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RESEARCH ARTICLE

The effect of yoga in improved cognitive functions in medical students: A comparative study

Ambareesha Goud Kondam[1], Nagadeepa W[1], Jagan N[2], Jyothinath K[3], Suresh M[4], Chandrasekhar M[5]

[1]Department of Physiology, MNR Medical College and Hospital, Sangareddy, Medak, Telangana, India, [2]Department of Pharmacology, MNR Medical College and Hospital, Sangareddy, Medak, Telangana, India, [3]Department of Anatomy, MNR Medical College and Hospital, Sangareddy, Medak, Telangana, India, [4]Department of Physiology, Sri Ramakrishna Dental College and Hospital, Coimbatore, Tamil Nadu, India, [5]Department of Physiology, Meenakshi Medical College and Hospital, Kanchipuram, Tamil Nadu, India

Correspondence to: Ambareesha Goud Kondam, E-mail: drambreeshphysio@gmail.com

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ABSTRACT

Background: The medical students experience a lot of stress, which increase when they appear for internal assessment examination. Yoga as an anxiolytic tool which has been practiced over centuries in India. **Aims and Objectives:** To assess the efficacy of yoga in increasing the cognitive performance in medical students after practicing it for 6 months. **Materials and Methods:** A comparative study was conducted in the Department of Physiology, MNR Medical College and Hospital, Sangareddy, Medak District, Telangana, India. A total number of 80 medical students who were ready to undergo their first internal examinations were selected. Students were randomly assigned to four groups and were given a 60-min session on pranayama and suryanamaskar. Group I, Control group, was not underwent any kind of yoga during the study period and were given a lecture on stress reduction, practice of meditation without any yoga instructions, Group II, study Group, who can practice only pranayama, Group III who can practice only suryanamaskar and Group IV practices both pranayama and suryanamaskar. The investigator who was unaware of the groups had taken the Addenbrooke's Cognitive Examination-Revised questionnaire of the students two times (a) before appearing for internal examination and (b) after immediately appearing for examination and both were compared after 6 months of yoga for their improvement in cognitive functions. Statistical analysis was performed using analyses of variance (ANOVA) by SPSS V.16. **Results:** The statistical results showed a significant improvement in the Group A compared to Group B (ANOVA; $P < 0.001$). **Conclusions:** This study concludes that yogic breathing and yogic postures (suryanamaskar) has a significant effect on the reduction of anxiety level and improvement in cognitive functions of medical students.

KEY WORDS: Medical Students; Pranayama; Suryanamaskar; Stress; Cognitive Function; Yoga

INTRODUCTION

Yoga is one of the many different techniques for achieving relaxation by breathing and postural exercises.[1] Yoga has its origin in ancient India and is consisted of a system of spiritual, moral and physical and physiological practices.[2] The most central and common aspects of yoga practice today are different bodily postures. Suryanamaskar and breathing exercises (pranayamas)[3] that aim to focus the mind, achieve relaxation and increase wellness.[4] Several studies reported beneficial effects of yoga on anxiety, stress reduction, and general well-being.[5-8] In general, medical students experience more stress than the general population all over the world.[9,10] Kieser and Herbison[11] reported that clinical dental students are most anxious about surgical procedures, which negatively impacts their physical and mental health.[12] O'Shea et al.[13]

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suggested that having a calm manner, smiling, being friendly to the patient, and giving emotional support to the patient throughout treatment by medical students can decrease patient anxiety which in turns exacerbates. Patients' distress during procedures.[14] Malathi and Damodaran[15] studied the effect of yoga on reducing stress in first-year medical students. In the medical literature, few studies have examined stress-management interventions.[16-19] The objectives of this paper are to evaluate the effect of yoga intervention in reducing medical students' anxiety before and during or immediately or after first internal assessments and improves cognitive performance.

MATERIALS AND METHODS

The study was conducted in MNR Medical College and Hospital, Sangareddy, Medak, India, which is a private medical college affiliated with the NTR University of Health Sciences, Vijayawada, India. Ethical clearance was obtained from the Ethical Committee and the dean of the college before initiating the study. Data collection took place in July 2015 in the first academic term for the year 2015-2016. The sample includes 80 undergraduate medical students (males 56%, females 44%). These students were randomly selected and included in our study. The participants were divided into four groups, namely control, pranayama, suryanamaskar, and combined group of pranayama and suryanamaskar.

Methods

All the participants were subjected to the 6 months of pranayama and suryanamaskar training by a certified yoga teacher in department of physiology. All the subjects were asked to practice daily for about 1 h. Yoga classes started with a brief prayer. The duration of the study was 6 months; the yoga training was performed for 30 min, daily for 5 days a week. This was followed by 30 min of either pranayama (Group II) or suryanamaskar (Group III) or combined Group (pranayama and suryanamaskar).

General characteristics (age, body weight, height, and body mass index) were observed in subjects. All subjects were assigned to learn the whole yoga protocol and were explained in detail by the investigator. On the 1st day of study, subjects came to the training room and cognitive functions were assessed using standard test. These were pre-yoga exercise values. After 6 months of yoga training, the same tests were conducted which were designated as the post-yoga values after internal assessment.

The yogic exercises allotted to the group were as follows:

Pranayama

1 Bhastika pranayama
2 Kapal bhati pranayama
3 Bramhari pranayama
4 Nadisuddi pranayama/anulom vilom
5 Pranava pranayama was classified into (i) Adhobhagiya (ii) Madhyama bhagiya (iii) Urdhwabhagiya.

Suryanamaskar (sun salutation pose)

This practice was started at 4.30 pm on an empty stomach in a clean, ventilated, and quiet lab room. Suryanamaskar pre-training was given for 7 days by a yoga trainer and the performance of suryanamaskar was analyzed using performance chart. The participants were trained to perform suryanamaskar in a slow manner so that each of the 12 poses was held for a duration of 30 s. Each round took 6 min to complete and 5 rounds were performed in 30-40 min.

Cognitive function tests[20]

The Addenbrooke's Cognitive Examination-Revised was given to all the participants. It was a brief and simple cognitive screening tool. It is established as a sensitive screening test for mild cognitive impairment, dementia, and Alzheimer's disease. The following criteria were considered for scoring appropriate points such as attention and orientation (18), memory (26), fluency (14), language (26), and visuospatial (16). This cognitive questionnaire test was conducted before and after yoga training and the total score achieved by the students were analyzed.

We then conducted a two-tailed independent-groups *t*-test to test whether cognitive performance differed between the two groups (before yoga and after yoga). To score the cognitive test, we calculated the number of correct responses from each participant. The questionnaire was scored between the various values of different parameters, with one point given for each corrects answer, and was applied to all the participants.

Statistical Analysis

All the values obtained before and after performing pranayama, suryanamaskar and combined pranayama, suryanamaskar yogic exercises were expressed as mean ± standard deviation. The data were analyzed by SPSS 16.0 version one-way analyses of variance followed by paired *t*-test (Dennett's test) which was used to compare pre- and post-training results. $P < 0.05$ was accepted as a significant difference between the compared values.

RESULTS

A total of 80 students were randomly assigned into four groups of 20 students each, comparison of cognitive score before and after yoga practice.

Was done after 6 months of yoga period, immediate after internal assessment. The memory and visuospatial were significantly increased ($P < 0.05$) in the combined group

(Group IV) and suryanamaskar group, whereas attention and orientation, fluency and language were significantly decreased ($P < 0.05$) in suryanamaskara group (Group III) than pranayama (Group II) and combined group. All the above-mentioned values were statistically more significant in combined group (Group IV) than other groups ($P < 0.05$).

DISCUSSION

The purpose of this study was to investigate the efficacy of a 6 months yoga intervention in improving cognitive and functional outcomes in healthy student volunteers. The participants in the yoga intervention showed significantly improved performance on all cognitive parameters. The 6 months yoga intervention improved executive functions including attention and information processing speed, working memory capacity and mental efficiency. In conjunction with the cognitive outcomes, the functional fitness measures showed a significant time effect that was comparable to the control group. In summary, 6 months of regular yoga practice had cognitive and physical health benefits that demand rigorous replication and systematic examination in future studies.

Cognitive functions are intellectual processes by which one becomes aware of, perceives, or comprehends ideas. These functions help us to focus on the problem, process the required information, arrive at the logical conclusion, make decision and then execute the task. There was a significant improvement observed in all the parameters including attention and orientation ($P < 0.05$), memory ($P < 0.005$), fluency ($P < 0.005$), and visuospatial ($P < 0.005$) in our study. The significant improvement was observed in pranayama group, suryanamaskar group ($P < 0.005$), when they performed individually. This kind of improvement was quite commonly explained in many of the yogic studies. But in Group IV (combined group) this improvement was much more significant ($P < 0.005$). Because the individual benefits of pranayama (controlled breathing) and suryanamaskar (yogic postures) were combined in Group IV. Consistently Group IV individuals performed better than individual group participants.

Table 1: Different groups with duration of training

Groups	Number of participants	Duration of training
Group I (before yoga group)	20	-
Group II (pranayama)	20	6 months
Group III (suryanamaskar group)	20	6 months
Group IV (combined group of pranayama and suryanamaskar)	20	6 months

These results suggest that yoga practice brings about a greater improvement in task analysis which requires selective attention, concentration, visual scanning abilities, and a repetitive motor response. Joshi et al. found that left nostril breathing increases performance of participants in the spatial cognitive task.[21] Therefore, left nostril breathing increases the spatial tasks, whereas right nostril breathing increases verbal tasks. These results may be related to the enhancement of contralateral hemispheric function found with selective nostril breathing. Yogic practices are reported to cause a shift in autonomic balance toward parasympathetic dominance, the students following pranayama took significantly less time in solving problems compared to time taken for solving the problems prior to the training[22] ($P < 0.001$). Studies show that practice of yogic techniques cause improvement in aspects of perception, thinking, reasoning, and remembering the task. Yogic techniques especially pranayama and suryanamskar improve attentiveness. Increased attentiveness decreases response time or reaction time. A decrease in reaction time indicates an improved sensory-motor performance and enhanced processing ability of the central nervous system. This may be due to greater arousal, faster rate of information processing, improved concentration and/or ability to ignore extraneous stimuli practice can lead to improvement in many physiological and psychological functions.[23] It is claimed that pranayama and suryanamaskar practice improves general health and fitness. It improves pulmonary, cardiovascular and cognitive functions and helps to develop self-discipline. We, therefore, conclude that pranayama and suryanamaskar should be practiced by medical and non-medical healthy individuals every day to get these beneficial effects. Scientific research has shown that yogic techniques produce consistent and beneficial physiological changes. 6 months

Table 2: Comparison of cognitive score before and after yoga practice

Parameters	Before yoga (Group I) (n=20) (control)	After Pranayama (Group II) (n=20)	After Surya Namaskar (Group III) (n=20)	Combined group - (Group IV) (n=20)
Attention and orientation (M.S-18)	14.02±0.21	16.24±0.63**	14.23±0.21	17.32±0.72**
Memory (M.S-20)	16.96±0.62	19.18±0.58*	20.91±0.64*	24.21±1.13**
Fluency (M.S-14)	7.74±0.68	12.09±0.58**	11.61±1.27**	12.51±0.31**
Language (M.S-26)	16.29±0.92	24.92±1.20**	18.20±0.20*	25.18±0.11**
Visuospatial (M.S-16)	9.02±1.06	11.72±0.89*	14.92±1.42**	15.01±0.91**

Values are expressed as mean±SD; *P<0.05, **P<0.001 significant compared with before yoga. M.S: Multiple sclerosis

of disciplined yoga has beneficial effects on other cognitive functions. Swenson, 1999 reported that the act of breathing removes attention from worldly worries and de-stress. This stress free individual adapts better to the daily emotional, physical and mental stresses.[24]

Joshi et al. (2008) reported a progressive increase in critical flicker fusion frequency following 10 day yoga training program. The critical flicker fusion frequency is the frequency at which a flickering stimulus is perceived to be steady, with higher values suggesting greater perceptual accuracy. Yoga practice is globally in these days. Yoga has become an experimental science. In our study, we tried to elucidate the role of two major yoga exercises namely pranayama and suryanamaskar on cardiorespiratory status, autonomic status and cognitive functions in young medical students who were prone for stressful situation in their routine work. 6 months of yoga training showed significant beneficial effect on heart rate, blood pressure and improved cardiorespiratory efficiency. It also had a significant effect on autonomic nervous system by decreasing the sympathetic activity and increasing the parasympathetic activity. It also showed gross improvement in cognitive and problem solving ability. Our study shows that if pranayama and suryanamaskar were combined and implemented regularly for 6 months, there would be a profound improvement in cardio, respiratory status, autonomic status and higher functions. It was observed in another study by Bhavanani et al. (2003) that pranayama produced immediate and significant reduction in the auditory and visual reaction time, indicating an improved sensory motor performance and an enhanced processing ability of the central nervous system.[25]

Pratima et al. (2008) reported with increased awareness and interest in health and natural remedies, yogic techniques including pranayama are gaining importance and becoming increasingly acceptable to the scientific community. Yoga and lifestyle interventions have been included with conventional therapy in the treatment of many clinical conditions and they have shown a "positive outcome." Yoga emphasizes on controlled breathing (pranayama), body posture (asana), relaxation of mind (meditation) keeps a person energetic and healthy for maintaining health and fitness and for treating diseases.[26]

Limitation of the Study

The limitation of the study was that there was no biochemical parameter assessed during the study period. And probable hormone that could have been studied would have been corticosteroids, catecholamine, and acetylcholine. This yogic exercise could have been also extended to female subjects as they are more stressed and emotionally involved than their male counterparts. This study could have also included larger population to have a better correlation and certain parameters lacked accurate measurements which could have been rectified.

CONCLUSION

Hence, pranayama and suryanamaskara practice induces more beneficial effects than physical exercise which mostly affects skeletal muscles. To meet the modern lifestyle which is full of challenges and stress, an all-round personality development has become mediatory for the student, this aspect of relaxation and detachment is lacking in our education process and it is this new dimension (yoga) that needs to be added to the curriculum. Hence by regular practice of various body postures (suryanamaskar), breathing techniques (pranayama) and meditation, it is believed that one can obtain a sound physical body as well as a calm and peaceful mind with enhancement of cognitive functions.

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