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ORIGINAL RESEARCH ARTICLE

Effect of *Trataka* on Selected Psychomotor Abilities of Female Athletes

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ABSTRACT

Background: Psychomotor ability is an important attribute for mental processing. The main aim of this present study was to observe the effect of trataka on selected psychomotor abilities.

Methodology: A total of 20 female athletes were selected as subject and further subdivided in two equal groups such as control group (CN = 10) and trataka group (TG = 10). The average age of all the subjects was 23 years. The measurable psychomotor abilities were simple reaction time (SRT), visual memory (VM), and hand-eye coordination (HEC), depth perception (DP), and executive function (EF), respectively. These were measured from the trusted online website named by Human Benchmark and CogniFit. *Trataka* training program was planned for 8 weeks for 35–60 min, 5 days/week, and following the principle of progressive method. The data were analyzed with the help of Shapiro–Wilk test, Levine's Test, one-way analysis of covariance, and Bonferroni *post hoc* comparison.

Results: Results of SRT, VM, and HEC, DP showed a significant difference at 0.05 level and EF did not showed a significant difference.

Conclusion: From this study, it was concluded that the current treatment protocol helps to develop selected psychomotor abilities that positively influence cognitive function.

1. INTRODUCTION

Psychomotor ability is a mental process that controls the functioning of muscles and other organs and systems. Psychomotor abilities can be optimized through practice to the extent that the individual may have acquired them innately. Human abilities have four domains: Cognitive, psychomotor, physical, and perceptual-sensory. The psychomotor domain is often described with three components, including perceptual-motor behavior, fine motor skills, and gross physical function.[1,2] Psychomotor abilities include accuracy, coordination, response orientation, rate control, reaction time, steadiness, manual dexterity, finger dexterity, wrist-finger motion, and aiming.[3-6] It is undeniable that psychomotor ability plays a very important role in performing well in sports. Current researchers believe that any accurate and perfect throwing, catching, shooting, smashing, and hitting requires proper reaction time, perception, perfect body movement, accurate coordination between eyes and hands, and accurate aiming. Therefore, an athlete practice and trained regularly so that his cognitive areas are properly improved and the above-mentioned components are properly nourished. However, nowadays sports competition has become huge, and with the increased glamor of sports, it was difficult to maintain the right mental state and performance of athletes. Due to the excessive stress, mental instability prevents the athlete from using his full cognitive field properly. If this condition persists, the athlete loses focus, patience, creativity, and effective use of memory.

Yoga is a popular philosophical tradition originating from the Indian continent, which includes practices such as Yama, Niyama, Asana, Kriya Pranayama, and Meditation, if practiced regularly improves the quality of every domain of an athlete as well as any person. Above all trataka and meditation play an important role in enhancing cognitive

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areas such as attention, patience, memory, and so on. To get the correct results of the research, the present researcher followed a slightly simpler method like trataka than meditation which athletes can easily practice. As a training protocol, trataka also promotes its importance in the sports community. It was both a cleansing technique and similar to focus meditation. Hence, simultaneously the eyes are cleansed, the eye muscles are strengthened, the eye movement is controlled and the benefits of meditation are also achieved.[7] The main goal of the present researcher was to observe how the 8 weeks trataka training protocol effects the selected psychomotor abilities such as reaction time, visual memory (VM), coordination, and executive function (EF).

2. METHODOLOGY

2.1. Subjects

A total of 20 state-level female athletes of different games (Kho-Kho, Cricket, Track and Field, and Martial Arts) were selected from Panskura Banamali College (Autonomous) Purba Medinipur. The average age of all the subjects was 23 years. Then further the subjects were subdivided randomly in two equal groups, one was considered control group (CN = 10), and another one considered as trataka group (TG = 10). The written consent was taken from all subjects. The departmental research committee of Panskura Banamali College approved the study. Written informed consent was obtained from individual participants before their recruitment to the study.

2.2. Measuring Criteria and Tools

2.2.1. Personal data

Age was evaluated through the date of birth, and weight and height were measured through well calibrated weighing machine and stadiometer with minimal cloth and without shoes.

2.2.2. Psychomotor abilities

Simple reaction time (SRT), VM, and hand-eye coordination (HEC) were measured through Human Bench Mark Online Computerized Test.[8] Depth perception (DP) was measured through Howard Dolman Apparatus. EF was measured through a CogniFit Online Computerized Test named as TMT.[9,10]

2.2.3. Training protocol

The study was conducted in the Classroom of the Department of Physical Education, Panskura Banamali College at 6 am. The trataka training program conducted 35–60 min, 5 days/week, for 8 weeks and followed the principle of progressive method. Details of the program are given in charts separately. The CN groups were requested to do just the routine task and not change their normal daily life pattern during this training period. The training protocol was specified in detail in Table 1.

During the entire exercise, participants sat comfortably on the floor. The exercise consists of four distinct phases. The first phase involved a preparatory phase of eye exercises for 10 min.

At this stage, participants were asked to do a gentle massage of the eyes and move the eyeballs in horizontal, vertical, diagonal, and circular directions. The second phase was Jyoti Tratak phase where subjects try to focused as long as possible toward the candle without blinking the eyes. The third phase is the anta trataka phase where the eyes were closed and the candle flame was visualized between the eyebrows. The fourth phase was the relaxation and recovery phase where the eyes were lightly massaged and Om meditation was done.

2.3. Statistical Analysis

All the statistical analyses were performed using SPSS, version 25.0 on Windows 10.0, and a significant level considered 0.05. At first, some selected descriptive statistics were computed for a simpler interpretation of the data. Shapiro–Wilk test and Kolmogorov–Smirnov test were computed to determine that the sample data have been drawn from normally distributed population or not, and Levine's test was computed for homogeneity test to determine the equal distribution of single categorical variables of the groups and found satisfactory results. One-way analysis of covariance (ANCOVA) was used to determine differences among the groups. Bonferroni *post hoc* comparison was computed to compare the effects of 8-week elastic resistance training program on each group.

3. RESULTS

The result of this study was mentioned in three sections, the first section interprets the normality and homogeneity of data, the second section showed the characteristics of the data, and last section find out the effect of *trataka* on psychomotor abilities. All the subjects were complete the 8 weeks *trataka* training protocol.

The normality and homogeneity of the data were calculated for the selection further inferential statistics. Data showed that 67 person cases followed the normality pattern and 72 person cases data followed homogeneity pattern and remaining 33 person cases data not followed the normality pattern and 28 person cases data were not homogenous. Although selection of inferential statistics was quietly challenging in this case but maximum cases followed normality and homogeneity for this reason present investigator decided to go with parametric statistics. Because doing two types of statistics at the same time, it will increase more confusion in the field of research and the current researcher felt that there will be considerable problems in interpreting the results. As the rest of the data were not normal or homogeneous, the present researcher assumed, there was a lot of dispersion within the data if judged in terms of mean.

The descriptive characteristics [Table 2] were calculated through mean and standard deviation. From there the present investigator aware about the condition of the subject. One-way ANCOVA [Table 3] was performed to find out the effect of training after adjusting the pre-test data. From this result, it was observed that SRT, VM, HEC, and DP showed significant difference at 0.05 level and the F value between the group was (df = 1.17) 4.72, 42.89, 6.63, and 4.95. Remaining variables such as EF did not able to showed significant difference after the implementation of the training. Normality and homogeneity of all variables is given in Table 4.

4. DISCUSSION

This experimental study was conducted on 20 state-level players of different games; from there ten subjects were randomly selected for experimental group, and remaining ten were considered as CN group. All the subjects were actively participated in the training program and their attendance was approximately 100%.

Reaction time is related to a number of cognitive and neurological processes, including as decision-making, motor execution, and sensory processing.[11-13] Prolonged trataka practice increased the ability to focus and altered overall cognitive functioning, which the present researchers attributed to improved simple visual reaction time. A research paper by Sukladas *et al.*,[14] similar to the present study, showed improvements in reaction time in cricketers after 8 weeks of trataka training. Different authors showed a significant reduction of visual reaction time following regular trataka practice due to speeding up the cognitive processing, sensory-motor integration, and improving cognitive functions such as memory and attention.[15-19] It had been shown from different studies cognitive function and voluntary attention which play a crucial role to improve reaction time.[20-22] According to Theofilou *et al.,*[22] improvement the neuroplasticity was the main reason to improve reaction time. It was assumed that it was happened due to improvement in blood flow and an increase the secretion of neurotrophins which regulate neural development, functioning, synaptic plasticity, connectivity, and neurogenesis particular areas related to attention, sensory processing, and motor control.[15-19,23-26] Pal *et al.* and Telles *et al.* highlighted improvements in visual reaction times, due to strengthens neural pathways involved in processing visual and auditory information.[16,19]

In respect of VM, the current researcher believes that by looking at an object for a long time without blinking, the distractions from the mind and brain were reduced, the attention-oriented network of the brain was improved, and visual processing was improved so that the brain can encode and store visual information more effectively. The findings of several authors similar to the present study which showed improvements in VM due to reducing the mental distractions, enhanced neural efficiency, and reduced cognitive load.[27,28] It was predicted from those above study that Eight-week trataka practice leads to neuroplastic changes in brain areas related to visual processing and memory. The result of this study also suggests that long-term practice of trataka improved VM and these interventions were effective for the general population. Talwadkar *et al*., done a study on effect of trataka on cognitive function of elderly population where the protocol introduced for 1 month and showed a significant improvement on different kind of memories. This study was sufficient to support the present research. This study also shows that trataka improves overall cognitive functioning. VM mechanism totally depends on three primary processes encoding, storage, and retrieval. The primary visual cortex in the occipital lobe, which deals with many components of visual information such color, shape, and motion, processes the visual inputs initially during the encoding stage.[29-31] Through the requirement of constant attention to a single visual spot, trataka probably improves the effectiveness of these encoding processes by encouraging frequent and focused visual input. The hippocampus and medial temporal lobe assist in the transition of encoded visual information from the storage phase into short-term memory and eventually long-term memory.[32] Long-term potentiation is also observed due to the increased synaptic strength and various biochemical changes in memory regions of the brain due to regular exercise which reinforces the synaptic and system consolidation processes.[33] It was also thought that the prefrontal cortex and the parietal lobe are more likely to work together, resulting in improved VM.[34]

Since while trataka, one tries to stay in the same gaze for a long time without blinking, which stimulates the person's attentional processes and increases mental engagement, which helps to increase the neuroplasticity of the person's visual cortex area, due to this reason the current researcher believes that the memory was improved.[33] The brain uses the parietal cortex to combine different visual elements into a cohesive memory picture, and practicing trataka likely enhances this process.[35] Trataka may improve feature binding accuracy and efficiency by teaching the brain to sustain a steady visual attention. Because trataka needs persistent visual attention, activating the dorsolateral prefrontal cortex which focuses cognitive resources on pertinent stimuli may greatly enhance the encoding of visual information.[36] This improved attentional control makes sure that visual information is processed more efficiently.

In response to visual stimuli Aim timer test measure the individual's ability to perform precise and rapid movements. This test evaluates hand-eye coordination, reaction time, and accuracy, often by requiring participants to touch or click on specific targets as quickly and accurately as possible. The present researcher predicted that due to prolonged eye gaze at the candle flame; the eye muscles have become strengthy, resulting in the subject's eye movement control, which helps him to observe an object in depth. Apart from this, due to prolonged gaze at the flame, the mental stability increases, and attention was increased, which may improve the precision and hand and eye coordination of this task. Different research studies showed that sustained focus improved visual attention and allows better detection capacity and processed visual stimuli which help to do any work with precision and quick reaction and also enhanced coordination between visual input and motor responses which leads to more accurate and timely actions.[37,38] From the work of Tang *et al.*, it was understood that long-term focus engaged prefrontal cortex which enhance cognitive control. Through improving cognitive control individual enables better management of attentional shifts and reduces reaction time, contributing to superior performance in aim timer tasks.[39,40]

The results of one-way ANCOVA of DP showed significant result after adjusted the post-test mean after 8 weeks of trataka practice. The Mean difference between CN and TG was 0.91 cm. That mean the DP of experimental group was improved approximately 57% after 8 weeks of trataka training. Researchers believe that the reason for this improved DP was the minimization of rapid eye movements that help to focus on an object with fixed gaze and extract deep information about the object. Similar studies also found that trataka practice influence oculomotor fitness and visual acuity which were an important component of DP, stimulate to more precise and deep detection of spatial relationship between objects.[12,28,38] According to Tang *et al.*, consistent trataka practice increased neural connectivity and plasticity of the concern area of the brain which helps to processes the visual information more effectively.[39,40] Zeidan *et al.*, suggest that continue trataka practice reduces the visual fatigue and strain from the eye which helps to improved DP.[41]

The results of one-way ANCOVA of EFs using the trail-making test B showed no significant difference between the control and experimental group but the adjusted mean difference showed 17.75 ms improvement in the case of experimental group EFs. This results suggesting a trend toward enhanced EF and working memory. The present investigator realized that the small sample size of this study was one of the reasons for the statistical insignificance result, which affect the power to detect the meaning full effect. According to certain research studies, task switching and cognitive flexibility are necessary for the TMT-B. By strengthening the brain's capacity to control attentional shifts and block irrelevant information, as well as by improving neural connectivity between different brain regions, trataka practice may enhance these EFs and enable quicker and more accurate cognitive processing.[39,40] Zeidan and other coauthors claim that trataka practice entails meditative attention, which has been demonstrated to lower stress and enhance general cognitive function. Lower cognitive load from less stress enables more effective cognitive processing when working on tasks.[41]

5. CONCLUSION

It was concluded from this study that the current treatment protocol helps to develop selected psychomotor abilities that positively influence cognitive function. This training protocol may be used for the improvement of psychomotor ability in the general population as well as for athletes.

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7. AUTHORS' CONTRIBUTIONS

All the authors contributed equally in design and execution of the article.

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9. ETHICAL APPROVALS

This manuscript not required ethical approval.

10. CONFLICTS OF INTEREST

Nil.

11. DATA AVAILABILITY

This is an original manuscript and all data are available for only review purposes from principal investigators.

12. PUBLISHERS NOTE

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Figure 1: Jyoti Trataka practice by the athletes

Figure 2: Bahi Jyoti Trataka practice by the athletes

Figure 3: Depth Perception Test

Figure 4: Depth Perception Test

Figure 5: Computerized Psychomotor test performed by athletes

Table 1: Eight weeks trataka protocol

Prayer		1 min	
Preparatory exercise		10 min	
Exercise	**Set**	**Rep**	**Time**
Up and down	2	10	2 min
Right and left	2	10	2 min
Diagonal	2	10	2 min
Circular	2	10	2 min
Eye massage			2 min
Week	**Set**	**Time**	**Density**
1^{st}	6	B: 1 min, A: 1 min (12 min)	30 s
2^{nd}	6	B: 2 min, A: 1 min (18 min)	30 s
3^{rd}	5	B: 3 min, A: 1 min (20 min)	30 s
4^{th}	5	B: 4 min, A: 1 min (25 min)	30 s
5^{th}	5	B: 5 min, A: 1 min (30 min)	30 s
6^{th}	4	B: 6 min, A: 2 min (32 min)	30 s
7^{th}	4	B: 6 min, A: 2 min (32 min)	30 s
8^{th}	4	B: 7 min, A: 2 min (36 min)	30 s
Eye Massage			2 min
Om chanting			5 min
End prayer			1 min

B: Bahi Trataka, A: Antah Trataka, Total recovery for each session was 2.30 min

Table 2: Characteristics of all variables

Variables	Group	Mean	SD
Age (year)	CG	23.00	1.41
	TG	22.7	0.67
Weight (kg)	CG	52	8.08
	TG	47.7	6.71
Height (cm)	CG	157	6.14
	TG	153.35	5.84
SRT pre (ms)	CG	353.50	58.43
	TG	304.1	55.01
SRT post (ms)	CG	337.2	78.98
	TG	258.4	36.24
VM pre (pts)	CG	6.82	0.97
	TG	8.01	0.50
VM post (pts)	CG	7.36	0.46
	TG	9.10	0.38
AT pre (ms)	CG	1046.00	162.14
	TG	1061.20	298.73
AT post (ms)	CG	1084.60	200.98
	TG	903.70	117.96
DP pre (cm)	CG	3.56	2.53
	TG	1.20	0.93
DP post (cm)	CG	3.09	2.41
	TG	0.280	0.10
EF pre (s)	CG	115.60	15.77
	TG	112.30	31.96
EF post (s)	CG	108.50	23.62
	TG	89.40	20.02

CG: Control group, TG: *Trataka* group, SRT: Simple reaction time, VM: Visual memory, HEC: Hand-eye coordination, DP: Depth perception, EF: Executive function

Table 3: One-way ANCOVA of psychomotor variables

Source	Mean difference	*F*	*P*	η^2
SRT	65.45	4.72*	0.04	0.22
VM	1.58	42.89**	0.00	0.72
HEC	184.36	6.63*	0.02	0.28
DP	0.90	4.95*	0.04	0.23
EF	17.75	3.97	0.06	0.19

df=1.17. Tabulated $F_{0.05 \& 0.01}$: 4.45* & 8.40**.

SRT: Simple reaction time, VM: Visual memory, HEC: Hand-eye coordination, DP: Depth perception, EF: Executive function

Table 4: Normality and homogeneity of all variables

Variables	Group	Sha-Wi	df	*P*	Levene	df1	df2	Sig.
Height	TG	0.920	10	0.358	0.071	1	18	0.793
	CG	0.943		0.587				
Weight	TG	0.944		0.594	0.000			0.985
	CG	0.813		0.021				
Age	TG	0.802		0.015	80.077			0.011
	CG	0.887		0.158				
SRT Pre	TG	0.935		0.498	0.315			0.581
	CG	0.899		0.212				
SRT Post	TG	0.789		0.011	190.382			0.000
	CG	0.864		0.085				
	CG	0.916		0.328				
HEC Pre	TG	0.955		0.722	20.585			0.125
	CG	0.924		0.388				
HEC Post	TG	0.839		0.043	10.727			0.205
	CG	0.932		0.463				
EF Pre	TG	0.834		0.037	10.768			0.200
	CG	0.942		0.579				
EF Post	TG	0.826		0.030	0.124			0.729
	CG	0.965		0.836				
VM Pre	TG	0.844		0.049	40.951			0.039
	CG	0.935		0.497				
VM Post	TG	0.785		0.009	10.676			0.212
	CG	0.722		0.002				
DP Pre	TG	0.854		0.064	330.434			0.000
	CG	0.768		0.006				
DP Post	TG	0.895		0.191	410.087			0.000
	CG	0.797		0.013				

CG: Control group, TG: *Trataka* group, SRT: Simple reaction time, VM: Visual memory, HEC: Hand-eye coordination, DP: Depth perception, EF: Executive function