

Effects of a Yoga Program on Health, Behaviour and Learning Ability in School Children: A Single Arm Observational Study

Abstract

Background: Learning difficulties, Stress and behavioural problems are widely prevalent in high school children that contribute to dropouts and poor performance. Yoga as a mind body intervention has been shown to improve performance in pilot studies. In this large observational study we assess the impact of yoga intervention on learning, cognitive abilities, behaviour and health in high school children.

Methods: Seven hundred and sixty eight schools across fifty talukas in Karnataka with around seven thousand six hundred and one children were assessed on improvements in learning, cognition, behaviour and health following two months of yoga intervention. Physical education teachers from these schools were trained to impart yoga intervention over two months to students of both higher primary and high school. Assessments were done by class teachers and parents of students who were not involved in imparting intervention.

Results: There was a significant improvement in health, learning ability, cognitive ability, behaviour, and positive emotions and decrease in negative emotions (all p 's < 0.001). The effect size of change was modest for emotions, behaviour and cognitive ability and large for learning ability and health.

Conclusion: The results suggest beneficial effects of yoga intervention in higher primary and high school children.

Keywords: Yoga; Performance; Learning; Cognition; Adolescents; School children

Research Article

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Introduction

Educators, researchers, and health care providers working with children have long been interested in understanding what causes children with average intelligence to suffer from academic underachievement, particularly when these academic difficulties are not the result of physical, social and environmental factors. Behavioural problems in children including mood disorders, emotional distress, peer pressures, learning disorders and adjustment problems are all said to contribute towards academic underachievement [1]. For example emotional distress, disrupted cognitive functioning, and deterioration in academic performance have all been theorized to be possible results of depressive moods that have resulted from peer pressures, family conflicts, and having to contribute to financial needs of the family [2]. School dropout rates have also been attributed to learning difficulty and poor academic performance [3]. Schemes like mid-day meals have failed to improve classroom attendance [4]. Dropout rates in Karnataka according to national sample survey statistics is around 7.9% in rural areas and 3.1% in urban areas with marginally more dropout rates in males compared to females. Specific clinical features of depression such as reduced

attention span, lethargy, poor concentration and memory, as well as abridged task perseverance are all factors that have emerged as obstacles to effective learning. Furthermore, poor academic performance has been associated with an increase in social and behavioral problems [5]. Though overt clinical depression is seen in a few a majority of them express depressive mood swings that are usually seen in adolescents. The stress to perform and its accompanying physiological and behavioural stress response can result in mood swings, emotional distress, loss of sleep and cognitive impairment. Poor classroom performance is consistently demonstrated in children with depressive symptoms when no other intervening learning disability is present [6]. Negative correlations between severity of depressive symptoms and intelligence scores, particularly by adolescence, have also been reported [7,8]. Similarly, a weaker performance on a variety of measures assessing cognitive functioning has been observed in cohorts of children with symptoms of depression [8]. These children have also exhibited a weaker performance on academic achievement measures including mathematics and knowledge clusters [5-9] and reading abilities [10]. In addition, behavioural manifestations of depression including attention difficulties [8,11-14].

It has been reported that student fatigue also markedly increases from elementary school to junior high school [15]. Identifying fatigue-related factors is thus important for preventing increased levels of fatigue during this transition period.

Exercises and play have helped students learn ways to cope with emotional, social and mental stressors they endure as teenagers [16]. Exercise, group activities and play have been known to improve self-esteem that's needed to overcome the emotional upheavals during the adolescence age [17]. Regular physical activity and exercise is known to produce strong healthy bones and muscles, reduce risk of obesity and chronic diseases, reduce feelings of anxiety and promote psychological wellbeing [18]. Moreover, obesity is a growing problem in teens and participation in physical activity decreases as age or grade in school increases further contributing to this problem [17]. Physical activity can improve self-image, self-confidence, mood, relieve stress tension and premenstrual tension, increased alertness, increased energy and increased ability to cope with stress [19]. Yoga is one such mind body intervention that uses postures or asanas, breathing exercises and pranayama (regulated nostril breathing) that has similar metabolic effects as an exercise [20]. Studies have shown that while breathing through right nostril facilitates increase in basal metabolic rate and reduces obesity [21], left nostril breathing has anxiolytic effects [22] Pranayama also influences tidal volume [23]. Similarly as an as are known to improve strength, flexibility [24], and heart rate variability [25] that enhances cardio protective effects [25], performance, endurance and stamina in children [26]. Yoga has also been shown to improve self esteem and promote mental health in adolescents [27]. In this study we evaluated the effects of two months yoga intervention in primary and high school students across all districts in Karnataka.

In this study teachers from each selected taluk from each district in Karnataka trained in yoga will evaluate the effects of two months of yoga in adolescent school children studying in higher primary and high school in rural districts of Karnataka on executive functions and their performance.

Study Objectives

- i. To integrate yoga into rural education in higher primary and high schools in each selected taluk of different districts in the state.
 - ii. To evaluate the effects of yoga on abilities of learning, cognition, behaviour and health in higher primary and high school children.
- a. **Hypothesis:** Yoga will improve abilities of learning, cognition, behaviour and health in higher primary and high school children following two months of intervention.

Methods

Subjects

All School children in higher primary (6th-7th grade) and high school (8th-9th grade) enrolled in schools that were selected for participation in the yoga education program by the education department were assessed before and after two months of yoga intervention. The program was carried out over a period of two consecutive years during the period between Novembers to

February in both years. Assessments in this study were carried out by respective class teachers who were not involved in imparting the intervention. The yoga intervention was impacted by physical education teachers who had undergone an intensive residential training program. This was a state program that enrolled teachers and students of schools from all thirty districts. A total of six thousand fifty seven schools were selected for the program covering five lakh six thousand nine hundred seventy four students. Among these only schools with adequate teacher to student ratio and different teachers for specific grades were selected to participate. Only those students were selected that satisfied the selection criteria.

Selection criteria for subjects

Inclusion criteria: a) Higher primary and high school children of both sexes. b) Age between 12- 15 years.

Exclusion criteria: a) Those with h/o congenital heart disease, motor and mental retardation. b) Those with h/o epilepsy, severe exercise induced asthma. c) Fevers or infection at time of screening and recruitment.

Outcome measures: a) Student checklist filled by both teachers and their parents [27].

Intervention

Yoga program: The Yoga intervention comprised a series of asanas, pranayama, meditation and relaxation given over a one hour period daily 6 days a week for 2 months. The classes started with loosening stretches, breathing exercises followed by eight asanas intersped with yogic relaxation. This was followed by pranayama (regulated nostril breathing). Similar program had been used earlier in school students that showed improvement in spatial and verbal memory scores [28,29].

Data analysis: Data was analysed using SPSS 18.0 for Windows. Mean scores for learning ability, cognition, health, behaviour and emotions were compared before and after intervention using paired t test. The effect sizes of change were determined for each variable.

Results

The mean age of the study population was Years. The number of schools that participated in the program and its geographical location is given under Table 1. Number of schools selected for assessments is given in Table 2. Among the eligible 9547 students around 7601 students were assessed.

Learning abilities

There was a significant improvement in learning abilities such as oral comprehension (p<0.001), listening (p<0.001), reading (p<0.001) and writing (p<0.001) following yoga intervention (See Table 3, Figure 1.

Health

There was a significant improvement in eyesight (p<0001), sports activities (p<0001), sickness prevention (p<0001) and health (p<0001) following yoga intervention (Table 4 and Figure 2).

Table 1: List of schools, students selected in district and taluks to undergo Yoga assessments.

Sl. No	District	2011-2012 Taluks	2012-2013 Taluks	Selected Taluks	Total Schools (11-12& 12-13)	Selected Schools	Total Students Trained in Yoga	Total Students Eligible for Assessment	Selected Students for Assessment
1	Bagalkote	2	3	5	386	47	13526	1140	663
2	Belgaum	3	3	2	417	17	31771	38	23
3	Bijapur	0	2	2	175	43	17318	792	792
4	Chitradurga	2	1	3	235	132	14640	745	235
5	Dharawad	0	4	2	338	19	43543	159	159
6	Davangere	0	2	2	165	29	10326	531	505
7	Gadag	0	3	1	271	16	35501	225	210
8	Yadgiri	1	1	2	136	15	15015	300	114
9	Bellary	2	1	1	230	20	16011	504	490
10	Koppala	0	1	1	70	09	5625	153	153
11	Raichur	1	1	1	188	25	17755	500	363
12	Bidar	1	1	1	144	10	4551	112	111
13	Gulbarga	1	2	1	273	6	43838	150	147
14	Madikeri	0	1	1	89	14	10348	182	176
15	Mandya	0	2	2	120	32	17181	639	628
16	Mysore	2	4	6	464	77	31518	1032	633
17	Hassan	1	2	1	227	03	38806	21	21
18	Ramanagar	1	2	2	241	50	16879	629	567
19	Chamarajnaragar	0	1	1	69	5	4485	70	69
20	Tumkur	0	2	1	160	13	22239	237	217
21	Kolar	1	1	1	121	19	6300	165	146
22	Chikkamagalur	2	1	1	186	05	10220	90	89
23	D.K.Mangalore	0	1	1	57	09	2730	90	90
24	Karwar	1	6	4	556	16	14182	250	240
25	Haveri	0	2	2	139	38	9815	200	185
26	Shimoga	1	1	1	90	12	8620	298	290
27	Udupi	0	3	2	235	47	6931	295	285
28	Chikkaballapura	0	1	0	22	0	1320	0	0
29	Bangalore (urban)	0	1	0	93	0	18600	0	0
30	Bangalore(r)	0	1	0	86	0	17200	0	0
	TOTAL	22	55	50	6057	728	506794	9547	7601

Table 2: Number of schools selected for assessments.

Year	No of Schools	Students trained in Yoga	No of Taluks	Sample of Assessments		
				Selected Taluks	Selected Schools	Selected Students
2011-12	1832	124278	22	50	728	7601
2012-13	4225	382516	55			
Total	6057	506794	77	50	728	7601

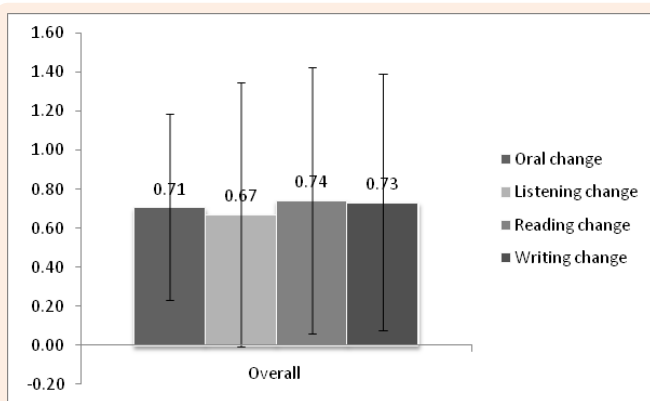


Figure 1: Change in learning ability following yoga intervention (Learning Change).

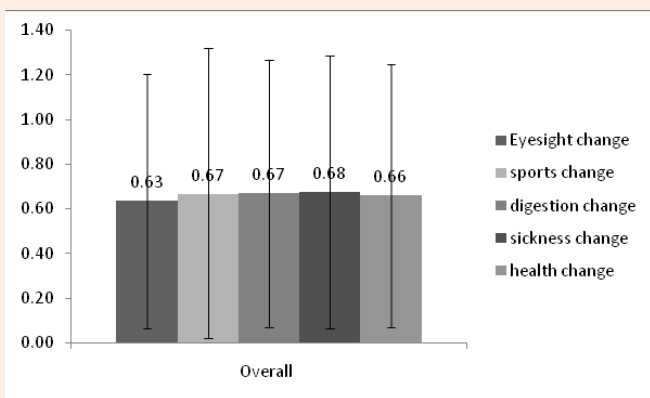


Figure 2: Health change following yoga intervention (Health Change).

Table 3: Learning abilities following yoga intervention.

Learning Abilities	PRE	POST
Oral	2.85±0.87	3.52±0.68
Listening	2.83±0.88	3.53±0.66
Reading	2.82±0.93	3.54±0.67
Writing	2.84±0.92	3.53±0.66

Table 4: Health before and after yoga intervention.

Health	PRE	POST
Eyesight	3.02±0.91	3.62±0.62
Sports	2.89±0.94	3.57±0.63
Sickness	2.95±0.89	3.61±0.62
Health	3.00±0.88	3.64±0.59

Cognitive abilities

There was a significant improvement in concentration ($p<0.001$), intellect ($p<0.001$), memory ($p<0.001$), intelligence

($p<0.001$), learning ($p<0.001$), reasoning ($p<0.001$), interaction ($p<0.001$), direct speech ($p<0.001$), and attention ($p<0.001$), following yoga intervention (Table 5 and Figure 3).

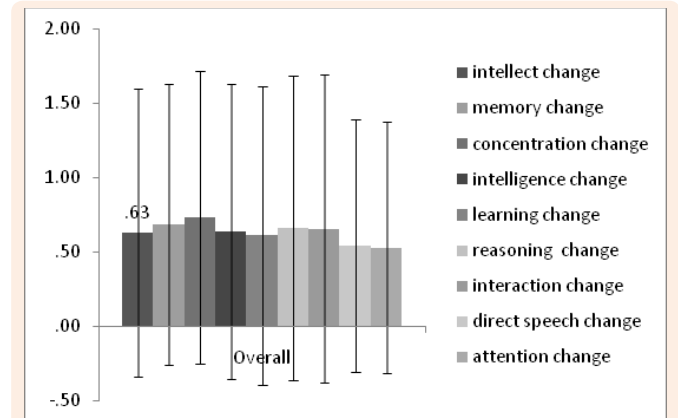


Figure 3: Cognition Change following yoga intervention.

Table 5: Cognitive abilities following yoga intervention.

Cognitive Abilities	Pre	Post
Intellect	2.82±0.84	3.49±0.65
Memory	2.74±0.87	3.45±0.66
Concentration	2.75±0.91	3.50±0.66
Intelligence	2.85±0.91	3.52±0.65
learning	2.85±0.89	3.48±0.67
Reasoning	2.75±0.91	3.44±0.69
Interaction	2.75±0.92	3.42±0.71
Direct speech	1.98±0.71	2.52±0.61
Attention	2.06±0.70	2.60±0.57

Negative emotions

There was a significant decrease in negative emotions ($p<0.001$) such as being unhappy ($p<0.001$), fear ($p<0.001$), stubborn ($p<0.001$), being reserved ($p<0.001$), impulsive ($p<0.001$), feeling laziness ($p<0.001$) and loneliness ($p<0.001$) (Table 6 and Figure 4).

Table 6: Negative emotions before and after yoga intervention.

Negative Emotions	PRE	POST
Unhappy	.91±0.76	.66±0.84***
Fear	.91±0.76	.48±0.64***
Stubborn	.81±0.75	.41±0.63***
Reserved	.90±0.72	.47±0.64***
Impulsive	.88±0.74	.46±0.63***
Loneliness	.77±0.74	.39±0.60***
Laziness	.80±0.75	.41±0.63***

*** $p<0.001$ on Wilcoxon's signed rank test

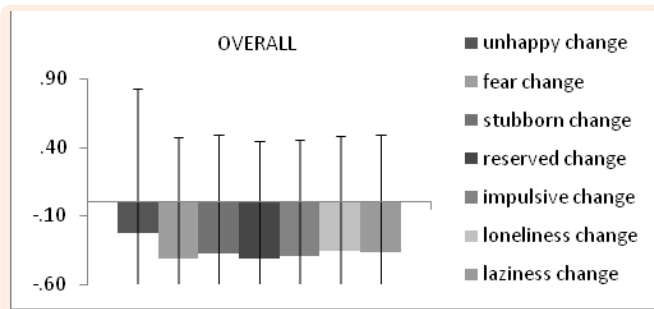


Figure 4: Negative Emotions Change following yoga intervention.

Positive emotions

There was a significant improvement in positive emotions such as discipline ($p < 0.001$), accommodating ($p < 0.001$), respect ($p < 0.001$), organization capacity ($p < 0.001$), being social ($p < 0.001$) and obedient ($p < 0.001$) (Table 7 and Figure 5).

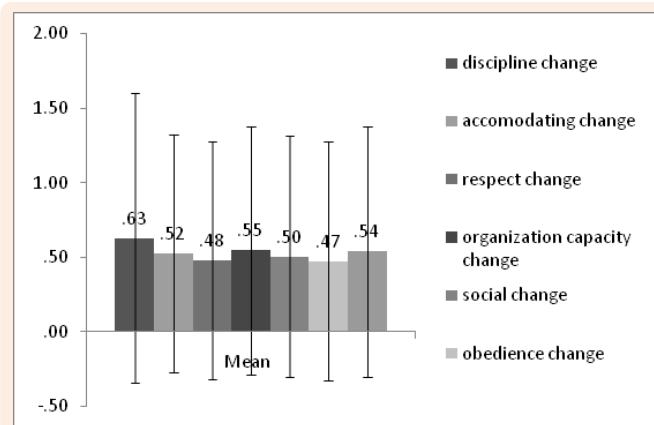


Figure 5: Positive Emotions Change following yoga intervention.

Table 7: Positive emotions before and after yoga intervention.

Positive Emotions	PRE	POST
Discipline	2.93±0.92	3.58±0.62
Accommodating	2.10±0.69	2.63±0.54
Respect	2.16±0.69	2.64±0.54
Organization capacity	2.01±0.68	2.55±0.58
Social	2.12±0.68	2.63±0.55
Obedience	2.14±0.69	2.62±0.55

Effect size

Effect size was large for learning and health and moderate for cognition and emotions See Table 8.

Overall results

The implementation of yoga education program and yoga in schools in various districts of Karnataka showed improvements

in all indices of learning and cognitive function in primary and high school students. The results showed beneficial finding with yoga with maximum change being observed in listening, reading, writing indicating better attention and sports indicating healthy physically active lifestyle. There was also an overall improvement in concentration, memory, mathematical ability, discipline and overall personality development following this program.

Improvements in Individual domains in overall sample:

There was a significant (all p 's < 0.001) suggesting improvement in all domains in the total sample of 7601 students. Those who fared poor, below average and average in pre assessment showed improvement at post assessment with many of them faring average and good on these domains. Learning (Oral and written expression, mathematical ability) behaviour, cognitive functions (attention, memory, concentration, IQ) improved significantly indicating overall personality development in children.

Discussion

The results of our study suggest an improvement in learning and health, significant reduction in negative health behaviours, improvement in cognition and positive emotions. The effect sizes for improvement were largest for learning and health and moderate for cognition, positive and negative emotions and behaviour. Though the high effect sizes could be due to absence of a control group, they nevertheless show benefit finding on the above measures.

The intervention was carried out in early teen population where in behavioural changes are profound due to influence of sex hormones in this growth period. Surveys have shown prevalence of psychosocial problems in this age group to be around 10-40% [30-32]. This is an age wherein teens experience externalizing behavioural problems such as confusion, personality conflicts, educational difficulties, substance abuse, hyperactivity, or internalizing emotional upheavals such as anxiety or depression [32-34]. This coupled with transition stress of moving from primary school to high school can add to the prevailing psychosocial disturbance [32].

Our results are similar to earlier observations that have shown yoga to help improve learning, self-esteem, reduce anxiety, depression, aggression, impulsiveness, shyness and other negative emotions seen in teenagers [35,29]. These observations are similar to those gained by using physical education (exercise) and activity that have shown improvements in self-esteem, performance and learning on these measures [36].

Yoga is training in internal awareness and relaxation and teens can appreciate their endurance with postures, flexibility, and strength and internalize their self-progress over time in a non-competitive environment [37]. This aspect of yoga could help facilitate adherence to being physically active and adhere to a planned physical regimen. Salutatory effects of exercise could have helped reduce aggressiveness, reduce emotional upheavals, laziness, and improve mood and wellbeing [38]. This could have brought about a decrease in stress, improved memory, attention span, and learning [39].

Table 8: Effect sizes following yoga intervention.

Learning and Health		Cognition		Positive Emotions and Behaviours		Negative Emotions and Behaviors	
Post-Pre	Effect Size	Post-Pre	Effect Size	Post-Pre	Effect Size	Post-Pre	Effect Size
Oral change	1.48	Intellect change	0.65	Discipline change	0.65	Unhappy change	-0.21
Listening change	0.99	Memory change	0.73	Accommodating change	0.66	Fear change	-0.47
Reading change	1.09	Concentration change	0.74	Respect change	0.60	Stubborn change	-0.43
Writing change	1.12	Intelligence change	0.65	Organization capacity change	0.66	Reserved change	-0.48
Eyesight change	1.12	Learning change	0.61	Social change	0.62	Impulsive change	-0.46
Sports change	1.02	Reasoning change	0.65	Obedience change	0.59	Loneliness change	-0.43
Digestion change	1.12	Interaction change	0.64	Self-confidence change	0.64	Laziness change	-0.43
Sickness change	1.10	Direct speech change	0.64				
Health change	1.12	Attention change	0.63				

One of the major limitations in our study was the results may be prone for bias as this was a state sponsored program and improvements could have been shown by the teacher as benefits of this program. However we had a part of scoring done by class teacher who was not the trained yoga instructor and part of the study about health and behaviour was also scored by the parents to obfuscate this problem. Secondly, having a comparator arm could have delineated the effects of yoga clearly from physical exercise. Third, the questionnaire was more or less subjective and objective valuation of benefit could not be ascertained. Fourth, having participated in a group yoga program could have facilitated group bonding and support that could have contributed to increased wellbeing. However, despite these limitations the geographical extent and diversity and size of study of population add significant credibility and power to this observational study. Further randomized control trials with exercise as a control intervention are needed to validate these findings in a controlled sample population.

Conclusion

The results offer support for beneficial effects of yoga intervention in improving learning, cognitive abilities, health and behaviour in high school children. The results also suggest that imparting yoga in school is a feasible option and can be integrated with the routine physical education. Further randomized controlled trials are needed to validate this intervention.

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