स्वामी विवेकानन्द योग अनुसंधान संस्थान

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Certificate

This is to Certify that the Doctoral Committee confirms that this is an authentic approved copy of the thesis titled **"Psychophysiological Changes Associated with Trataka" submitted by Dr. Swathi P S bearing Registration No. PhD/RES/04/Jan16.**

The Viva-voce examination was conducted on Saturday, 24th September 2022 through online google meet with session link: meet.google.com/vcs-yasw-aku

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We also declare that the subject matter of this thesis has not previously formed the basis of award of any degree, diploma, associate-ship, fellowship or similar titles .

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I, hereby declare that this study was conducted by me at Swami Vivekananda Yoga Anusandhana Samsthana (S-VYASA) Deemed to be University, Bengaluru, under the guidance of Dr. Raghavendra Bhat, Associate Professor, S-VYASA, Bengaluru and Dr. Apar Avinash Saoji, Associate Professor, S-VYASA, Bengaluru. I also declare that the subject matter of my thesis entitled "**Psychophysiological Changes Associated with Trataka – Yogic Visual Concentration"** has not previously formed the basis of the award of any degree, diploma, associate-ship, fellowship or similar titles.

Date: 16 April 2022 **Swathi P S**

Place: Bengaluru **(Candidate)**

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Date: 16 April 2022

Place: Bengaluru **Swathi P S**

Standard International Transliteration Code
(used to transliterate Sanskrit words in the text)

अ	=	**a**	ड	=	**ḍa**
आ	=	**ā**	ढ	=	**ḍha**
इ	=	**i**	ण	=	**ṇa**
ई	=	**ī**	त	=	**ta**
उ	=	**u**	थ	=	**tha**
ऊ	=	**ū**	द	=	**da**
ऋ	=	**ṛ**	ध	=	**dha**
ए	=	**e**	न	=	**na**
ऐ	=	**ai**	प	=	**pa**
ओ	=	**o**	फ	=	**pha**
औ	=	**au, ou**	ब	=	**ba**
अं	=	**m**	भ	=	**bha**
अः	=	**ḥ**	म	=	**ma**
क	=	**ka**	य	=	**ya**
ख	=	**kha**	र	=	**ra**
ग	=	**ga**	ल	=	**la**
घ	=	**gha**	व	=	**va**
ङ	=	**ṅa**	श	=	**śa**
च	=	**ca**	ष	=	**ṣa**
छ	=	**cha**	स	=	**sa**
ज	=	**ja**	ह	=	**ha**
झ	=	**jha**	क्ष	=	**kṣa**
ञ	=	**ña**	त्र	=	**tra**
ट	=	**ṭa**	ज्ञ	=	**jña**
ठ	=	**ṭha**			

ABSTRACT

BACKGROUND:

Trāṭaka (Yogic Visual Concentration) is one of the six cleansing techniques (*Ṣaṭakarma*) explained in *Haṭha yoga pradīpikā*. *Trāṭaka* means gazing continuously at a small point until tears are shed. This point of concentration activates the inner potential and can absorb the mind. *Bahiranga trāṭaka* (external concentrated gazing) is gazing at a candle flame or any other external objects, and *antaranga trāṭaka* (internal concentrated gazing) is focusing on the inner visualization of the object (Muktibodhananda, 1999). The practice of *trāṭaka* is considered an essential part of *Ṣaṭakarma*. Literature suggests that *trāṭaka* has many benefits, but there is a lack of clear understanding of the effects of *trāṭaka* scientifically.

A study assessed the immediate effect of *trāṭaka* on critical flicker fusion (CFF) in thirty healthy volunteers. A significant increase in CFF immediately after *trāṭaka* sessions indicated better visual perception (Mallick & Kulkarni, 2010). In another study, the effect of *trāṭaka* on cognitive functions in the elderly population was assessed. Results showed significant improvements in cognitive functions such as Digit Span Test, Six Letter Cancellation Test, and Trail Making Test-B compared to the control group (Jagannathan et al., 2014).

Another study demonstrated better performance on the Stroop colour-word test following *trāṭaka* compared to a control session. The research suggests *trāṭaka* technique increases selective attention, cognitive flexibility, and response inhibition (Raghavendra & Singh, 2016). Changes in heart rate variability and breath rate were assessed in 30 healthy

volunteers (Raghavendra & Ramamurthy, 2014). There was a significant reduction in breath rate and an increase in the high-frequency component of HRV after the immediate practice of *trāṭaka*, indicating a trend of relaxation and parasympathetic activity. The above-mentioned study looked at only frequency domain components of HRV, hence, in this study, we have investigated the time domain, nonlinear components, and association with the psychological task. Thus, the current study was proposed to understand the effects of *trāṭaka* on pre, during, and post-intervention.

AIM AND OBJECTIVES:

The present study was proposed to understand the psychophysiological changes associated with *trāṭaka* in healthy volunteers. The objectives of the study were to investigate the effects of *trāṭaka* and eye exercise on i) Autonomic functions viz. Heart rate variability, Heart rate, Respiratory rate, Skin Conductance, and Simple Visual Reaction Time task (SVRT), ii) Psychological well-being and visual strain, iii) Visuospatial short-term working memory through Corsi block tapping task (CBTT).

METHODS

Participants:

For the Autonomic function and SVRT task, a total of thirty volunteers, for Visual strain and psychological well-being, a total of one hundred and six volunteers, and for CBTT, a total no of forty-one volunteers of both genders with ages ranging from 18 to 30 years participated in the study. They were students of a Yoga University in South India. They had the minimum experience of Yoga practice for six months.

Design

We adapted the self as control trial to assess the autonomic changes and visual reaction time, wherein each participant was assessed twice during experimental and control sessions. The assessments for Autonomic changes were done for the duration of 5 min before, 20 min for during the session, and immediately after the practice of *trāṭaka* or control session. For Simple Visual reaction time, the assessments were done for the duration of 5 min before and immediately after the practice of *trāṭaka* or control sessions. For the assessment of the performance of Corsi block tapping task, a repeated measures design was adapted. Each participant was assessed thrice, at baseline, following the practice of *trāṭaka* and control sessions. We adopted a randomized controlled trial to assess visual strain and psychological well-being, and questionnaires were administered at baseline and at the end of two weeks.

Assessments:

i. Electrocardiogram (ECG) and respiration were recorded using a 16-channel human physiology system (Power lab 16/35. A.D. Instruments, Australia)

ii. Visual Fatigue Scale (VFS), Visual symptoms checklist (VSC), Mind-wandering questionnaire (MWQ), and State mindfulness attention awareness scale (SMAAS) were administered.

iii. SVRT task and CBTT were presented using the Inquisit Millisecond software package 4.0 (Millisecond Software, LLC, Seattle, USA)

Intervention:

The *trāṭaka* module consists of 2 distinct stages, which were administered for 20 min. As a preparatory stage of *trāṭaka*, eye exercises were performed. The eye exercises were done with eyes open in a well-lit room. The second stage was the practice of *trāṭaka* itself. The

participants were asked to fix their gaze on the candle's flame for about 2 to 3 minutes without blinking their eyes. This process was repeated for three rounds (simple focusing, intense & deep focusing for 5 min each), and practice was ended in silence with the prayer. The second stage consisted of about 15 minutes.

During the control session, subjects practiced only eye exercises for 10 minutes, and for the next 10 minutes, they sat quietly with their eyes closed without doing any concentration or meditation exercise.

RESULTS:

i. Autonomic Functions & Simple visual reaction time task: Enhanced heart rate variability was observed during and following *trāṭaka*, indicative of possible parasympathetic activity in the autonomic activity. There was also a reduction noted in Respiratory rate, Skin Conductance, and SVRT task.

ii. Visual Strain & Psychological well-being: There was a significant reduction in VFS and VSC scores, MWQ, along with an increase in SMAAS scores in the *trāṭaka* group after two weeks of intervention.

iii. Performance in Corsi Block Tapping Task: The results demonstrate an enhanced working memory, spatial memory, and spatial attention following the practice of *Trāṭaka* in the Cosri Block Tapping Task.

CONCLUSION:

The practice of *trāṭaka* was found to reduce visual strain and mind wandering while improving state mindfulness. The *trāṭaka* (yogic visual concentration) leads to increased vagal tone and reduced sympathetic arousal along with reduction observed in SVRT Task.

Also, *trāṭaka* enhanced working and spatial memory in the CBTT. The results indicate the practice of *trāṭaka* to be safe in healthy volunteers.

NEED OF THE STUDY:

There is a paucity of scientific studies about the effects of *trāṭaka* on autonomic and cognitive functions and visual strain and psychological functions. All these domains could be potentially influenced positively through the practice of *trāṭaka*. Thus, we undertook studies to evaluate the effect of *trāṭaka* to understand autonomic changes during the *trāṭaka* and on Visual Reaction Time; performance in CBTT (for working and spatial memory) and to evaluate the effect of *trāṭaka* on the visual strain and promoting psychological well-being.

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