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Original Article

Changes in Bioenergy Field of Children with Autism following Non-pharmacological Interventions: A Randomized Controlled Study

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ABSTRACT

Introduction: The effectiveness of integrated approach using complementary therapies for children diagnosed with Autism spectrum Disorder (ASD) is poorly studied. This is due to limited objective assessments and lack of well-designed therapeutic module. **Aim:** This study examined the effect of yoga and naturopathy interventions on Electrophotonic Imaging (EPI) parameters in children with autism. **Methods:** This study consisted of three groups i.e., Yoga (YG), combination (Yoga and Naturopathy, YNG) and Control Group (CG) tested a 24 days intervention duration. Yoga group received series of yoga practices and combination groups received both yoga and naturopathy for the same duration. The control group maintained their daily usual activities. The EPI parameters included Activation Coefficient (AC, stress parameter), Integral Area (IA, general health parameter), Integral Entropy (IE, disorderliness parameter) were compared between groups and within group after interventions. Seventy-seven children with autism were randomized and 70 children completed the study with 95% adherence to the yoga and naturopathy interventions. **Results:** The results of the analysis showed that there was a significant improvement in energy level of YG and YNG in IAL ($p<0.01$; $p<0.001$), IEL ($p<0.05$; $p<0.001$) and no change in control group. Moreover, there were a significant difference in post assessment of YG and YNG from CG in IAL ($p<0.001$), IEL ($p<0.05$) and IAR ($p<0.01$) parameters of EPI. **Conclusion:** This study provides evidence that interventions of yoga and naturopathy may be useful to reduce the severity of symptoms and improve energy level that is required for children with autism and other neurodevelopmental disorders.
Key words: Yoga, Naturopathy, IAYT, Neurodevelopmental disorder, Children, Electrophonic imaging.

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INTRODUCTION

Autism Spectrum Disorder (ASD) is a complex neurodevelopmental disorder that includes impaired communication and social skills, that results in the presence of stereotype, repetitive or restricted behaviour. These symptoms may vary across individuals at a different age. A recent WHO report estimated that worldwide one in 160 children has an ASD.[1] There is no current epidemiological data available on the prevalence estimation of ASD in India. However, an early report suggests that one in 100 children in the age group of 1-10 years might be affected by ASD in India, which is lower than the global Prevalence.[2] Other epidemiological studies have been conducted over the past 50 years, indicating a dramatic increase in ASD globally.[3-5]

Scientific studies suggest no evidence or causative theory exists, but few risk factors may be associated with ASD, including environmental and genetic factors.[6-8] Therefore, early diagnosis of ASD is challenging and symptoms may appear 3 years of age. Early diagnosis is an important criterion to plan appropriate intervention once ASD is identified. However, inappropriate autism diagnostic tools and limited evidence-based clinical intervention studies on ASD restrict ASD symptoms efficiently. There are many therapies for autism, including behavioral, cognitive,[9] selective diet,[10,11] mega doses of selected vitamins and nutraceutical,[12] complementary and alternative medicine (CAM)[13] and mind-body intervention, someway address the symptoms of ASD. CAM's usefulness was reported 40-62% population of ASD in a recent survey conducted in Germany.[14] CAM therapy includes acupuncture, physical therapy, yoga, music, etc. with limited evidence for effective treatment of ASD core symptoms and associated comorbidities. Autistic children are mainly affected by behavioral problems, physiological conditions such as gastrointestinal (GI), autonomic abnormalities, impaired motor functions and sensory integration problems.[15-18] The severity of autism in children aged 7-15 years was reduced after yoga training and improved sleep quality and GI issues.[19,20] The motor

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impairment and improper coordination were enhanced by after 8-weeks of yoga training.[21]

Further, the behavioral, social and emotional patterns of ASD children were improved following either yoga, dance, or music therapy measured through behavioral scales.[22-24] The outcomes of the previous study on Yoga suggests that it may regulate the psychological and psycho-physiological states of children with ASD. A study using a biometric tool called electrophotonic imaging (EPI) helps assess the functional state of the organ and organ system of the human body by recoding the physiological process through fingertips.[25] Few other studies have been trying to understand ASD's biological pattern of ASD but limited evidence-based and randomized controlled studies are reported in this area. The parameters of EPI have not been studies after the intervention of yoga or naturopathy in ASD children.

Therefore, the current study was aimed to explore the efficacy of yoga and naturopathy interventions on the EPI parameters of children with ASD.

MATERIALS AND METHODS

Participants

Seventy participants aged between 7 to 15 years (mean and SD; 9.12±2.3 years) were recruited from specific autism centers in Bangalore and Kolkata, India. This study was conducted between March 2018- August 2019. Children diagnosed with mild or moderate ASD by a psychiatrist using the stipulated guidelines in the Diagnostic and Statistical Manual of Mental Disorders (DSM–5) for autism[26] were recruited in the present study. The selected children were physically active, able to follow instructions and ready to undergo for yoga and naturopathy interventions. We have excluded children if they have severe behaviour problems, uncontrolled seizures, neurological problems, including visual or auditory impairments. Each child was assessed using the Childhood Rating scale (CRS),[27] which demonstrated a mild to moderate autism range. Those who marked a severe range of autism were not accepted into this trial. The CONSORT Flow diagram of the trial is given in Figure 1.

Ethics approval and informed consent

The research study was carried out following the Declaration of Helsinki and approved by the Institutional Ethics Committee (IEC) of the University. Further, the course was registered in the Clinical Trial Registry of India (CTRI) [CTRI/2018/08/015267] before the recruitment of participants. The informed consent was obtained from school authority, parents, or guardian of all participants after explaining the nature of the study and were informed about the EPI technique and procedure of data acquisition.

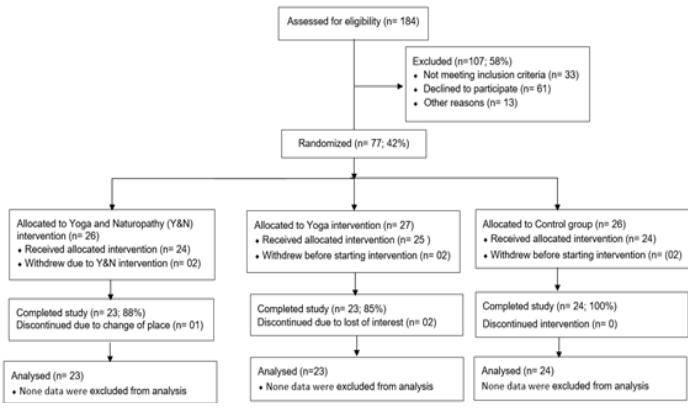

Figure 1: CONSORT flow chart of ASD children through study.

Randomization

The autistic children were randomized into either 24-days yoga or yoga and naturopathy interventions or routine physical activity (active control) group. After CRS at baseline, all eligible participants were randomized into three groups using a computer-generated random assignment scheme. Participants were assigned in a 1:1:1 ratio to each group in the block of 10-12 participants. The principal investigator, investigator who acquired data and statisticians were blind to the assigned group. It was not possible to mask the intervention from the subject.

Instrumentation

This study utilized electrophotonic imaging (EPI) tool, model number: FTDI.13.6001.110310 (Kirlionics Technologies International company, Saint Petersburg, Russia), also known as gas discharge visualization, following guidelines of Kirlian effect. EPI allows us to measure the energy field in humans and used as a scientific device in few other studies demonstrated the level of stress, general health and disorderliness through stimulated optoelectronic emission of humans.[28-30] The EPI is based on applied physical and Chinese meridian theory to assess subtle bio-energy changes in the body using fingertips. Each fingertip is subdivided into various sectors and was correlated with different organs and organ systems of the body.[31] The biophotons can be captured from ten fingertips by placing them on dielectric glass, which is stimulated by high voltage (10kV) and high frequency (1024 Hz) for less than a millisecond. Due the presence of high electric field, the electrons extracted from the surface of skin and can be seen as a luminous glow around the finger and capture using an optical CCD (charge-coupled device) camera.[32] The health-related information can be derived from sectors of the fingertip quantified by EPI software. If there is a gap in any sectors shows imbalance in the concerned organ within the body.[33] Few studies used a specially designed plastic sheet that is placed above the dielectric glass surface before data acquisition (with filter) and then without filter data was collected.[25,34] For short duration recording, the EPI parameters were found to be consistent and with filter data are more stronger than without filter data.[32,33] Therefore, in the present study we acquired data 'with filter'. This tool provides information about physiological and psychophysiological states through electromagnetic field of human body. The normative data of EPI measurements showed that the healthy individual fall within the range of 4.1-6.6% and highly reliable for different clinical conditions such as cancer, autism, diabetes, sports, mind-body medicine.[35,36]

EPI tool enabled four different parameters: (1) activation coefficient (AC), measures the stress level and normal range is 2-4 in healthy people; (2) integral area (IA) from left and right side: measure of general health index with a range of -0.6 to +1 for healthy; (3) integral entropy (IE) from left and right side: measures of human energy filed of disorderliness with a range of 1-2 in healthy people.[33]

Procedure for data-acquisition

Each ASD diagnosed child seated in electrically isolated comfortable chair and asked to place their fingertip on a dielectric glass at 45° angle for a short duration (approx. 15-20 sec). The data collection was done in morning after three hours of food intake. Parents or Guardians were asked to remove metallic items from their children at least one day before data acquisition. The variability in environmental conditions including temperature (26.8°C at Pre and 27.3°C at Post) and humidity (51.8% at Pre and 50.6% at Post) was monitored using Hygrometer (Equinox, EQ 310 CTH) because it may affect electrophotonic emission from human

participants.[37] Prior to data collection on EPI, children were exposed to the method of placing their fingertip on a plane glass surface. Once they are comfortable and stable, data was acquired as per the instructions stipulated in the EPI manual. If still the collected data was not clear, it was repeated twice or participant was discarded from the study. None of the potential participants were discarded due to above reason. After data collection from all 10 fingertips, every child underwent for randomly assigned intervention for a period of 24 days.

Interventions

The study intervention was 24-day structured 60 min integrated yoga protocol, yoga and naturopathy in morning and afternoon with the gap of 2 hrs of food intake. Integrated yoga was a combination of easy physical postures (*sukshma vyayama; asana*), yogic breathing (*pranayama*) and guided relaxation and followed up with mantra chanting that engaged ASD children to be attentive for their body and being present in the moment. The yoga and naturopathy were a combination of above-mentioned yoga practices and eight sessions of naturopathy intervention that included abdominal mud pack and enema using lukewarm water, which is therapeutically efficacious and safe.[38] Additionally, the diet pattern was advised by a dietician to yoga and naturopathy group children. The intervention protocol is given in Table 1. The yoga practice and yoga and naturopathy interventions were led by an experienced yoga trainer for children from Yoga University, Bangalore, India. The control group participants continued their normal routine as usual without any change.

Statistical analysis

Total eighty-four parameters were extracted from left side and right side of EPI data to give a comprehensive energy level description at different organs and organ systems of ASD child. All analyses were conducted using IBM SPSS statistics 24.0 (IBM Corp. Released 2018, IBM SPSS Statistics for Windows, Version 24.0; IBM Corp., Armonk, NY, USA) and JASP 0.10.2. The EPI data is a continuous variables and descriptive statistics were tabulated including the means and standard deviations presented in Table 2. Data analysis was based on the Per-protocol analysis (PPA) method that included all available data in a mixed-model analysis. The EPI parameters were analysed using repeated measures analysis of variance (ANOVA) with two factors *i.e.,* Factor 1: three intervention Groups (YG, YNG and CTL); Factor 2: Time points (Pre and Post). Each EPI parameters were assessed with a Group × Time interaction term. The repeated measures of ANOVAs were carried out followed by *post-hoc* analysis with Bonferroni corrections, for all the parameters of EPI.

RESULTS

The ANOVA results of within subject and between subject outcomes are given in Table 3.

Baseline comparison of YG (n=23), YNG (n= 23) and CTL (n=24)

The 2-way repeated measures of ANOVA showed that there was a significant difference in baseline energy level of IAL, IAR between autism (YG and YNG) and healthy control (p<0.001). After intervention period, the ASD control group showed significant difference in IAL (p<0.05) compared to healthy control group. Similarly, YG showed significant difference with YNG (p<0.05), ASD control (p<0.05) and healthy control (p=0.001). The YNG group showed significant difference with ASD control (p<0.001) and no difference with healthy control (p>0.05).

Within group comparisons (pre-post) in groups

Post hoc analysis with Bonferroni adjustment showed a significant improvement in YG and YNG groups as reported in Table 2. The yoga intervention showed a significant improvement in IAL (p<0.01; Cohen's d=0.41) and IEL (p<0.05; Cohen's d= 0.46) when compared with pre. Similarly, YNG showed there were significant improvement from pre to post in IAL (p<0.001; Cohen's d= 1.50) and IAR (p<0.001; Cohen's d= 1.31) whereas no changes were observed in ASD control group.

DISCUSSION

The aim of the present study was to examine the effect of Yoga and combination of yoga and naturopathy interventions on the important parameters of EPI that measures the pattern of bioenergy field in children with autism. Bioenergy field can be one of the indicators to assess the human health.[28] Moreover, it can be also utilized as an important parameter to assess the effectiveness of interventions given to the children with autism, as attempted in the current study.[39,40] The autistic children underwent for one-month yoga and combination of yoga and naturopathy interventions that showed promising outcome in the bioenergy field measures through EPI. Both YG and YNG showed improvement in IAL and IAR which is an important indicator of in general health parameter. The IEL and IER reflect the disorderliness in energy pattern. Following the intervention of yoga and naturopathy

Table 1: Yoga practices and naturopathy interventions structure and components

A: Yoga.

Name of the practice (Yoga)	Duration (min)
Starting prayer	1 min
Breathing Exercises	2 min
Preparatory/Dynamic Practice	10 min
Wind Releasing Practices	5 min
Sun Salutation (10 step)	5 min
Relaxation	1 min
Standing asana	5 min
Sitting asana	6 min
Prone Posture	2 min
Supine Posture	4 min
Breathing Practices (Pranayama)	5 min
Relaxation	8 min
Chanting sloka	5 min
Ending Prayer	1 min

B: Naturopathy

Name of Treatment	Duration of session (min)	Total number of sessions
Mud Pack to abdomen	20	8
Enema (lukewarm water)	10	8
Diet	Diet advise will be given (what to eat, how to eat, when to eat)	

Table 2: Within group and between group comparisons of electrophotonic imaging (EPI) parameters before and after interventions.

Variables	Yoga (*n*=23)		Cohen's d	Yoga and Naturopathy (*n*=23)		Cohen's d	Control (*n*=24)		Cohen's d
	Pre	Post		Pre	Post		Pre	Post	
AC	3.01 ±1.62	3.38±1.58	0.23	3.69 ±2.25	3.36±0.92	0.19	3.42±2.03	3.35±2.01	0.03
IAL	0.17±0.34	0.29±0.23**$$$	0.41	-0.03±0.33	0.43±0.18***$$$	1.50	0.14±0.85	0.17±0.80	0.04
IEL	1.77±0.22	1.87±0.21*	-0.46	1.78±0.21	1.84±0.27$	0.25	1.79±0.40	1.79±0.39	0.00
IAR	0.11±0.37	0.22±0.36$$	0.30	-0.06±0.35	0.43±0.19***$$$	1.31	-0.11±0.26	0.01±0.18	-0.53
IER	1.88±0.15	1.91±0.17	0.18	1.83±0.18	1.91±0.19	0.43	1.81±0.41	1.84±0.37	-0.08

AC: activation coefficient; IAL: integral area left side; IEL: integral entropy left side; IAR: integral area right side; IER: integral entropy right side. * p<0.05; **<0.01; ***<0.001; represent significant level in post compared with pre. $<0.05; $$<0.01; $$$<0.001 represent the significant difference from control group.

Table 3: ANOVA results.

Measures	Source	F (df)	*p*-value	Partial η^2	Observed Power
AC	Time Point	0.004 (1, 65)	>0.05 (NS)	0.00	.05
	Time Point × Group	2.41 (2, 65)	>0.05 (NS)	0.07	0.47
IAL	Time Point	24.78 (1,65)	<0.001	0.28	0.32
	Time Point × Group	10.70 (2, 65)	<0.001	0.25	0.99
IEL	Time Point	2.29 (1, 65)	>0.05 (NS)	0.03	0.32
	Time Point × Group	0.65 (2,65)	>0.05 (NS)	0.02	0.15
IAR	Time Point	28.99 (1,65)	<0.001	.31	1.0
	Time Point × Group	7.74 (2,65)	0.001	.19	.94
IER	Time Point	2.61 (1,65)	0.11 (NS)	.04	.36
	Time Point × Group	0.30 (2,65)	>0.05 (NS)	.0.01	.09

showed improvement in general health and energy pattern throughout the body of children with autism. However, we have not observed any changes in stress level as reflected by AC parameter of EPI. This may be due to ASD children may have delayed self-awareness and struggle with poor insight.[41,42]

Children with autism is associated with inattentiveness, overactivity and impulsiveness that constantly affect the metabolic process and replenishing their required energy for normal functioning. This is mainly due to children with ASD have gastrointestinal (GI) symptoms including abdominal pain, constipation and diarrhoea that increases severe rigid-compulsive symptoms.[43] This is the first study, where yoga was given with add-on naturopathy intervention that showed beneficial effect on the energy pattern in EPI parameters of children with ASD. The naturopathy intervention included cleansing practices that help to remove toxins from the body and improves the health of gut (enteric) microbiome (GM) in ASD children. The GM play a causative role in ASD[44] and can be modified through yoga and naturopathy interventions.[45] Moreover, yoga practice influence microbiome-gut-brain axis, a complex communication pathway, that has causal effects on brain and behaviour.[46] The microbiome has intricate communication between the external environment and the human body that influence brain function and behaviour.[47] Other few studies demonstrated the effectiveness of yoga on the functional abdominal pain including reduction of pain intensity and frequency and improve the quality of sleep in children.[48,49]

The practice of yoga helps to energize the body and bring harmony between body and mind.[50] The structured yoga program with continuous repeated sessions increases attentiveness, calmness, with reduction in severity of symptoms.[19] Moreover, the repeated sessions enhance recall ability, imitation skills, facial expression and verbal receptive skills in children with ASD. Scientific studies showed that when children imitate repeatedly the body positions and movements guided by a yoga therapist may stimulate mirror neurons system (MNS).[51] Activation in MNS in autism improves higher level of cognitive process and social learning behaviour.[52] Following yoga practice improves motor abilities including balance, strength and flexibility) and social behaviour in children. However, few other studies reported yoga practices have beneficial effect on physical activity including hyperactivity, self-efficacy and socialization in children with autism.[53,54] The results of the previous findings are in agreement with the present study outcome that energy level was improved following yoga and naturopathy interventions in children with autism.

Despite of encouraging results, the current study has several limitations including development and standardisation of yoga and naturopathy module that may limit the feasibility of the current study. However, the considered module was taken from the previous study.[55] The other limitation was not assessing the quality of life of parents though they were also present during the data acquisition and interventions. Future study can be plan on both children and parents using various comprehensive neuropsychological and petrophysical scales for better understanding. A feasibility study can be planned after standardizing and validating yoga and naturopathy module neurodevelopmental disorder including autism.

CONCLUSION

The practice of yoga with naturopathy interventions showed beneficial for children with autism. Yoga can be considered as one of the therapeutic techniques that helps to channelize the energy through the body which helps to reduce the severe of symptoms in autistic children. Moreover, naturopathy intervention can play a major role to reduce the physical complications including constipation, irritable bowel syndrome (IBS) and other GIT related issues in children.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

ABBREVIATIONS

ASD: Autism Spectrum Disorder; **EPI:** Electrophotonic imaging; **YG:** Yoga Group; **YNG:** Yoga and Naturopathy; **CG:** Control Group; **AC:** Activation Coefficient; **IAL and IAR:** Integral Area left and right; **IEL and IER:** Integral Entropy left and right; **IAYT:** Integrated approach of yoga therapy; **CAM:** Complementary and alternative medicine; **GI:** Gastrointestinal; **CRS:** Childhood Rating scale; **ANOVA:** Analysis of variance; **MNS:** Mirror neurons system; **IBS:** Irritable bowel syndrome; **GIT:** Gastro Intestinal Tract.

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