RESEARCH ARTICLE

Improvement in Cognitive Abilities, Mental and Emotional Well-being of Teenagers following a Meditation Retreat: An Open-Trial Pilot Study

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Abstract: ***Background*****:** Today's teenagers face several challenges that result in poor mental health, depression and anxiety. Several studies in the past decade have explored meditation as adjunctive therapy for mental illness however, the long-term residual benefits of meditation have rarely been studied.

Objective**:** The aim of the study was to investigate the benefits of a four day meditation retreat on cognitive abilities, mental and emotional well-being of teenagers.

Methods**:** 303 teenagers participated in this study. Cognitive abilities of the students were measured using the Six letter cancellation test (SLCT). Mental and emotional well-being was measured using World Health Organization Well-being index (WHO-5) and Strength and Difficulties questionnaire (SDQ), respectively. Data analysis was performed using paired sample t-test and repeated measure ANOVA.

Results**:** Teenagers demonstrated a 33% increase in average accuracy for SLCT post intervention. WHO-5 mental well-being index scores also increased significantly ($p < 0.001$). The participants experienced a significant reduction in emotional problems and hyperactivity as measured by SDQ. The benefits of the retreat continued to persist, when measured after 40 days of the intervention.

Conclusion**:** A well-structured meditation retreat has significant and long-term benefits on teenagers' mental well-being, emotional stability and cognitive capacity.

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1. INTRODUCTION

Meditation and yoga practices have emerged as effective tools in managing the mind, especially for teenagers (Breedvelt *et al.,* 2019).

During the previous decades' meditation has been widely researched and practiced by individuals of all age groups. According to a survey from the United States, the population of individuals between 4-17 years practicing meditation has increased considerably from 1.6% in 2012 to 7.4% in 2017 (Wang C, Li & Gaylord, 2019). Meditation techniques have been demonstrated to bestow innumerable physical and mental health benefits in adults (Horowitz, 2010

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and Schreiner and Malcolm, 2008). A systematic review on the effect of mindfulness based interventions expounds their positive effect on cognitive and socio-emotional outcomes among the primary and secondary school students (Maynard, Solis, Miller & Brendel, 2017 and Zeidan, Johnson, Diamond, David & Goolkasian, 2010). Recent studies on yoga and meditation have shown a significant reduction in stress and anxiety levels amongst college students (Lemay, Hoolahan & Buchanan, 2019) and in reducing symptoms of physical and mental distress in junior college students (Yang, Su & Huang, 2009). Yoga has been highlighted as complementary to physical education for children and adolescents in schools (Folleto, Pereira & Valentini, 2016; Smith, 2020). Studies have shown that meditation can reduce discouragement, hostility and worry among young people and improve working memory (Galla, 2017 and Baranski, 2018). In adolescents, with learning difficulties mindfulness meditation may lessen anxiety, promote social skills, and improve academic performance (Beauchemin, Hutchins & Patterson, 2008). A review that evaluated evidence from 15 peer-reviewed studies of school meditation programmes with respect to three student outcomes: well-being, social competence and academic achievement, stated that transcendental meditation had higher significance than other meditation programs. Based on the outcomes, the authors proposed that meditation improves student success by improving cognitive functioning and emotional regulation. (Waters, Barsky, Ridd & Allen, 2015). A systematic review suggests improvement in cognitive performance, stress, resilience and emotional problems domains with mindfulness based interventions (Zenner, Herrnleben-Kurz & Walach, 2014).

Although research on meditation and yoga techniques is increasing globally, there is a paucity of studies on meditation from India, especially ones that look at the effects of meditation retreats on teenagers. The aim of our study was to gather scientific evidence around the residual long term effects of a four-day meditation retreat on the mental health, cognition and social behavior of the teenagers.

2. MATERIALS AND METHODS

2.1. Study Design

An open trial single arm pre and post study was conducted to understand the impact of a novel meditation retreat on teenagers. The study was conducted from April to June 2019 at the Art of Living International center, Bengaluru, India. The students were assessed for their mental and emotional well-being, social behavior, and cognitive skills before and after the workshop. An extended time point of day 40 was included for obtaining data on long term effects.

2.2. Participants

During the summer of 2019, several meditation retreats for teenagers were conducted at the Art of Living International Centre. The retreats were popularized through word of mouth and social media. Hundreds of parents registered their children (teenagers) for these retreats. Convenience sampling was used to enroll study participants. All the parents were explained about the research study in detail. Those parents and teenagers willing to enroll in the study were requested to fill an informed consent. In summary, the study subjects were a subset of those who were attending the meditation retreats at the Centre. 303 teenagers participated in the study. The sampling frame is reflective of a typical middle class or upper middle class family across India who had some positive inclination towards yogic practices. Since the parents were willing to send the teenagers four days to the center, we may assume that there was some acceptance towards yogic practices within the families. The parents were necessarily not practitioners of yoga themselves but the children had experienced yoga before. When asked, parents did not report any psychiatric disorder; hence screening for the psychiatric conditions was not performed for the study subjects.

2.2.1. Ethical Approval

The ethical approval for this study was obtained from the Institutional ethical committee

of Sri Sri Institute for Advanced Research bearing the registration number SSIAR/IEC/07.

2.3. Intervention

The retreat was designed as a four-day residential program. It incorporated yoga postures and yogic breathing techniques to prepare the mind and body for meditation. The participants were encouraged to spend time in nature and engage in interactive processes to enhance their experience. The intervention included meditation sessions appropriate for teenagers.

2.4. Measures

2.4.1. Six Letter Cancellation Test (SLCT)

This test measures the ability for sustained attention, visible scanning and speedy response activation and inhibition (Balaram & Nagendra, 2008). It has been used by several authors on Indian teen populations and found to be a reliable measure of cognitive abilities (Gulati, Sharma, Telles & Balkrishna, 2019 & Telles, Gupta, Gandharva, Vishwakarma, Kala & Balkrishna, 2019). The components of SLCT measure various functions of brain. Motor skills and cognition of the participant are measured by the total number of cancellation. Net score of the participant is a functional measure of attention. The number of wrong cancellations is an indicator of the lack of focused attention and mental distraction. (Bhuyan, 2013)

The test consists of letters of the English alphabet arranged randomly in 22 rows and 14 columns. Six target letters are identified at the top of the grid (J, T, K, M, U, F). Subjects are asked to cancel as many target letters as possible within a designated time frame of two minutes. Higher accuracy percentage represents a greater cognitive capability. The frequency of each letter appearing in the test is: J-13, T-12, K-15, M-10, U-12, F-11. Raw scores for each letter were calculated by adding the number of cancellations made in designated time, for example, if a subject cancelled the letter 'J' 7 times, raw score obtained will be 7. Accuracy for each letter is calculated by dividing the raw score by total number of occurrences of the letter in the sheet and multiplying by 100 (in this case (7/13)*100). Similarly, accuracy for all six letters is obtained. Finally, the average accuracy for all six letters is taken for analysis. Total accuracy is (accuracy for J+ accuracy for K+ accuracy for T+ accuracy for M+ accuracy for U+ accuracy for F)/6

2.4.2. World Health Organization-Five Well-Being Index (WHO-5)

This self-report questionnaire focuses on the individual's perception of his or her present day well-being and contentment (Topp, Ostergaard, Sondergaard & Bech, 2015). The questions are scored from 0-5 with 0 indicating 'at no time' and 5 indicating 'at all times'. Higher scores for an individual indicate greater mental well-being.

2.4.3. Strengths and Difficulties Questionnaire Test (*SDQ*)

The SDQ comprises 25 questions regarding an individual's positive and negative attitudes (Goodman, 1997). The questions are divided into five sub-domains namely emotional problems, conduct problems, peer-problems, hyperactivity and pro-social behavior. All questions are scored on a 3-point scale with 0 indicating 'not true', 1 indicating 'somewhat true', and 2 indicating 'certainly true'. Higher scores on the pro-social subdomain reflect good social behavior. On the contrary, higher scores in the other four subdomains reflect difficulties. A complete difficulty score can be determined by adding the scores on the first four sub-domains. The participant population is further categorized based on the total scores; overall and for each subdomain of SDQ. Participants scoring <=15 are designated in normal category, 16-19 designated in borderline category and >=20 in abnormal category. Subjects in abnormal category may be suffering from mental illness and require immediate attention.

For the study population, SDQ scores were calculated and the population was divided into 3 categories for comparison before, after and on day 40 of the program to evaluate the impact of the retreat on the subjects.

2.5. Data Analysis

Descriptive statistics tools were used to obtain various means and standard deviations. Comparison of scores was made using paired sample't' test. To measure the effect of time along with grouping variables of gender and covariate of age, general linear model using repeated measure ANOVA was used for pre-post-day 40 analysis. Reliability of scale and internal consistency of the questionnaire was tested by calculating Cronbach's alpha while effect size was also calculated using Cohen's d value. Level of significance was kept at 0.05. Bonferroni correction was applied wherever necessary to keep the type 1 error down. Data distribution has been checked for the use of parametric tests, but it may be noted that ANOVA test as such is robust for violations of normality. The test of sphericity as performed also indicates that assumptions of uniformity of variances are not violated.

F test was also performed for the assumptions of normality. Levene's test of equality of error variances and Mauchly's test of sphericity were also carried out. Level of significance was kept at 0.05.

3. RESULTS

Table **1** depicts the demography of the population. The mean age was 15 years. 52.4% of the population was male and 47.5% was female. A 100% response was obtained during pre-post data collection but for 40-day assessments, data for only 19% of the participants could be obtained. Since the study subjects were minors, data collection at day 40 was dependent on the participation of their parents. In the cases where parents were busy or did not have any interest, data for the subject could not be collected.

3.1. Six Letter Cancellation Test

Table **2** shows the average accuracy for six letter cancellation test (SLCT). The Cronbach alpha score measuring reliability for SLCT was found to be 0.71(pre) and 0.77(post). The average accuracy score of the population increased by 33% with a p value of <0.001. Both genders show an increase in SLCT accuracy ($p<0.001$). It is observed that considering all the factors, overall there is no statistically significant effect of gender on the average accuracy scores. (Wilk's lambda 0.995, sphericity assumed, $F(1,275)=1.372$, $p=0.243$; partial eta squared =0.005). The effect size (Cohen's d value) pre-post was 0.57, which is indicative of medium size effect. It also implies that 73% of the population experienced an improvement in their scores post retreat (Coe, 2002).

Table 1. Participants characteristics (N=303) n(%).

Characteristics	Type	All Participants
Gender n(%)	M	159(52.4)
	F	144(47.5)
Age (years)	Mean (SD)	15 (1.35)
	Min	12
	Max	18

3.2. WHO-5

Table **3** depicts the results of WHO-5. The mean score was 17.3 pre-assessment, which increased to 20.5 post-retreat and was at 18.98 after 40 days of the program ($p<0.001$). Cronbach alpha was found to be 0.717 (pre), 0.826 (post) and 0.853(day 40). The effect size (Cohen's d value) pre-post was 0.83 and pre-day40 was 0.54, which is indicative of a large effect size. It also implies that 79% of the population experienced an improvement in their scores post retreat (Coe, 2002).

3.3. SDQ

Table **4** depicts the results for the Strength and Difficulty questionnaire. The population is divided into normal, borderline and abnormal

Table 2. Average accuracy for six letter cancellation test - Mean(SD) and p value.

	Pre retreat	Post retreat	p value	Significance
Total population	48.6 (16.6)	64.2 (16.6)	<0.001	Yes
Male	45.3 (15.8)	60.1 (15.7)	<0.001	Yes
Female	52.1 (16.8)	68.6 (16.5)	<0.001	Yes

Table 3. WHO-5 mean scores, SD and p value for pre, post and day 40 time points.

	Pre (n=303)	Post (n=303)	Day 40 (n=54)	p value Pre-post	Significance	p value Pre-day 40	Significance
Mean score	17.3(4.80)	20.5(3.83)	18.98(4.32)	<0.001	Yes	<0.001	Yes
Male	17.6 (4.81)	20.54 (3.97)	20 (3.63)	<0.001	Yes	<0.001	Yes
Female	17.02 (4.78)	20.58(3.67)	17.8 (4.82)	<0.001	Yes	<0.001	Yes

categories based on the total scores obtained for the SDQ. The table depicts the percentage values. A significant increase in the percentage of participants in the normal category for all five domains was observed ($p<0.001$). Considering all the factors, overall, there was no statistically significant effect of gender on the total SDQ scores (Wilk's Lambda 0.910, sphericity assumed, $F(1,102)=2.485$, $p=0.094$, partial eta squared =0.090). All the sub-domains showed a decrease in percentage of population in abnormal category, especially domains of emotional problem and hyperactivity. The Cohen's d value for SDQ scores was found to be 0.69 for pre-post data and 0.33 for pre-day 40 data. It implies that 76% of the population experienced an improvement in their scores post retreat and 62% of the population experienced improvement after 40 days of practice. (Coe, 2002).

4. DISCUSSION

Supporting adolescents during what is for many a turbulent period of mixed emotions and impulsive action is essential for their physical, mental, social and cognitive development. Stress is a ubiquitous experience and an underlying cause for many diseases: teenagers are no exception to this phenomenon. A study on high school students in India showed that more than half of (63.5%) the study population was stressed due to academic and parental pressure (Deb, Strodl & Sun, 2015). Comprehension and cognition slow down drastically under stress (Lupien, Maheu, Tu, Fiocco & Schramek, 2017). This realization has led to increased use of mind-body interventions to mitigate stress and effectively cope with the pressures of life. Such coping strategies pave the way for adolescents to become efficient and successful individuals in future. Empathy, an important motivator for prosocial behavior is best inculcated at a young age.

The results of this pilot study indicate a positive effect of a four-day residential meditation retreat on the teenagers' mental, social and emotional well-being as well as cognitive capacity. Our study demonstrated enhanced cognitive performance after the retreat. The results also highlight the stabilizing effect of

Table 4. Percentage of population %(n)- in abnormal, normal and borderline categories for SDQ questionnaire: Pre-post and day 40.

	Population Percentage (n=303) PRE	Population Percentage (n=303) POST	Population Percentage (n=54) DAY40	p value Pre-post (Significance)	p value Pre-Day 40 (Significance)
SDQ Total				<0.001 (Yes)	0.123 (No)
Normal Category	68.6 (208)	87.1 (264)	83.3 (45)		
Borderline Category	18.8 (57)	7.6 (23)	7.4 (4)		
Abnormal Category	12.5 (38)	5.3 (16)	9.3 (5)		
Emotional Problems				p<0.001 (Yes)	p=0.005 (Yes)
Normal Category	81.2 (246)	92.7 (281)	85.2 (46)		
Borderline Category	6.6 (20)	3.6 (11)	5.5 (3)		
Abnormal Category	12.2 (37)	3.6 (11)	9.3 (5)		
Conduct Issues				p<0.001 (Yes)	p=0.318 (No)
Normal Category	93.7 (284)	96.7 (293)	88.9 (48)		
Borderline Category	3.9 (12)	1.9 (6)	5.5 (3)		
Abnormal Category	2.3 (7)	1.3 (4)	5.5 (3)		
Hyperactivity				p<0.001 (Yes)	p=0.007 (Yes)
Normal Category	79.5 (241)	91.7 (278)	88.9 (48)		
Borderline Category	7.9 (24)	4.6 (14)	5.5 (3)		
Abnormal Category	12.5 (38)	3.6 (11)	5.5 (3)		
Peer-problems				p=0.202 (No)	p=1.00 (No)
Normal Category	92.7 (281)	95.7(290)	92.6 (50)		
Borderline Category	4.6 (14)	1.9(6)	5.5 (3)		
Abnormal Category	2.6 (8)	2.3 (7)	1.9 (1)		
Pro-social				p=1.000 (No)	p=0.058 (No)
Normal Category	90.8 (275)	90.1 (273)	94.4 (51)		
Borderline Category	4.6 (14)	3.3 (10)	5.5 (3)		
Abnormal Category	4.6 (14)	6.6 (20)	0		

meditation on the emotions of a teenager. A significant improvement was observed in the psychological well-being of the participants. They had an enhanced positive attitude towards life post retreat. A considerable reduction was observed in hyperactivity. Although the intervention module took place over only four days, the beneficial effects of the meditation retreat were still present at 40 days, demonstrating residual long term benefits. This finding is particularly striking as teenagers were not provided with any practices at home after the retreat.

Participants in our study were drawn from an Indian middle class population who were mostly aware of the benefits of yoga and meditation practices. A study of the perception of yoga among the Indian populace highlighted that 96.4% of the study population have heard about yoga. Also, 95% of the yoga practitioners and 94% of non-yoga practitioners from the study population believed that yoga is good for them. (Kanchibhotla and Rau, 2019)

In our study, the six letter cancellation test scores demonstrated an improvement in the cognitive performance. Gulati and colleagues evaluated the benefits of yoga on the mental well-being and cognitive abilities of school children. Significant improvement in the SLCT performance, social and academic self-esteem was observed following four and half months of yoga practice (Gulati, Sharma, Telles & Balkrishna, 2019). A similar study that assessed the effect of yoga on pre-teen school children found significant decrease in the anxiety scores post intervention. In the study, girls scored higher on attention based cancellation test compared to boys. (Telles, Gupta, Gandharva, Vishwakarma, Kala & Balkrishna, 2019). Yogic breathing techniques and meditations are known to activate the parasympathetic nervous system which could explain the participants' sense of calm after the program (Bhaskar, Kharya, Deepak & Kochupillai, 2017). Among the sub-domains of SDQ, an immense reduction was noted for the hyperactivity sub-domain. This could be a result of deep breathing methods practiced during the retreat. The participants were able to cope with the emotional turbulences as depicted by improvement in emotional sub-domain for SDQ. Additionally, this study reiterates that a favorable social environment is a predictor of good conduct, whereas an unfavorable environment is known to increase the risk for behavioral disorders. A systematic review by Luberto *et al.*, 2018 on the benefits of various meditation practices on pro social behavior evaluated 26 studies with 1,714 subjects. Most studies observed a small to medium sized effect of the intervention and suggested neuro-physiological and psychosocial mechanisms at play. (Luberto, Shinday, Song, Philpotts, Park, Fricchione & Yeh,2018). A 15 peer reviewed studies on school based mediation and evaluated outcomes on student well-being, social competence and academic achievement. A total of 76 results were calculated out of the 15 reviews; 67% of the studies had small effect while 24% studies had medium sized effect and 9% of the studies had large effect size of the intervention on the student outcomes.

There were several limitations in the study. They include the usage of convenience sampling, the absence of a control group, drop-outs of participants during the 40th day assessment and inclusion of only an urban based study population. Also data regarding the history of psychiatric disorders, use of medication or previous treatments were not collected in the study. For conclusive results, further study incorporating the control group and larger sample size are recommended.

Despite these limitations, the study results strongly indicate that the mediation retreat had a positive effect on the emotional stability, mental wellbeing, social behavior and cognitive capacity of the participants.

Such meditation retreats customized for 13-18 year old students may be explored as an intervention to improve their academic performance. This one-time practice potential long term benefits for an individual’s cognitive capacity, overall social and psychological well-being. Meditation retreats could also be incorporated as part of psychological therapy offered to adolescents with behavioral disorders, and also be used to relieve stress and emotional

turbulence that accompany the normal teenage experience.

CONCLUSION

During adolescence, it is important to inculcate practices that would help an individual to develop into the best version of themselves. The results from this study indicate that meditation can empower teenagers to handle their emotions, enhance their mental well-being and cognitive capacity. When the practice of meditation is started at a young age, it can have a significant impact not only on physical health but also a profound impact on mental well-being, positive social behavior and academic performance.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

No Animals/Humans were used for studies that are the basis of this research.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

Due to the nature of this research, participants of this study did not agree for their data to be shared publicly, so supporting data is not available.

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None.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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