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Original Article

Complementary/Alternative Section

The Effect of Yoga Practices on Cognitive Development in Rural Residential School Children in India

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ABSTRACT

Objective: To study the effect of yoga practices on selected cognitive development variables among adolescent rural residential school children.

Materials and Methods: Eighty two students, age ranged from 11-15 years, were randomly divided into experimental (n=41) and control (n=41) groups. Selected cognitive development variables were evaluated at the baseline and at the end of 12 weeks of yoga training in both groups.

Results: Significant improvement was observed in measures of mental ability and memory in experimental group. However, no statistically significant changes were observed in measures of mental ability and memory tests in control group.

Conclusion: Selected cognitive development variables were improved after 12 weeks of yoga training in adolescent rural residential school children.

Keywords: Cognitive development, Schoolchildren, Yoga,

INTRODUCTION

Mental health is "a state of well-being in which the individual realises his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community [1]." It can also be defined as a state of emotional and psychological well-being in which an individual is able to use his or her cognitive and emotional capabilities, function in society, and meet the ordinary demands of everyday life [2].

Cognitive performance refers to a person's mental processes, including memory, attention, producing and understanding language, learning, problem solving, reasoning, and decision making [3]. Cognitive development starts in early adolescence and is influenced by many factors such as postnatal psychosocial environment [4], poverty, malnutrition [5], family stressors, environmental stressors [6,7], and maternal depression [8]. Adolescent rural children are more likely to be subjected to poor socioeconomic conditions as compared to urban adolescent children [9,10]. Poor quality of home environment can adversely affect children's development, leading to cognitive deficits [11]. Findings of one study suggested that the experience of persistent economic hardship, as well as, very early poverty undermines cognitive functioning at five years of age [12]. However, according to a recent experimental research, both acute and chronic aerobic exercise promotes children's executive function. Executive function refers to the cognitive processes necessary for goal-directed cognition and behaviour which develop across childhood and adolescence [13-15].

In this context, ancient traditional practice of yoga might be helpful in improving mental health and thus cognitive development. The Sanskrit term yoga means "the union of the individual self (Jiva-atman) with transcendental self (Parama-atman)". The word 'Yoga' is derived from the Sanskrit root verb "Yuj" means bind, make union, control. Patanjali defines yoga as the "restriction of the wheels of consciousness and paths of ecstatic self-transcendence or methodical transmutation of consciousness to the point of liberation from the spell of ego personality" [16]. Yoga has multiple physical, mental and spiritual benefits and holds that the influence of the mind on body is far more powerful than the influence of body on mind. Yoga helps in gentle and automatic massaging of internal organs and thus helps in enhancing functioning of digestive system, circulatory system, respiratory system, endocrine system, nervous system, and excretory system [17]. According to a study conducted in a secondary school, preliminary results suggest that yoga has the potential of playing a protective or preventive role in maintaining mental health [18].

There are scientific evidence that yogic practices enhance mental health [19], muscle strength, flexibility, respiratory system, cardiovascular system, promote recovery from addiction and its treatment, reduce stress, anxiety, depression, relieve chronic pain, improve sleep patterns and enhance

Variables	Experimental Group		Control Group	
	Baseline (M±SD)	Final (M±SD)	Baseline (M±SD)	Final (M±SD)
Mental Ability Test 1(CFC)	6 ±2.06	6.54 ±1.79	5 . 3 2 ±2.32*	6.30 ±2
Test 2(CFS)	3.97 ±2.08	4.8 ±2.31*	3.32 ±1.92	3.92 ±2.24
Test 3 (NFC)	6.74 ±2.78	7.34 ±2.7	6.46 ±2.84	7.22 ±2.81
Test 4 (EFC)	5.57 ±2.39	6.83 ±2.73**	5.30 ±2.74	5.97 ±2.92
Test 5 (NFR)	3.54 ±3.16	3.74 ±3.55	3.05 ±2.68	4.05 ±2.66
Test 6 (NFS)	7.17 ±3.14	7.83 ±2.95	6.86 ±2.91	7.35 ±3.03
Test 7 (EFR)	1 0 . 0 9 ±2.64	10.17 ±2.32	9.30 ±3.36	1 0 . 2 2 ±2.91
Test 8 (EFS)	1 0 . 2 6 ±2.68	10.94 ±2.91	9.92 ±2.98	10.73 ±3
Test 9 (EFI)	6.91 ±2.16	6.97 ±2.56	6.54 ±2.80	6.24 ±2.89
Memory Test 1 (MFC)	7.00 ±2.59	7.91 ±2.17*	7.46 ±2.41	7.73 ±2.06
Test 2 (MSC)	8.77 ±4.04	9.94 ±5.01	9.32 ±4.35	9.84 ±4.57
Test 3 (MMR)	7.17 ±3.93	7.66 ±3.51	6.84 ±3.88	6.95 ±3.92
Test 4 (MBC)	7.06 ±3.14	7.51 ±3.67	6.97 ±3.44	7.51 ±3.04

[Table/Fig-1]: Pre test and post testmean & S.D. values of selected variables after 12 weeks of yoga training
*p<0.05, **p<0.01

overall well-being and quality of life [20,21]. Earlier findings suggest that yoga reduces stress in school children which enhances their academic performance [22].

Even though there are several research reports indicating positive impact of yoga on health but there are limited research studies exploring effect of yoga on cognitive development in adolescent children. Therefore, the goal of this research study was to determine whether yoga intervention during early adolescence has lasting effects on the cognitive development of rural adolescent residential school children in India.

MATERIALS AND METHOD

Subjects

Eighty two school children, aged 11 to 15 years (13.02±1.24) studying in 5th to 9th grade in a rural residential school, participated in this study. All the students belonged to different rural areas of Maharashtra, India. Written permission to conduct this study was obtained from the Institutional Ethical Committee, Kaivalyadhama Yoga Institute, Lonavla, prior to the start of this research study. Written consent was obtained from the guardian of the students after explaining the aims and the objectives of the research study. Oral consent of the children was taken concerning the procedure and benefits of the study, at the outset. Also, medical examination was conducted by Medical doctors appointed by Kaivalyadhama Yoga Institute, Lonavla, to assess general health conditions of the participating students, prior to the start of yoga training. There were 41 students in each group at the baseline testing. However, at the end of 12 weeks, there were 37 students in Experimental Group and 34 students in Control group because of 11 drop-outs. Drop-outs were due to various reasons, mainly disinterest, academic pressure, illness and absence during either pretesting or post-testing. All the students who participated in the research study were in apparent good health.

Research design

Quasi experimental pre post design was used for conducting this research study. The students were randomly assigned into Experimental Group (n=41) and Control (n=41) group by Chit method for random selection. Both Experimental and Control group were assessed on the first day and after 12wks of the intervention. The subjects of Experimental Group then underwent a training of yoga practices, under the supervision of a yoga expert, for one hour in the morning, excluding Saturdays, Sundays and holidays for a total period of 12wks. The Control group did not undergo any yoga training during this period. However, both the groups continued to participate in their regular extracurricular activities during school hours.

Psychological Assessment

The following tests were administered to the children: A test battery of Cognition Function tests (CFTs), an Indian adaptation based on Guilford's Structure of Intellect Model, devised by Jnana Prabodhini's Institute of Psychology, Pune, India was administered on each student. This test was suitable for use in children of 11-15 yrs of age.

Abilities measured:

Level 1 and 2

Mental Ability Test Battery: This battery contains nine tests based on J. P. Guilford's Structure of Intellect (SOI) model. It involves observing and identifying similarity and differences between figures and numbers, observing developmental sequence between figures and numbers, as well as observing and identifying transformations occurring in these two. Following are the names and definitions of Factors Measured:

Test 1- Cognition of Figural Classes (CFC)

Ability to recognise or understand common attributes among figures and classify them accordingly. Reliability=0.99.

Test 2- Cognition of Figural Systems (CFS)

Ability to structure a system by joining parts of a figure considering appropriate directions. Reliability=0.63.

Test 3- Convergent Production of Figural Classes (NFC)

Ability to search for some rule or principle on the basis of which figures can be classified into mutually exclusive classes. Reliability=0.61.

Test 4 Evaluation of Figural Classes (EFC) Ability to make judgement regarding adequacy of a figure as a member of certain class. Reliability=0.98.

Test 5- Convergent Production of Figural Relation (NFR)

Ability to identify relations among presented figures and implement the same to given figures. Reliability=0.68.

Test6 -Convergent Production of Figural Systems (NFS)

Ability to arrange the given figures sequentially according to certain rule. Reliability=0.86.

Test 7- Evaluation of Figural Relation (EFR)

Ability to weigh the similarity in the relation observed in the pairs of figures. Reliability=0.81.

Test 8- Evaluation of Figural Systems (EFS)

Ability to give a judgement regarding correctness of the sequence of given figures. Reliability=0.78.

Test 9- Evaluation of Figural Implications (EFI)

Ability to judge implications of changes introduced in the figure. Reliability=0.78.

Memory Kit

Level 1 and 2

This test battery involves immediate recognition after correctly identifying and understanding of the common characteristics of a group of figures, common letters, feelings or emotions expressed and meaningful relations between two words. It contains four tests based on J. P. Guilford's Structure of Intellect (SOI) model. Three of the tests are different for grades 5th, 6th and 7th, 8th, and 9th. Remaining one is common to all grades. Following are the names and definitions of factors measured:

Level 1-grades 5th and 6th

Memory of figural classes (MFC): Ability to observe and retain the common characteristic/principle presented in groups of figures and later to recognise that characteristic in other figures. Reliability=0.99.

Memory of symbolic classes (MSC): Ability to identify and remember common letter groups and later recognise words containing the same letter groups. Reliability=0.83.

Memory of semantic relations (MMR): Ability to understand and retain an observed relationship/connection between two things stated in a sentence and later recognise correctly the statement that indicates the same relation. Reliability=0.57.

Memory of behavioural classes (MBC): Ability to identify and retain the common feelings/mental state depicted in a group of pictures and later recognise the correct picture which reflects the same feelings/emotion/mental state. Reliability=0.44.

Level 2-grades 7th, 8th, and 9th

Memory of Figural Transformations (MFT): Ability to observe and retain a specific portion of a figural block and later identify it correctly in a pair of two figural blocks. Reliability=0.80.

Memory of Symbolic Transformations (MST): Ability to understand and remember a certain kind of letter arrangement in a sentence and later recognise the same correctly. Reliability=0.99.

Memory of Symbolic Implications (MSI): Ability to understand and retain the association in a pair of words and later recognise it correctly. Reliability=0.80.

Memory of behavioural classes (MBC): Ability to identify and retain the common feelings/mental state depicted in a group of pictures and later recognises the correct picture which reflects the same feelings/emotion/mental state. Reliability=0.44.

Well trained psychologists from Jnana Prabodhini Institute of Psychology administered the cognitive tests. All the tests were administered on the same day. The available time for the administration of this test was less. The tests were administered after completion of school. This affected the testing as the tests were lengthy and children were restless and tired. The tests were given in English and Marathi depending on the student's preference of language. After completion of baseline data, yoga training was started.

INTERVENTION

Yoga module was prepared by a senior Yoga expert from Kaivalyadhama Yoga Institute, Lonavla. Each Yoga session was conducted for 45min, 5d a wk, for 12wks in the school premises. Each Yoga session was started with Om chanting and a prayer, and was concluded with Shanti Path. The Experimental Group practiced Yoga asanas (postures) and Pranayama (breathing techniques). Each asana pose was maintained for 15-30 sec initially, and for 1min in the later stages. Duration of Pranayama was 2-3 min initially and was gradually increased to 5min. The supine position asanas included ardh-halasana (half plough pose), Ekpaduttanapadasana (Single leg raise pose), uttanapadasana (leg raise pose), ardhapavanamuktasana (half wind release pose), pavanamuktasana (wind release pose), naukasana (boat pose), viparitakarani (inverted pose), matsyasana (fish pose), setubandhasana (bridge pose) and shavasana (dead pose). The prone position asanas include bhujangasana (cobra pose), sarpasana (snake pose), ardhashalabhasana (half locust pose), shalabhasana (locust pose), dhanurasana (bow pose) and makarasana (crocodile pose). The sitting position asanas included vakrasana (twisted pose), ardhamatsyendrasana, gomukhasana (cow face pose), paschimatanasana (posterior stretching pose), ardhaushtrasana (half camel pose), ushtrasana (camel pose), mayurasana (peacock pose), vajrasana (pelvic pose), padmasana (lotus pose), yoga mudra (yoga pose), brahma mudra (Brahma pose). The standing position asanas were tadasana (mountain pose), chakrasana (wheel pose), trikonasana (triangle pose), vrikshasana (tree pose), and utkatasana (chair pose). The pranayama practices

for this experiment were anulomvilom, ujjayi, and bhramari [17].

Control group continued with their regular schedule of physical training sessions throughout the study period. During the experimental study, all the students continued with their daily routine.

STATISTICAL ANALYSIS

Standard methods were followed for the data extraction for each of the variables (mentioned above). Data was analysed using paired t- tests, independent t- test and descriptive statistical method. The mean values ± SD of pre and post variables are presented in [Table/Fig-1].

RESULTS

Mental Ability Test

The result showed that at the baseline there were no significant differences in all the parameters between groups. In case of within group comparison, experimental group showed significant improvement in two of the nine factors, i.e. Cognition of Figural Systems (CFS) ($p<0.05$) and Evaluation of Figural Classes (EFC) ($p<0.01$).These factors refer to ability to structure a system by joining parts of a figure considering appropriate directions and ability to make judgement regarding adequacy of a figure as member of certain class respectively. Surprisingly, control group also showed significant improvement in two of the nine factors, Cognition of Figural Classes (CFC) ($p<0.05$) and Convergent Production of Figural Relation (NFR) ($p<0.05$). These factors refer to ability to recognise or understand common attributes among figures and classify them accordingly and ability to identify relations among presented figures and apply the same to other figures. The remaining factors of mental ability test did not showed any significant difference in both experimental and control groups.

Memory Test

In memory test experimental group showed significant improvement in 'Test-1' ($p<0.05$) which includes memory of figural information. Remaining three tests, which do not show improvement, include memory of information in the form of symbols, language or behaviour. Control group did not show significant improvement in any of the memory tests.

DISCUSSION

The findings of this 12wk research study suggests, amply, the effectiveness of yoga training in improving primary cognitive processes such as attention [23], perception [24,25] and observation. Overall findings shows that observation and critical evaluation of figural information improved in experimental group which could be result of maturation and intervention [26, 27]. The result of our study is also in line with previous research findings. According to a recent finding, yoga practices improved memory and general well-being of the experimental group subjects [28,23]. Control group also showed improvement in understanding and logical thinking which could be result of maturation [26, 27] and in part due to the practice effect over time [29]. The findings of memory tests indicate intervention probably has affected primary processing of visual inputs and not higher order processing. According to a study, shorter duration of yoga training does not influence the cognitive development of students [30,31]. Within limitations, the findings of this study demonstrate that shorter duration of yoga intervention is beneficial in improving some of the mental ability and memory parameters. In fact, future investigations on larger population and longer period of follow up are necessary to establish and expand the results of present study.

CONCLUSION

The present study has demonstrated that yoga training probably has affected primary cognitive processes such as attention, perception and observation. Yoga, being a simple and inexpensive health regimen, can be incorporated as an effective adjuvant therapy to governmental child health initiatives in school curriculum, and thus, ensures a bright future for our children. Further studies on a larger scale and longer time period would be required to further substantiate these findings.

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