Short Communication

Effect of repetitive yogic squats with specific hand position (*Thoppukaranam*) on selective attention and psychological states

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ABSTRACT

Context: Research on the effect of *Thoppukaranam* is limited despite it being practiced as a form of worship to the elephant-headed deity Lord Ganapati and punishment in schools.

Aims: The purpose of this study was to examine the effect of *Thoppukaranam* on selective attention and psychological states in a sample of young adults.

Settings and Designs: A randomized self-as-control within subjects design was employed. Thirty undergraduate students (4 females and 26 males) from a residential Yoga University in Southern India were recruited for this study (group mean age ± standard deviation, 20.17 ± 2.92).

Materials and Methods: The d2 test, State Anxiety Inventory-Short Form and State Mindful Attention Awareness Scale (SMAAS) were used to measure cognitive performance and psychological states. Assessments were made in three sessions: Baseline, control (squats), and experimental (*Thoppukaranam*) on 3 separate days.

Statistical analysis used: Data were analyzed using one-way repeated measures analyses of variance between three sessions, that is, baseline, squat, and *Thoppukaranam*.

Results: There was a significant improvement in all measures of the d2 test of attention (TN, E, TN-E, E%, and concentration performance) and state mindfulness after *Thoppukaranam*. Further state anxiety reduced significantly after the experimental session.

Conclusions: These findings indicate *Thoppukaranam* results in enhancement of cognitive functioning and psychological states.

Key words: Mental Concentration; selective attention; state anxiety; state mindfulness; squats; *Thoppukaranam*

INTRODUCTION

In the Indian tradition, the elephant-headed deity *Ganapati*, is worshipped as the remover of obstacles, bestower of knowledge and success.[1] Intrinsically, his blessings are sought before the commencement of any endeavor. Yogic squats with specific hand position (*Thoppukaranam*), a physical act of worshiping the deity, are practiced throughout India (especially in the South).

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While practicing *Thoppukaranam,* devotees hold earlobes between thumb and forefinger with hands crossed in front of chest and perform repetitive squats. This is done 18 or 108 or 1008 times. General belief is *Thoppukaranam* will bestow success in all endeavors. Further, it has been used as a form of punishment in schools. Even though not mentioned in any Vedic scriptures, it has been passed down as narration and is followed even today with great faith. Further, in Chinese Acupuncture therapy and Indian Ayurveda, earlobe is believed to contain energy meridians which correspond to the head. Moreover, in auricular therapy, ear is believed to correspond to whole body in shape of an inverted fetus curled in womb and the earlobe stands for the head.[2]

Testimonial on super brain yoga—a similar practice using the thumb and a finger to apply pressure to each earlobe

while doing knee bends and taking breaths—shows increased class participation, concentration, improved quality of academic performance and social skills in a sample of US school students.[3] To our knowledge, there is no study to date using *Thoppukaranam*. Hence, current study examines the effect of traditional practice of *Thoppukaranam* on cognitive and psychological states in healthy individuals.

MATERIALS AND METHODS

Participants

A total of 36 undergraduate students from a residential Yoga University in Southern India were recruited for this study. The final sample comprised 30 volunteers (86.66% male), due to drop out. The reasons for dropout (a) not completed the orientation, (b) ill health and, (c) personal reason. Participants' age ranged from 17 to 29 years with a mean age of 20.17 years (standard deviation =2.92). All reported having a normal or corrected vision. Those who had any history of psychological illness, heart disease, renal failure, recent surgery, joint pain, or any other debilitating condition, and unwillingness to participate in the study were excluded.

Design

This was a randomized self as control within-subjects design. Participants were assessed on 3 separate days in neuropsychology laboratory of the above university. Participants were counterbalanced randomly into three sessions: Baseline, control (squats), and yogic squats (*Thoppukaranam*) to minimize the order effect.

ASSESSMENTS

Sociodemographic questionnaire

A sociodemographic checklist was developed to document participants' basic information such as name, gender, age, level of education, and experience in yoga.

d2 attention test

The d2 attention test is a timed test of selective attention and mental concentration.[4] The one-page test consists of 14 lines, each comprising of 47 characters of letters "d" and "p" with one to four dashes, arranged either individually or in pairs above and below the letters. The subject is required to scan across each line to identify and cross out all "d's" with two dashes. The subject is allowed 20 s per line. All other combinations of letters and dashes are considered irrelevant. In a series of tests-retests, and intervals of up to 40 months, d2 test indices, total number of items processed (TN), total performance (TN-E, where E is error), and concentration performance (CP) demonstrate satisfactory to good reliability ($r > 70$). Further, over a 5-h interval in adults, the test has shown good test-retest reliability.[4]

State trait anxiety inventory-short form

The state trait anxiety inventory-short form (STAI-SF) consists of two questionnaires of 20 items each. The first questionnaire measures state anxiety (how one feels at the moment); the second, trait anxiety (how one generally feels).[5] A standardized, short-form of STAI has been used for this study. STAI-SF consists of six items assessing the extent to which patients feel "calm," "tense," "upset," "relaxed," "content," and "worried" on a 4-point scale ranging from "not at all" to "very much." Items consist of equal numbers of anxiety-present and anxiety-absent. Three items are scored in reverse order to avoid a response bias. The items were summed to produce a total score in which higher scores are related to greater anxiety. The six items STAI-SF demonstrated good reliability coefficient ($r > 82$).[6]

State mindful attention awareness scale

The SMAAS is a valid tool for measuring state mindfulness.[7] The scale is designed to assess the short-term or current expression of a core characteristic of mindfulness; this is a receptive state of mind and sensitive awareness of observing the present moment. The SMAAS draws items drawn from the trait form of the MAAS (e.g., "I'm finding it difficult to stay focused on what's happening in the present"). SMAAS has shown excellent psychometric properties (Cronbach's alpha = 92).

Procedure

Participants were briefed on the purpose and nature of the study. Confidentiality was assured as part of the research process. Eligible participants were briefed on the study and informed consent approved by the institutional ethics committee was obtained. Eligible participants underwent familiarization on the practice of *Thoppukaranam* and squats for a period of 10 days. They were also familiarized with procedure of assessment tools. During baseline session, participants completed the psychological state and attention test.

Experimental session (*Thoppukaranam*)

Participants practiced 108 rounds of *Thoppukaranam*. The procedure for *Thoppukaranam* was to squat with specific hand position. The procedure for squat was a modified form of the Mayo Clinic's practice.[8] Instructions are as follows: Stand with your feet slightly apart, greater than shoulder width and toes pointing ahead. The hands

cross over each other (left over right), maintaining a gentle pressure holding the earlobes throughout with thumb in front and the finger to the back. Slowly descend, bending through hips, knees, and ankles, and stopping when knees reach a 90°angle. Then return to the starting position. Keep the back in a neutral position and abdominal muscles tight. Do not flatten the curve of the lower back or arch back. Keep knees centered over feet while going down. Do not let knees roll inward or outward. Keep movements smooth and controlled with normal breathing.

Control session (squats)

Subjects practiced 108 rounds of squats with the same instructions as *Thoppukaranam* but with variation in hand positions. The hands are kept crossed over the chest (left over right), holding onto the opposite shoulder instead of holding the earlobes.

RESULTS

Data were extracted from the completed tests as per test manuals and scoring keys. Statistical analysis was carried out using the Statistical Package for Social Sciences (version 16.0). Data were analyzed using one-way repeated-measures analyses of variance between three sessions, that is, Baseline, squat, and *Thoppukaranam*. The group mean and standard deviation of scores obtained in the d2 test of attention and psychological states are presented in Table 1.

d2 test of selective attention

TN is a highly reliable measure of attentional allocation (selective and sustained), processing speed, amount of work completed, and motivation.[4] A one-way repeated measures analysis of variance revealed a mean TN differed statistically significantly between sessions [F (14.52), $P < 0.001$]. *Thoppukaranam* session showed a significantly higher TN score when compared to the baseline and squat. However, TN score did not show a statistically significant difference between baseline and squats. Error scores are related to attentional control, rule compliance, accuracy of visual scanning, and quality of performance, carefulness and cognitive flexibility.[4] Mean total *error* differed statistically significantly between sessions [F (6.79), $P < 0.001$]. Results indicate significant reduction in total error scores compare to baseline and squat following the practice of *Thoppukaranam*. The mean E% indicates accuracy, quality of work, and degree of carefulness by subjects on the test.[4] The results show that mean E% scores differed statistically significantly between sessions [F (9.18), $P < 0.001$]. Statistically significant reduction in E% scores following *Thoppukaranam* compared to baseline and squats sessions. The CP is a highly reliable measure of coordination of speed and accuracy performance on the test.[4] Mean CP differed statistically significantly between sessions [F (17.98), $P < 0.001$]. Results showed a statistically significant increase in CP scores from baseline and squat following the practice of *Thoppukaranam*. Further mean TN-E [F (17.32), $P < 0.001$] scores also indicate statistically significant increases between sessions. TN-E score showed significant improvement after the practice of *Thoppukaranam* compared to baseline and squat. Results indicate that *Thoppukaranam* enhanced attentional and inhibitory control.

Table 1: Scores on the d2 test of attention, state mindfulness, and state anxiety between sessions (baseline, squat, and *Thoppukaranam*)

	Mean (SD)		
	Baseline	Squat	*Thoppukaranam*
d2 Test			
TN	505.83 (82.78)	505.13 (85.27)	556.07 (73.44)*†
E	44.23 (43.90)	38.13 (42.97)	27.63 (30.26)*†
E %	8.83 (8.50)	7.33 (7.43)	4.88 (4.97)*†
TN-E	461.60 (91.26)	467.00 (84.72)	528.43 (72.95)*†
CP	177.17 (54.15)	182.70 (47.39)	215.70 (44.28)*†
STAI-SF	1.79 (0.53)	1.67 (0.42)	1.53 (0.42)*
SMAAS	4.37 (1.03)	4.51 (1.06)	4.82 (1.14)*

*$P<0.05$ compared with baseline, †$P<0.05$ compared with squat,
TN = Total number processed; E = Error; CP = Concentration performance;
STAI-SF = State trait anxiety inventory - Short Form;
SMAAS = State mindful attention awareness scale; SD = Standard deviation

State anxiety and state mindfulness

The results show that the state anxiety was significantly affected [F (4.80), $P > 0.01$] by the type of sessions. Further state anxiety score showed significant reduction immediately following the practice of *Thoppukaranam* compared to baseline. Further STAI-SF score did not change statistically comparing baseline and squats. The present moment awareness scores [F (3.01), $P < 0.05$] indicated statistical significance between sessions. Results show that immediately after the practice of *Thoppukaranam*, there was a significant increase in state mindfulness compared to baseline. Further, SMAAS score did not change statistically comparing baseline and squats.

DISCUSSION

The purpose of this study was to assess the effect of *Thoppukaranam* on selective attention, mental concentration, state mindfulness, and state anxiety in a sample of young adults. Findings suggest that the practice of *Thoppukaranam* has an immediate effect on selective attention and CP compared to baseline and squats. Further, *Thoppukaranam* session shown enhanced mindfulness and reduced state anxiety compare to baseline. As per our knowledge, there is no previous report specific to *Thoppukaranam* on cognitive function and psychological states for comparison. But the findings are consistent with anecdotes regarding the effect of super brain yoga, a similar practice.[3]

The positive effect of physical activity on attention has been reported in previous research.[9] Studies also indicate that coordinated exercise increases one's attention.[10] The aspect of physical activity was consistent in both squats and *Thoppukaranam*. The component of holding the earlobes seen only in the practice of *Thoppukaranam* may account for the significant improvement in attention scores. Overall, the reduction in state anxiety and increased present moment awareness may be cited as a possible mechanism for the improved performance. Further, the role of stimulating acupuncture points on earlobes may enhance attention performance.

While this study resulted in important findings, the results have to be considered in light of several limitations. Representation of males and females ratio was not equal and small sample size does not allow for generalization of the findings to a realistic population. Moreover, neither physiological measurements nor the lasting effect of intervention was assessed. Furthermore, the study used a mix of novice and long-term yoga practitioners who were part of an on-going residential yoga course. Therefore, it is unclear what effect the yoga practice had in influencing the participants' performance and psychological states.

Though *Thoppukaranam* has been practiced throughout India, there has been no formal research studies carried out to understand the effect of the practice to date. This is the first attempt to study the effect of the practice. Future studies could measure physiological parameters using brain imaging techniques to understand the mechanism and fallout period of the effects. It is also recommended to include comparison of unguided individual practice across various age groups with varying needs such as students in primary, secondary, or tertiary level educational institutes as well as those with special needs, developmental and behavioral disorders.

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