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Original Article

Psychiatry/Mental Health Section

Immediate Effect of Ujjayi Pranayama on Attention and Anxiety among University Students: A Randomised Self-control Study

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ABSTRACT

Introduction: Elevated level of anxiety and low attention in university students has detrimental effects on their academic performance and well-being. The practice of pranayama is considered to enhance the attention and reduce anxiety of individuals. Though, ujjayi pranayama has a relaxing and tranquilising effect, its effects on attention and anxiety in students has not been explored yet.

Aim: To assess the immediate effect of ujjayi pranayama on sustained attention, selective attention and state-trait anxiety in university students.

Materials and Methods: This was a randomised self-control study in which 34 students were randomly divided into group A and group B using the lottery method. Inclusion criteria were students in the age range of 18-35 years, conversant in English, willing to participate and having at least two years of proficiency in pranayama practice. The assessment and intervention were conducted at the yoga hall of Swami Vivekananda Yoga Anausandhana Samsthana, Bangalore, Karnataka, India, in the month of April 2015. The duration of intervention was for 10 minutes. On day one, group A practiced ujjayi pranayama for eight minutes and two minutes of breath observation. Students in group B were asked to sit in a meditative posture with eyes open. The order was reversed on the day two. Students from both groups were assessed just before and immediately after the intervention using the Digit Letter Substitution Test (DLST), Six Letter Cancellation Test (SLCT), and State-Trait Anxiety Inventory (STAI).

Results: A total of 34 participants with mean age 23.35±3.82 years were randomised into group A and group B. Statistical analysis showed, a significant difference in STAI scores (9.00±3.05 vs 10.29±3.23, p=0.005). No significant difference was observed in other variables in between group comparison. Likewise, the within group analysis showed a significant difference in pre and post scores of DLST (53.68±9.35 vs 59.65±9.66, p<0.001), SLCT (30.21±10.29 vs 33.71±11.67, p=0.007), and STAI (11.5±3.40 vs 9.00±3.05, p<0.001) in the group A as well as a significant difference in pre and post scores of DLST (55.82±10.44 vs 60.00±9.51, p=0.002) and STAI (10.94±3.19 vs 10.29±3.23, p=0.024) in the group B.

Conclusion: The present study suggested that ujjayi pranayama improves sustained and selective attention and reduces the state-trait anxiety of university students. However, further studies to assess the chronic effect of ujjayi pranayama with greater sample size and advanced tools are required to support the present finding.

Keywords: Selective attention, State-trait anxiety, Sustained attention

INTRODUCTION

A large number of university students report stress and anxiety because of perceived pressure for better academic performance, high academic expectations from their parents, and uncertainty of the future [1-4]. The elevated anxiety level in students is negatively associated with their well-being [5]. Students with high anxiety also have poor attention [6]. Poor attention has negative effects on students' academic performance [7,8]. Research showed that the practice of pranayama can reduce anxiety and enhance the attention of students.

Sage Patanjali defined pranayama as regulation and control of the prana (vital life force). It is the cessation of inhalation and exhalation that follows after securing steadiness on physical posture [9]. It is a voluntary attempt to get mastery over involuntary bodily function [10]. In general, it is the systematic manipulation of breathing that helps to calm down the mind and relieves stress. Scientific studies have shown that pranayama causes inhibition of unnecessary responding to stimuli, improves response inhibition, cognitive control, executive functions, and reaction time [11-13]. Fast and slow pranayama reduce autonomic arousal and increase relaxation of the mind that decreases force fluctuations during isometric contraction, which leads to an increase in hang grip strength and endurance [14]. Other studies showed that pranayama practice is highly beneficial in the management of stress related disorders, autonomic nervous system imbalances, cardiovascular diseases, and pulmonary diseases [15-18]. It even increases parasympathetic tone in healthy adults [19]. Apart from the long-term benefits of pranayama, several studies have reported significant improvement in attention and reduction of anxiety as well as systolic and diastolic blood pressure immediately after pranayama practice [20-22].

Pranayama has been found to be an effective technique in reducing college students' anxiety, stress, aggression and negative affect as well as improving their executive functions and academic performance [13,23-25]. It also induces better sympathovagal balance and parasympathetic control in students [26]. There are numerous types of pranayama and each one of them has a distinct effect depending on how it is practiced.

Ujjayi is a type of pranayama that has an intensively tranquilising and relaxing effect at the psychic level [27]. Ujjayi is derived from the Sanskrit root 'ujj' which means to conquer or acquire by conquest. Ancient texts on yoga claim that ujjayi pranayama helps to conquer all the senses, promotes internalisation of these senses and brings mastery over the mind [28]. Ujjayi is a deep breathing technique in which epiglottis is contracted slightly and a gentle hissing sound is produced along with inhalation and exhalation. A scientific study showed that ujjayi pranayama increases cardiac output and decreases heart rate [29]. Another study showed, the practice of ujjayi pranayama was effective in resting heart rate and resting pulse rate [30]. Research also found that ujjayi pranayama along with shavasana produces a significant decrease in the heart rate, systolic blood pressure, diastolic blood pressure, pulse pressure,

mean arterial pressure, and the rate pressure product [31]. These findings indicates that ujjayi pranayama calms down the mind and could improve attention as well as reduce the anxiety of university students. Search was conducted to evaluate the acute and chronic effect of the ujjayi pranayama on attention and state-trait anxiety of university students did not surface during the intensive literature review. Therefore, the present study was carried out to evaluate the immediate effect of ujjayi pranayama on sustained and selective attention and the state-trait anxiety among university students.

MATERIALS AND METHODS

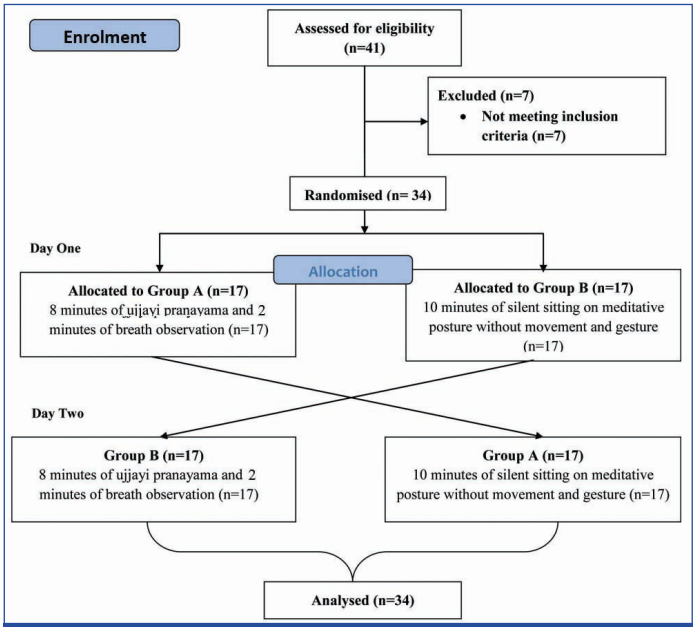
This was a randomised self-control study which was conducted at Swami Vivekananda Yoga Anusandhana Samsthana (SVYASA), Bangalore, Karnataka, India in April 2015. It was undertaken as part of undergraduate research requirements and protocols of the SVYASA {B.Sc. (Yoga)}. This study was approved by the Institutional Ethical Committee (IEC) of SVYASA. Written informed consent form was obtained from participants before considering them for assessment and intervention processes.

Inclusion criteria: (i) Students in the age range of 18-35 years; (ii) Conversant in English; (iii) Willing to participate; and (iv) Having at least two years of proficiency in pranayama practice were included.

Exclusion criteria: (i) Students self-reporting any kind of physical and psychological disorders as well as; (ii) Students with hearing difficulty.

Total 41 students were assessed for eligibility and seven of them were excluded for not meeting inclusion criteria. Finally, 34 (26 male and 8 female) graduate and undergraduate students were recruited. The central limit theorem considers sample size greater or equal to 30 is large enough [32].

Participants were randomly divided into group A and group B using the lottery method [Table/Fig-1]. Each student was given serial numbers from 1 to 34, which did not depend upon the order of enrolment. Each number was written on 34 pieces of paper. All pieces of paper were folded, kept in a box, and mixed properly. Then, papers were picked out from the box one by one by an individual having no role in the present research. The odd picked numbers were allocated into group 'A' while the even picked numbers were assigned into group 'B'.



[Table/Fig-1]: Flow Diagram.

Intervention

The intervention was conducted in the yoga hall of the university at 7 am. The duration of the intervention was for 10 minutes. On day one, group A practiced ujjayi pranayama for eight minutes and two minutes of breath observation. Students in group B were asked to sit in a meditative posture without closing eyes. Students were assessed just before and immediately after the intervention using DLST, SLCT, and STAI.

The instruction of ujjayi pranayama was as follows: "Sit in any comfortable meditative posture, and relax the whole body from head to toes and toes to head. Gently lean the neck slightly forward and inhale slowly through the nostrils producing soft snoring sound at the throat region and expand the chest completely. Exhale slowly through your nostrils producing a hissing sound from the throat. Sound should be audible to the practitioner alone. Concentrate at your throat region throughout the practice and feel the breath that is being drawn in and out through the throat, not the nostrils. Now close the eyes and keep them close throughout the practice. Try to keep the body stable throughout the practice. Continue the practice till you are instructed to stop" [28]. After eight minutes, participants were instructed to stop the practice and asked to observe the natural flow of the breath and the changes brought up by the practice. After 10 minutes, they were instructed to open their eyes with a few blinks.

While participants in group B were instructed to sit silently in any meditative posture without closing their eyes for 10 minutes. They were also restricted from looking at each other and gesturing. There was a 24 hours of washout period. The order was reversed on the day second i.e., group B was given eight minutes of ujjayi pranayama followed by two minutes of breath observation, whereas group A was asked to sit silently in a meditative posture without movement and gesture for 10 minutes. Both groups were assessed just before and immediately after the intervention using the same instruments as the day prior.

Assessment Tools

Digit Letter Substitution Test (DLST): DLST is a valid test to measure psychomotor performance i.e. visual scanning, mental flexibility, sustained attention and psychomotor speed of information processing [33]. The DLST worksheet comprises a set of random digits, 1 to 9 in 8 rows and 12 columns. The worksheet has instructions about the test on the top with an illustration of substituting a specific letter for each digit 1-9, the same coding applying to the entire test group. Subjects were instructed to make their strategy of letter substitution, whether selecting a particular digit randomly in the array one at a time horizontally or vertically. They were given the specified time of 90 seconds to substitute as many target letters as possible. The test was scored manually as per standard criteria by the researcher who was not involved in the study. The total score was obtained by counting, a total number of substitutions, the wrong score was obtained counting wrong substitutions and the net score was obtained by deducting the wrong score from the total score.

Six Letter Cancellation Test (SLCT): The SLCT assesses psychomotor function as selective and focused attention, visual scanning and the activation and inhibitions of rapid responses [34]. It requires visual selectivity and repetitive motor response. The SLCT worksheet consists of instructions and six target letters to be canceled on the top and the working section below with 14 rows and 22 columns of letters arranged randomly. Subjects were instructed to cancel as many letters as possible in the given specific time of 90 seconds. They were asked to make their own choice of cancellation, either choosing any one targeted letter or selecting all targeted letters at once. They were also told to follow horizontal, vertical, or random paths of cancellation as per their comfort. The scoring of the test was done by the researcher who was not involved in the assessment. The total score and wrong score was obtained by counting the total number of cancellation and wrong cancellation. The net score was calculated by subtracting the wrong score from the total score.

State-Trait Anxiety Inventory (STAI): STAI is self-reported appraisals indicating the intensity of feelings of anxiety [35]. The six items STAI was used to assess the state and trait anxiety of university students.

It comprises of six statements describing six different kinds of feelings. Subjects state how often they experience that feeling: not at all, somewhat, moderately, or very much. The scoring was done by the researcher who was not involved in the research. The scoring was 1 for not at all, 2 for somewhat, 3 for moderately, and 4 for very much, for 3 negative statements, and reverse for 3 positive statements. The total score was obtained by adding scores of six individual statements. Scoring has a direct interpretation, a high score means more anxiety, and a low means less.

STATISTICAL ANALYSIS

Data analysis was done by using International Business Machines (IBM) Statistical Package for the Social Sciences (SPSS) software (22.0 version). Repeated Measures Analysis of Variance (RM-ANOVA) was used to analyse the obtained data which was followed by post-hoc tests with Bonferroni adjustment. The RM-ANOVA had two within subjects' factors namely Factor 1: Sessions (Ujjayi Pranayama and Simply Sitting) and Factor 2: times (Pre and Post). The p-value for significance was set at 0.05 level.

RESULTS

A total of 34 participants (male=26 and female=8), in the age range between 20 to 32 years (mean age=23.35±3.82 years), were randomised into group A and group B.

Statistical analysis showed a significant difference in STAI scores (p=0.005, 95% CI=-2.16, -0.42) in the between group comparison. No significant difference was observed in other variables in the between group comparison. Likewise, within group analysis showed a significant difference in pre and post scores of DLST (p<0.001), SLCT (p=0.007) and STAI (p<0.001), in the group A as well as a significant difference in the pre and post scores of DLST (p=0.002) and STAI (p=0.024) in the group B [Table/Fig-2-4]. There was a significant interaction (sessions x times) in STAI scores {f (1, 33)=22.63, p<0.001}.

DLST	Preintervention score	Postintervention score	p-value (Intragroup)
Group A	53.68±9.35	59.65±9.66	<0.001
Group B	55.82±10.44	60.00±9.51	0.002
p-value (Intergroup)	0.196	0.744	

[Table/Fig-2]: DLST score comparison.
The p-value for significance was set at 0.05 level.

SLCT	Preintervention score	Postintervention score	p-values (Intragroup)
Group A	30.21±10.29	33.71±11.67	0.007
Group B	31.25±9.80	30.59±9.67	0.67
p-value (Intergroup)	0.63	0.14	

[Table/Fig-3]: SLCT score comparison.

STAI	Preintervention score	Postintervention score	p-value (Intragroup)
Group A	11.5±3.40	9.00±3.05	<0.001
Group B	10.94±3.19	10.29±3.23	0.024
p-value (Intergroup)	0.32	0.005	

[Table/Fig-4]: STAI score comparison.
The p-value for significance was set at 0.05 level.

DISCUSSION

The findings of the present research showed a significant increase in sustained attention of university students after ujjayi pranayama and simply sitting sessions, as measured by DLST. A significant increase in selective attention was observed only after ujjayi pranayama, as measured by SLCT. There was a significant decrease in state-trait anxiety after ujjayi pranayama and simply sitting as measured by STAI. However, reduction in state-trait anxiety was significantly greater after ujjayi pranayama compared to simply sitting.

As per our knowledge, this was the first research to evaluate the effect of ujjayi pranayama on attention and anxiety among university students. However, earlier studies showed both slow and fast pranayama reduced the stress of university students and enhanced cognitive functions [13,36]. Studies also showed that pranayama practice has an immediate effect on student anxiety and attention [27]. Apart from these studies, a systematic review showed slow breathing practice increases heart rate variability, increases alpha and decreases theta power as measured by Electroencephalography (EEG), and increases the activity of frontal, motor and parietal cortices. This study also reported that slow breathing increases comfort, pleasantness, vigour, and alertness, and reduces the symptoms of arousal, anxiety, depression, anger and confusion [37]. Similarly, diaphragmatic breathing was also found to improve sustained attention and decrease negative affect and cortisol levels of healthy adults [38].

The exact mechanism behind the improvement in attention and reduction in anxiety after ujjayi pranayama is not known yet clearly. However, some of the previous research on the physiological effects of ujjayi pranayama showed an increase in cardiac output and a decrease in heart rate [29,30]. Ujjayi pranayama along with shavasana decreased systolic blood pressure, diastolic blood pressure, pulse pressure, mean arterial pressure, and rate pressure product [31]. These findings indicated that the practice of ujjayi pranayama reduces activities of the sympathetic nervous system, increases the activities of the parasympathetic nervous system, reduces stress and induces the relaxation of the mind that can enhance sustained and selective attention and reduce state-trait anxiety among university students. Pranayama practices could increase attention by enhancing cognitive control and response inhibition to unnecessary stimuli [20]. Likewise, a Magnetic Resonance Imaging (MRI) and functional MRI (fMRI) study showed that pranayama significantly reduces anxiety and negative affect by regulating the activity of the amygdala, anterior cingulate, anterior insula, and prefrontal cortex, as well as connectivity of ventrolateral cortex and anterior insula, brain areas involved in emotion processing, awareness and attention [26].

There was also a significant improvement in sustained attention and reduction in state-trait anxiety immediately after the simply sitting session. A previous study conducted in pre-teen children also reported a significant anxiety reduction immediately after the quiet sitting session [21]. Simply sitting in a meditative posture without talking and gesturing would induce a meditative state of mind in the university students who already have two or more than two years of experience in yoga practice. It can be the reason for improving sustained and selective attention and reducing the state of anxiety after simply sitting sessions.

The current study suggested that ujjayi pranayama can improve attention and reduce the anxiety of university students. These are significant findings because university students failed to perform well in universities due to elevated levels of anxiety and lack of attention. High anxiety is negatively associated with academic performance [39]. Elevated levels of anxiety also have a negative relationship with the well-being of university students. Thus, ujjayi pranayama can be taught to university students to enhance their sustained and selective attention and reduce state and trait anxiety. Regular practice of ujjayi pranayama can improve the psychological well-being and academic performance of university students.

Limitation(s)

The study was limited by the small sample size. Although, the number of female students in the study was less, there would be difficulties to generalise the findings of a study among female students. In addition, the long lasting effect of ujjayi pranayama was not observed. To address these limitations future studies can be conducted with a bigger sample size including equal numbers

of female participants and using advanced tools. A prospective randomised control study to assess the chronic effect of ujjayi pranayama can be conducted to provide more authentic evidence to complement the results of the current study. Even research can be conducted using brain imaging tools to understand the underlying neural mechanism of ujjayi pranayama in improving attention and reducing anxiety.

CONCLUSION(S)

The findings of the present study indicate that ujjayi pranayama is effective in improving sustained and selective attention, and reducing the state-trait anxiety of university students. Based on the current findings, educational institutions can incorporate ujjayi pranayama in their daily schedule to enhance cognitive functions and minimize the anxiety level of students. However, further studies with greater sample size and advanced tools are required to support present findings.

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