigilance Test was also noted. A research done in the year 2022 stated that yoga can improve general intelligence, visuospatial working memory and attention, as well as reduces the anxiety with of students with low academic performance. The result of the present study showed significant (P<.05) improvement in Six Letter Cancellation Test which means that attention is improving.[16]

3. Research Methodology

3.1. Participants

Thirty university girls, whose age ranged between 17 to 23 years (group mean ± SD; 18.27 ± 1.44) participated in this study. The students were healthy and proficient in English. They all were literate and could understand and undertake the tests.

3.2. Inclusion criteria

1. Females aged between 17 to 23 years were involved in the study.
2. They were willing to follow study conditions.

3.3. Exclusion

1. Students suffering from serious medical issues.
2. Students taking psychiatric drugs, alcohol or tobacco in any form.
3. Using any other wellness strategy.

3.4. Research design

The study was designed as a single group pre-test post-test and was carried out at a yoga and ayurveda institution located in north of India.

3.5. Assessments

The participants were assessed for:

1. Six-letter cancellation test (SLCT)

2. Trial making test (TMT)

3.6. Six-letter cancellation test (SLCT)

The six-letter cancellation test consisted of a test worksheet that includes the six target letters to be cancelled and had a working section that consisted of letters of the alphabet arranged randomly in 14 rows and 22 columns. The participants were asked to cancel as many six target letters as possible which were written on top of the working section of test sheets, in specified time, that is 90 seconds. Participants were told that there were two possible strategies that is (i) doing all six letters at a time, or (ii) selecting any one target letter out of six. They were asked to choose whichever strategy suited them. They were also informed that they could follow a horizontal, vertical or a random path according to their choice.

The total number of cancellations and wrong cancellations were scored and the net scores were calculated by deducting the wrong cancellations from the total cancellations attempted.

3.7. Trial making test (TMT)

TMT is a brief paper and pencil neuropsychological test which measures cognitive dysfunction. Part A consists of numbers in circles on the page. One has to draw a line from one number to the next, in order. Start from the point 1, then point 2 and so on. One should not lift the pen as you move from one number to the next.

Part B is made up of circles, some of which contain numbers and other letters. One has to draw a line, alternating in order between the numbers and letters. Not to lift the pen while moving from one number or letter to the next as quickly and accurately as one can. The alteration between serial sequences of letters and numbers is thought to require executive control, specifically flexibility of thinking and greater demand for working memory.

3.8. Intervention

The yogic package of 3 months' duration was practiced by all the participants. The program was organized in an open and peaceful environment of a yoga and ayurveda institution located in north of India.

The yogic package includes shatkarma, āsana, prānāyāma (breathing exercises), mudra and yognidrā. The total duration of each session was 90 minutes.

The program was based on the holistic development of the students.

3.9. Data analysis

Statistical analysis was performed by paired t-test to examine the effect of three months' yogic practices on cognitive flexibility and attention in university girls.

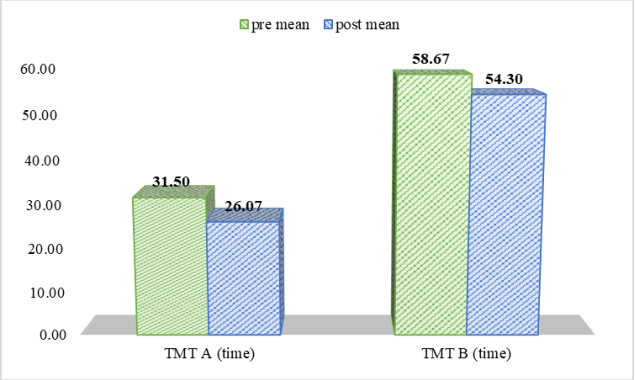

Figure 1: Change in trail making test scores after three months of yogic practices

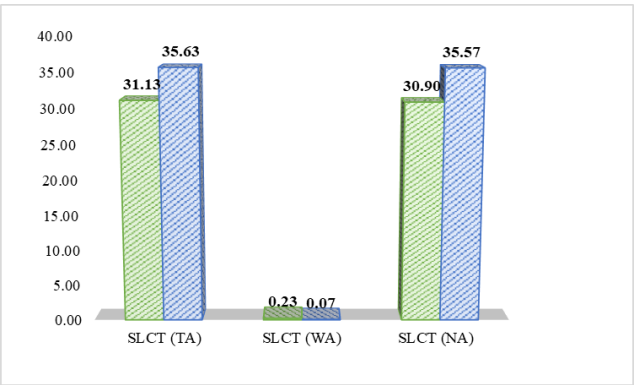

Figure 2: Change in six letter cancellation test scores after three months of yogic practices

4. Results

There was a significant decrease in time taken to complete TMT part A (t= 4.33; P<0.05) and a significant increase in total attempts (t= -2.75; P<0.05) and net attempts (t=-2.80; P<0.01) in six letter cancellation test after three months of yoga practice.

5. Discussion

The present single group pilot study was conducted to determine the effect of three months' yogic practice on cognitive flexibility and attention. Yoga has become popular as a cognitive impairment treatment method, with the expectation that improvement of attention as well as improvement of executive functions.[17,18] Improvement of executive functions require sustained attention and cognitive flexibility. Decrease in total time taken in TMT suggests improvement in visual-motor integration. Increase in scores of total attempts and net attempts in SLCT following three months' yogic practice suggest improvement in sustained attention. Previous study on Yoga reported enhanced sustained attention as a result of the practice of Yogic way of

Table 1: Paired samples t-test results for pre and post measures of trail making test and six letter cancellation test

Pair	Variables (Pre-Post)	Paired Differences					t-Value	df	Sig. (2-tailed)
		Difference of Means	SD	SEM	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	TMT A (pre)- TMT A (post)	5.433	6.872	1.255	2.867	7.999	4.331	29	0
Pair 2	TMT B (pre)- TMT A (post)	4.367	18.682	3.411	-2.609	11.342	1.28	29	0.211
Pair 3	SLCT TA (pre)- SLCT TA (post)	-4.5	8.963	1.636	-7.847	-1.153	-2.75	29	0.01
Pair 4	SLCT WA (pre)- SLCT WA (post)	0.167	0.699	0.128	-0.094	0.428	1.306	29	0.202
Pair 5	SLCT NA (pre)- SLCT WA (post)	-4.667	9.102	1.662	-8.065	-1.268	-2.808	29	0.009

TMT A- (Trail Making Test part –A), TMT B- (Trail Making Test part –B), SLCT TA- (Six Letter Cancellation Test -Total Attempts), SLCT WA- (Six Letter Cancellation Test - Wrong Attempts), SLCT NA (Six Letter Cancellation Test -Net Attempts), SD: Standard Deviation, SEM: Standard Error Mean, df: Degree of freedom

life. The result indicates the importance of Yoga to improve academic excellence.[19,20] The present study is consistent with these findings, suggesting that a systematic practice of the Yoga may enhance sustained attention as well as cognitiveflexibility, which may lead to academic excellence.

6. Conclusion

The present study suggests that three months of yogic practices enhance sustained attention and cognitive flexibility among students, thus paving the way for their academic excellence. Additional well-designed studies are needed before a strong recommendation can be made.

7. Source of Funding

None.

8. Conflict of Interest

None.

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Author biography

Sandeep Singh, Assistant Professor https://orcid.org/0000-0003-1608-650X

Yashi Tyagi, B.Sc. Scholar https://orcid.org/0000-0003-1608-650X

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