Analysis of Attention Factors and EEG Brain Waves of Attention Deficit and Hyperactivity Disorder (ADHD) - A Case Study Report

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Abstract- Studies have suggested that relaxation therapy can help children with ADHD to reduce their hyperactivity. This study aims to find out the changes on the absolute power of alpha and theta brain waves of Attention Deficit and Hyperactivity Disorder-Hyperactive Impulsive (ADHD-HI) case and attention factors are also analyzed by applying relaxation therapy as an intervention programme. The experimental sample for the present study was a single ADHD-HI case and control group for comparison with quasi experimental approach. Brain waves of the control samples including the experimental case were recorded for pre test using Electro Encephalogram (EEG) along with attention scores and relaxation therapy was given for the experimental case alone and post test was recorded on brain waves and attention scores again. Statistical analyses were done on the different brain waves. It is found that increase in alpha, theta and attention scores of the ADHD-HI case.

Index Terms- Brain Waves, ADHD, EEG, Relaxation Techniques

I. INTRODUCTION

A child with Attention-Deficit/Hyperactivity Disorder (AD/HD) demonstrates an inability to sit still, concentrate, develop self control, and maintain consistent work performance (American Psychiatric Association (APA), 2000). A range of studies have suggested that relaxation training can help children with ADHD to learn to relax thereby decreasing their autonomic activity (Chan, 2002; Goldbeck & Schmid, 2003). The EEG signal generated by alpha (8–12 Hz) activity was first described by Hans Berger in 1929, when he demonstrated that closing the eyes decreased sensory input and increased alpha power over the occipital scalp (Berger, 1929). This study aims to find out the changes on the absolute power of alpha and theta brain waves of Attention Deficit and Hyperactivity Disorder-Hyperactive Impulsive (ADHD-HI) case and attention factors are also analyzed by applying relaxation therapy as an intervention programme. Resting state EEG oscillations are typically subdivided into different bands such as low frequencies delta (1 - 4 Hz) and theta (4 - 8 Hz) and higher frequencies alpha (8 - 12 Hz) and beta (13 - 30 Hz). Alpha and theta EEG waves are considered in this study in order to compare with attention of ADHD-HI case. In general, increased low frequency power is a typical phenomenon in lower arousal functional states such as sleep (Cajochen et al., 2002; Campbell and Feinberg, 2009), neuropathology (Llinas et al., 2005; Llinas et al., 1999) or sedation (John et al., 2001).

Gregg D. Jacobs & Richard Friedman, 2004, conducted a study on EEG spectral analysis of relaxation techniques. This Controlled randomized study included thirty-six subjects were randomized to either RT or a music comparison condition. After listening to relaxation techniques audiotape or music audiotapes daily for 6 weeks, the acute central nervous system effects of relaxation techniques and music were measured using power spectral analysis of alpha and theta EEG activity in all cortical regions. Relaxation techniques produced significantly greater increase in theta activity in multiple cortical regions compared to the music condition. Maria Hernandez-Reif et al., 2001, studied the benefits of Tai Chi among ADHD children. For that thirteen adolescents with Attention Deficit Hyperactivity Disorder (ADHD) were selected for Tai Chi classes twice a week for 5 weeks. Teachers rated the children's behaviour on the Conners Scale during the baseline period, after the 5 week Tai Chi session period and 2 weeks later. After the 10 Tai Chi sessions the adolescents displayed less anxiety, improved conduct, less daydreaming behaviours, less inappropriate emotions, and less hyperactivity. These improved scores persisted over the 2-week follow up (no Tai Chi period).

II. OBJECTIVES OF THE STUDY

- To find out the impact of relaxation therapy on absolute powers of alpha and theta of ADHD-HI case.
- To find out the impact of relaxation therapy on attention of ADHD-HI case.
- To improve the quality of academic life of ADHD-HI case.

III. RESEARCH QUESTION

- Does relaxation therapy change the absolute powers of various wave patterns of the brain?

- Does relaxation therapy improve the attention of ADHD-HI case?

IV. DESIGN OF THE STUDY

Out of 150 slow learners (age range 14 - 17 years) 15 ADHD-HI students were chosen, from which eight ADHD-HI students were randomly selected from special school for learning disabled and they are called as control group. Initially Simple Random Sampling Technique was adopted for control samples' selection and Selective Sampling Method was used to select the Experimental Sample. Subjects were free from medical and sleep disorders as determined by history, physical examination, biochemical screening tests, electrocardiograms, and psychological screening questionnaires. Quasi-Experimental design is used for the study. Under that Single Case pre test and post test having control group design is framed for the present study. In order to measure their brain waves permission had been requested from the school authorities and parents of the selected students. After receiving the permission, Electro Encephalogram was recorded for all the students to measure their brain activation waves, attention scores were measured using the attention questionnaire of Johann M. Schepers, 2007 and these values were considered as pre test values. After that, one student had been taken randomly from the control group as a case for present research. Relaxation therapy was given to the single case for about a month. Post-test was recorded on brain waves while doing relaxation therapy for the experimental case at the end of the intervention programme and attention scores were also measured. A method proposed by Crawford and Howell (1998) that treats the control sample statistics as sample statistics (Crawford & Garthwaite, 2002) is used to compute the significance of difference between pre test and post test of the ADHD-HI case.

Attention Scores were measured using the Attention Questionnaire of Johann M. Schepers, 2007 which is the revised and extended version of De W Vos & Schepers, 1993. It deals with the factors of concentration ability, arousal and distractibility. There are totally 60 items in this attention questionnaire (Concentration Ability- 29 items; Arousal-21 items; Distractibility-10 items) and are measured using a seven point scale. Reliabilities of concentration ability, arousal and distractibility are 0.886, 0.757 and 0.863 respectively and validity of these three factors is 0.9412, 0.8700 and 0.9290 respectively.

V. STATISTICAL ANALYSES AND RESULTS

Table 1: Differentiation of pre and post test absolute power of Alpha and Theta from ADHD-HI Case

Case Category	Control Group N	Brain Waves	Pre Test Mean	Post Test Score	Theta/Alpha Ratio(Pre Test)	Theta/Alpha Ratio (Post Test)
ADHD-HI	8	Alpha	417.65	1103.68****	1.30	2.41
		Theta	543.40	2662.22****		

$P^{*} < 0.05$, $P^{**} < 0.01$, $P^{***} < 0.001$, $P^{****} < 0.000$

It is clear from the table 1 that the calculated 't' values of ADHD-HI Case are significantly greater than that of the table 't' values ($p<0.000$, $N=8$) for alpha and theta. Hence it is proved that there are significant differences between Pre Test and post test scores of alpha and theta brain waves of ADHD- HI Case before and after applying Relaxation Therapy. Increased theta/alpha ratio is also observed in post test score compared to the pre-test in ADHD-HI case after relaxation therapy.

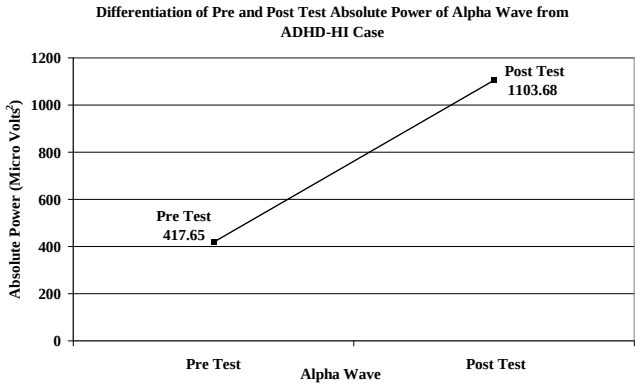

Figure (1)

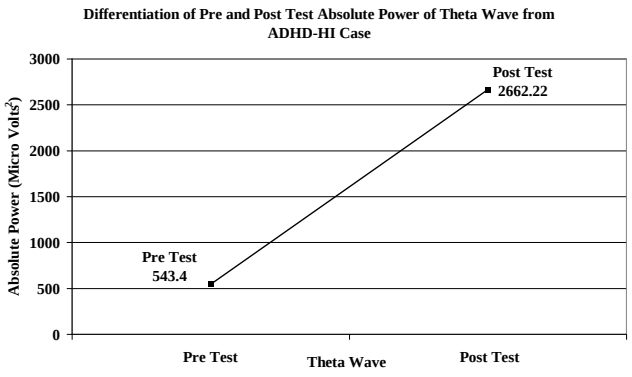

Figure (2)

Figure (1): Shows Differentiation of Pre and Post Test Absolute Power of Alpha Wave from ADHD-HI Case

Figure (2): Shows Differentiation of Pre and Post Test Absolute Power of Theta Wave from ADHD-HI Case

The above result is supported by the following studies. EEG studies have used these methods to limn the neurophysiological changes that occur in meditation (Rael Cahn & John Polich, 2006). (Lagopoulos et al., 2009) observed alpha power increase over the posterior regions. Alpha power increase is one of the more consistent findings about meditation state effects: alpha is generally associated with relaxation (Aftanas & Golocheikine, 2001). The most dominant effect standing out in the majority of studies on meditation is a state-related slowing of the alpha rhythm (8–12 Hz) in combination with an increase in the alpha power (Hirai, 1974). These findings were relatively robust, because they did not depend on either a certain meditation tradition or the experience of the mediators. (Anand et al., 1961) worked with Raj yoga meditation type having the experimental design of ((N=6) and rest vs. meditation) showed that increased alpha power during Samadhi in meditation state. (Travis, 1991) studied with Transcendental Meditation (TM) type having Long Transcendental Meditation and Short Transcendental Meditation design (N=20), showed that increased alpha power in their meditation traits. (Lee et al., 1997) analyzed with Qigong meditation type having Rest and meditation group (N=13) showed increased alpha power in their states. There was a significant increase in alpha power in the meditation condition compared to the rest condition, when averaged across all brain regions, and it was found that alpha was significantly greater in the posterior region as compared to the frontal region (Lagopoulos, 2009).

The most consistent finding is increased theta activity during relaxation therapy (Banquet, 1972, 1973; Corby, Roth, Zarcone, & Kopell, 1978; Fenwick, Donaldson, & Gillis, 1977; Hebert & Lehman, 1977; Jacobs & Lubar, 1989; Kasamatsu & Hirai, 1966; Stigsby et al., 1981; Wallace, 1970; Wallace, Benson, &Wilson, 1971; Warrenburg, Pagano, & Hlastala, 1980). Several researchers have also drawn parallels between increase in theta activity during relaxation therapy, Stage 1 sleep, and the hypnagogic state (Elson, Hauri, & Conis, 1977; Fenwick et al., 1977). Increased frontal theta power from Begin to end of the relaxation period was observed. The relaxation therapy group exhibited a significantly greater increase in central theta power from Begin to end of the relaxation period compared to the music group, $F(1, 31) = 9.54$, $p < .0043$. The relaxation therapy group exhibited a significantly greater increase in parietal theta power from Begin to end of the relaxation period compared to the music group, $F(1, 31) = 8.66$, $p < .0127$. The relaxation therapy group exhibited a significantly greater increase in occipital theta power from Begin to end of the relaxation period compared to the music group, $F(1, 31) = 5.59$, $p < .0246$ (Gregg & Richard, 2004). Studies reported increased theta EEG activity during the practice of relaxation therapy (Banquet, 1972, 1973; Corby et al., 1978; Fenwick et al., 1977; Hebert & Lehman, 1977; Jacobs & Lubar, 1989; Kasamatsu & Hirai, 1966; Stigsby et al., 1981; Wallace, 1970; Wallace et al., 1971; Warrenburg et al., 1980. EEG studies have widely reported increased theta activity during meditation (Aftanas &Golosheikine 2001, 2002; Jacobs & Lubar 1989). Significantly increased theta power was found for the meditation condition when averaged across all brain regions. On closer examination, it was found that theta was significantly greater in the frontal and temporal-central regions as compared to the posterior region (Lagopoulos, 2009).

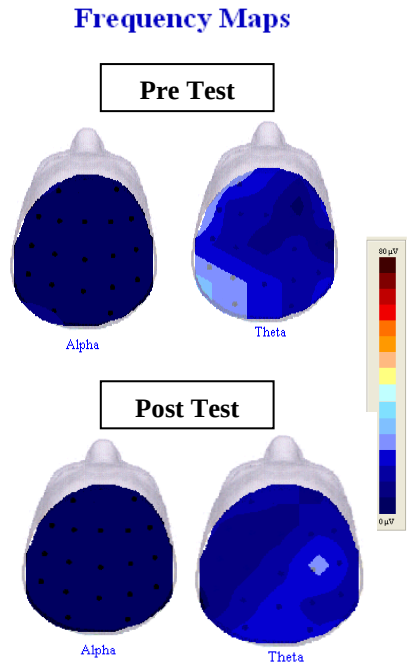

Figure (3)

Figure (3): Shows the Pre and Post Test Frequency Map of Alpha and Theta Waves of ADHD-HI Case

Egner et al. (2002) studied with alpha theta training on experimental group and mock feedback group and found that Theta/Alpha ratio increased in experimental group. Both the experimental and mock feedback group showed increased relaxation after treatment. Batty et al. (2006) investigated with alpha theta training and found that Theta/Alpha ratio increased in experimental group.

Table 2: Differentiation of Pre and Post test of Factors of Attention Scores and the Total Attention Score in ADHD-HI Case

Variable	N	Problem	Dimensions	Pre Test Mean	Post Test Score
Attention	8	ADHD-HI	Concentration Ability	100.75	145****
			Arousal	76.25	60***
			Distractibility	28.13	15**
			Total Attention	205.13	220*

$P^{*} < 0.05$, $P^{**} < 0.01$, $P^{***} < 0.00$, $P^{****} < 0.000$

It is clear from the table 2 that the calculated 't' values of ADHD-HI Case are significantly greater than that of the table 't' values ($p<0.000$, N=8) for concentration ability, for Arousal ($p<0.00$, N=8), for Distractibility ($p<0.01$, N=8) and for total attention ($p<0.05$, N=8). Hence it is proved that there are significant differences between Pre Test and post test scores of concentration ability, arousal, distractibility and total attention scores of ADHD- HI Case before and after applying Relaxation Therapy.

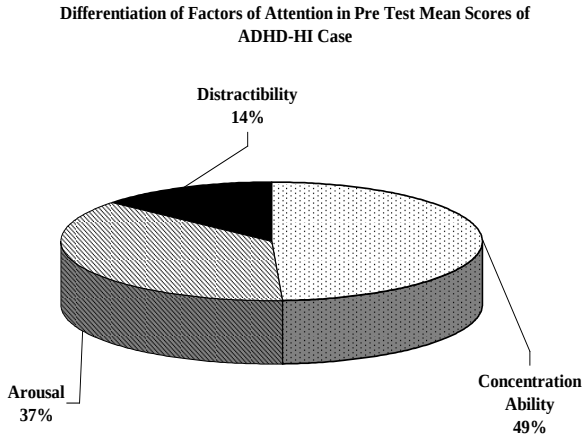

Figure (4)

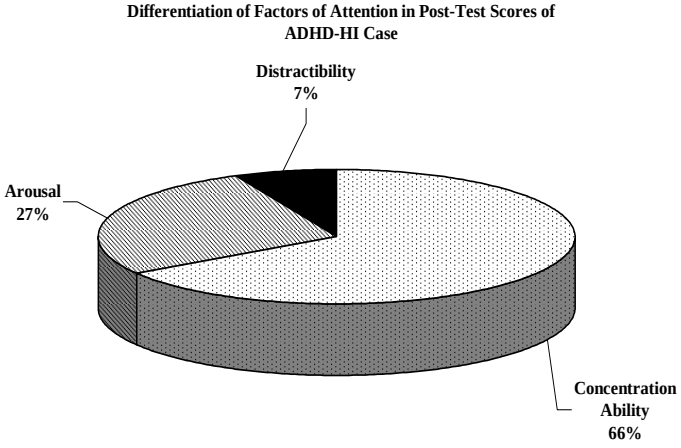

Figure (5)

Figure (4): Shows Differentiation of Factors of Attention in Pre-Test Mean Scores of ADHD-HI Case

Figure (5): Shows Differentiation of Factors of Attention in Post-Test Scores of ADHD-HI Case

One recent study has demonstrated improved attention and cognition with reduced anxiety and depression after an 8 week mindfulness training program (Zylowski et al., 2008). An another study demonstrated increased concentration and decreased hyperactivity after children with ADHD received 15 minute massages for 10 consecutive school days (Khilnani et al., 2003). A recent exploratory study conducted at a private school reported in current issues in Education stated that the use of meditation can be beneficial to 11 to 14 year old students diagnosed with ADHD (Robert Myers, 2010). The video game used biofeedback technology and combined relaxation techniques reported by Chang (1991) and Margolis, such as the use of meditation procedures, abbreviated relaxation methods, and visual images and auditory stimulus. Participants in this study took great interest and were stimulated with the therapy, through the video game format. Further research however, needed to explore long term effects of biofeedback on a greater number of participants, as it had been shown to have the ability to teach skills that can help in improving concentration and attention to tasks and activities, and may also help to reduce the core symptoms of AD/HD. Findings from previous research studies have shown that the use of yoga and meditation to have positive benefits for children with AD/HD in improving concentration, classroom behaviours, and emotional developments (Harrison, Manocha, & Rubia, 2004). Similarly, the use of neurofeedback has shown improvements in AD/HD symptoms and related behaviours

(Fuchs et al., 2003). Yoga and relaxation techniques can help improve students' classroom behaviors. Peck et al. (2005) implemented a yoga intervention program that included meditation for a group of elementary students that had been sent to the school psychologist's office for attention problems, even though the students were not diagnosed with ADHD (Attention Deficit Hyperactivity Disorder). The program was reported to decrease students' hyperactivity, inattention and anxiety. A program that consisted of positive touch, yoga, breathing and relaxation was used on a group of students that were at risk for exclusion from their classrooms because of behavioral and emotional problems. The program improved the students' listening skills, attention span, and relaxation while decreasing their fidgeting. The findings of the present study are in line with the above results.

VI. DISCUSSION

The present research study shows that relaxation therapy increases concentration, relaxed feeling, increased attention and reduced anxiety. Similar findings were observed in various studies. Benson (1975) showed relaxation response involves bodily changes when one experiences deep muscle relaxation. This response is a naturally occurring measure against overstress bringing the body back to a healthier balance. Focusing on the breath is a simple and effective way to achieve concentration, awareness and relaxation. Research indicates that incorporating stress reduction programs into the school curriculum is associated with improvement of academic performance, self-esteem, mood, concentration and behavior problems (Ballinger & Heine, 1991; Dendato & Diener, 1986; Kiselica, Baker, Thomas & Reedy, 1994; Napoli, 2002; Shillingford & ShillingfordMackin, 1991). Another study of third, fourth and fifth-grade students found that children who participated in mindfulness training reported positive changes in behavior, mood, and attitude after being taught to pay attention to their breath (Napoli, 2002). Children in this study also reported feeling more relaxed, experiencing reduced tension and anxiety. Reductions in problem behaviour, increased attention span and greater internal locus of control are other potential benefits of relaxation therapy. It should be noted, however, that these skills need to be practiced regularly for continued effect (Klein & Deffenbacher, 1977; Donney & Poppen, 1989; Raymer & Poppen, 1985; Dynn & Howell, 1982). Mindfulness meditation may also improve behavioural and neurocognitive impairments in adolescents and adults with ADHD (Chan, 2002; Goldbeck & Schmid, 2003). The effects of yoga have been associated with altered brain wave states, with specific increases in medium frequency and low beta ranges, which are related to concentration, perception, alertness, and attention (Aftanas & Golocheikine, 2001, 2002). According to the researchers, "the meditation technique has potential to improve attention, behavioral regulation, and executive function by naturally reducing stress and anxiety and improving brain functioning". Relaxation training has been known for sometime to provide benefits, and Robert Myers is using this technique along with others since '80s to help kids with ADHD (Robert Myers, 2010). In order to increase children's capacity to pay attention is the goal of mindfulness training; yet, there are other residual benefits that have been found. The hand-full of programs that have been implemented incorporating mindfulness with children have shown success in reducing anxiety and disruptive behavior, and improved concentration and self-control in children (Feindler, Marriott, & Iwata, 1984; Fluellen, 1996; Ryan, 2000). As evidenced by numerous studies, the positive effects of relaxation training in children include decreased dysfunctional behaviour, reduced stress and anxiety levels, alleviated headaches, encouraged reading achievement, improved self-concepts, and enhanced self-esteem (Margolis, 1990). (Powell, Gilchrist, & Stapley, 2008). Norlander, Moas, and Archer (2005) reported that relaxation techniques can be used to lower classroom noise and increase students' concentration.

As a result of the present research findings increase in alpha power by relaxation therapy in ADHD-HI case is because of the internal mental operations thereby relaxed and internal attention of the case has increased. The similar findings related to the present research were found in some of the previous studies. Alpha oscillations are known to arise from an increase of internal attention (Ray & Cole, 1985) which of course does not only occur due to meditation. Various studies showed an increase of alpha power related to internally driven mental operations, like the imagery of tones (Ray & Cole, 1985; Cooper et al, 2003; Cooper et al, 2006) or working memory retention and scanning (Jensen, 2002; Klimesch, 1999). Increase in alpha power was often observed when meditators are evaluated during meditating compared with control conditions (Aftanas & Golocheikine, 2001; Anand, Chhina, & Singh, 1961; Arambula, Peper, Kawakami, & Gibney, 2001). Several EEG meditation studies reported sleeplike stages during meditation with increased alpha power (Pagano, Rose, Stivers, & Warrenburg, 1976; Younger, Adriance, & Berger, 1975). The association between alpha changes and cortical activation had been assessed with combined EEG and fMRI–PET studies, with increased alpha power related to decreased blood flow in inferior frontal, cingulate, superior temporal and occipital cortices (Goldman, Stern, Engel, & Cohen, 2002; Sadato et al., 1998).

The results of the present study prove that reduction in cortical arousal leads theta power increase with the intervention of relaxation therapy. Many people with high amounts of theta brainwave activity are able to "get in the zone" and stay intensely focused and motivated with one idea. Many people with ADD or ADHD attribute their success in certain areas of life to their ability to hyperfocus. Hyperfocus is a unique phenomenon that can really only be experienced in the theta brainwave range (Drew, 2008). Researchers involved in meditations have also claimed to have learned the hyperfocus ability. Increased theta power across multiple cortical regions during relaxation therapy is consistent with widespread reductions in cortical arousal (Canteros et al., 2002; Jacobs & Lubar, 1989; West, 1980). Although the therapeutic effects of relaxation therapy have traditionally been attributed to reductions in sympathetic nervous system activity (Wallace, 1970; Wallace et al., 1971), relaxation therapy may exert their primary effects through reductions in central nervous system activity (Gregg & Richard, 2004). An increase in theta activity is associated not only with decreased activity in brain arousal systems but also with the sleep-onset

process itself (Canteros et al., 2002; Rechtschafen & Kales, 1968; Schacter, 1976; West, 1980), represent a hypoactive CNS state that is similar to Stage 1 sleep. Stage 1 is the transitional state between wakefulness and sleep. It is characterized by a gradual transition from a predominant alpha pattern (relaxed wakefulness, eyes closed) to the appearance of theta intermixed with alpha, followed by the disappearance of alpha and a predominant theta frequency as measured by poly-somnography (Rechtschafen & Kales, 1968). Stage 1 sleep and other states of decreased or abolished consciousness (e.g., reverie, hypnosis) involve cortical hypo-activation, widespread deactivation of stress/arousal systems, and reduced capacity for attending to and interpreting external stimuli that favors low levels of self-consciousness and hypnagogic/primary process/reverie mentation (Budzynski, 1976; Hobson, Pace-Schott, & Stickgold, 2000; Kutz, Borysenko, & Benson, 1985; Maquet, 2000; Schacter, 1976). Because relaxation therapy appear to induce a hypoactive CNS state that is similar in some respects to Stage 1 sleep, relaxation therapy may exert their therapeutic effects through similar mechanisms, probably as a result of a repetitive mental focus and reduced/monotonous sensory input. In a similar vein, relaxation therapy may serve as a cerebral energy conservation/restoration function by allowing the cortex to go offline from its normal activating, energy demanding role of processing complex, stressful stimuli (Jacobs, 2003). Elevated levels of theta activity are associated with alterations in CNS arousal commonly observed in meditation practitioners (Canteros et al. 2002; Jacobs & Friedman 2004). The widespread increase in theta power leads to general reductions in the brain arousal systems (Canteros et al. 2002; Jacobs & Friedman 2004). EEG-based Low-Resolution Electromagnetic Tomography Analysis (LORETA) have shown that the significantly increased theta activity during Triarchic Body-pathway Relaxation Technique(TBRT) was generated by the anterior cingulate cortex, an area that has been widely reported to be involved in attention (Asada et al. 1999; Ishii et al. 1999; Pizzagalli et al. 2003). Increased frontal midline theta during attention-demanding tasks (Asada et al. 1999; Ishii et al. 1999) was found to be closely associated with the concentrative aspect of meditation (Aftanas & Golosheikine 2002; Dunn et al. 1999; Kubota et al. 2001; Lazar et al. 2000; Pan et al. 1994). It was found that nondirective meditation techniques alter theta and alpha EEG patterns significantly more than regular relaxation, in a manner that is perhaps similar to methods based on mindfulness or concentration (Lagopoulos, 2009).

Reduction in sympathetic nervous system activity is the result of reduction in arousal. The same findings are observed in the present research study. Sympathetic nervous system is responsible for fight or flees in time responses that get our body aroused to respond. This system works with the parasympathetic nervous system which is responsible for calming our body after the arousal (to get back to normal). Both of these are actually part (subparts) of the autonomic nervous system. But also during rest, brain activity transiently fluctuates spontaneously between states of higher or lowered arousal. With the use of eyes-open (EO) and eyes closed (EC) conditions, systematic arousal variations can be induced in the resting state. Both EEG and fMRI reflect arousal related features of resting brain state regulation. In the EEG the sensitivity is reflected by the oscillatory compound (reviewed in (Olbrich et al., 2009; Sadaghiani et al., 2010) such as Alpha (10 Hz) oscillations typically reflect an "idling" state, higher frequencies (> 13 Hz) reflect an increase and lower frequencies (< 8 Hz) a decrease in arousal. Resting state fMRI features two major (and antagonistic) Resting State Networks (RSNs), they are the default mode network (DMN) (Raichle et al., 2001; Raichle and Snyder, 2007) and the attention network (ATN) (Fox et al., 2005) which activity reflects shifts along the arousal scale as their engagement relates to rest or attentional task activity. Vigilance and arousal is regulated among others by thalamic activity and thalamocortical circuitry (Llinas et al., 1998; McCormick and Bal, 1997; Steriade et al., 1993). A comprehensive study of resting state EEG–BOLD coupling covering the common spectral frequency bands and resting states has not yet been performed. Such a study is important, because the profile formed by different EEG rhythms is characteristic of different brain states and brain functions, and because eyes-open and eyes-closed states differ substantially in levels of arousal and EEG (Barry et al., 2007; Berger, 1929; Bianciardi et al., 2009; Marx et al., 2004; Marx et al., 2003) as well as in fMRI (Bianciardi et al., 2009; Marx et al., 2004; Marx et al., 2003). While the fMRI indicated increased activity during eyes-open, the EEG activity in contrast (in particular within alpha band, consistent with the classical observation of Berger, 1929) was increased during eyes-closed. This result is in line with other observations that synchronization of background EEG is often correlated with states of lower arousal or suppression of brain areas (Barry et al., 2007; Pfurtscheller, 2001), and illustrates the inverse relationship between lower frequency EEG and fMRI.

Where beta represents arousal, alpha represents non-arousal. Alpha brainwaves are slower and higher in amplitude. Their frequency ranges from 9 to 14 cycles per second. A person who has completed a task and sits down to rest is often in an alpha state. A person who takes time out to reflect or meditate is usually in an alpha state. A person who takes a break from a conference and walks in the garden is often in an alpha state. The post test results show increased alpha brain power and it is an evidence of relaxed condition and decrease arousal. The present study strongly proves that this result is in line with the similar studies.

On the left, the increased 'Theta' EEG power is clearly visible specifically in fronto-central brain areas. Satterfield and colleagues (Satterfield et al., 1973; Satterfield et al., 1971) were the first to investigate the potential use of EEG in predicting treatment outcome to stimulant medication. They found that children with excess slow wave activity and large amplitude evoked potentials were more likely to respond to stimulant medication (Satterfield et al., 1971) or more general that abnormal EEG findings could be considered a predictor for positive treatment outcome (Satterfield et al., 1973). Chabot et al. (Chabot, di Michele, Prichep & John, 2001; Chabot, Orgill, Crawford, Harris & Serfontein, 1999) found that ADHD and ADD children with excess relative alpha or beta power were likely to show behavioral improvement, whereas the relative excess theta group showed a worse response to medication. Their group exhibiting this 'excess Theta' was described as: 'generalized excess of theta absolute and relative power, decreased alpha mean frequency, and frontal theta

hypercoherence'. Note the mentioning of decreased alpha mean frequency, suggesting that in fact they were looking at a combined group of excess theta and slowed alpha power frequency. The function of the hippocampal theta rhythm is not clearly understood. Green and Arduini, in the first major study of this phenomenon, noted that hippocampal theta usually occurs together with desynchronized EEG in the neocortex, and proposed that it is related to arousal. Vanderwolf and his colleagues, noting the strong relationship between theta and motor behavior, have argued that it is related to sensorimotor processing. Another school, led by John O'Keefe, has suggested that theta is part of the mechanism animals use to keep track of their location within the environment. The most popular theories, however, link the theta rhythm to mechanisms of learning and memory. (Hasselmo, 2005)

In the present study the ADHD-HI case shows increased theta/alpha ratio in post test than pre test. It is obvious from this result that relaxation therapy produces hypoarousal state among ADHD case. EEG studies of children with ADHD have revealed a relatively consistent picture that includes an excess of slow-wave EEG activity (Predominantly theta) and increased theta/alpha and theta/beta ratios that are more predominant in children with ADHD combined than inattentive type. These results are generally in accord with theories that propose cortical hypoarousal in ADHD (sergeant, 2000). The point in time when theta activity supersedes alpha activity, the so-called theta/alpha "crossover", is commonly associated with loss of consciousness and the onset of early sleep stages (John Gruzelier, 2006). Earlier evidence shows that muscle relaxation training was effective to some extent in enhancing hypnotisability (Leva, 1974). Elevating the theta/alpha ratio is a widely used clinical and optimal performance EEG-neurofeedback protocol which we have recently validated (Gruzelier, 2005). It was originally developed to produce an hypnogogic state for the purpose of enhancing creativity when benefits were found in enhanced well being and psychic integration (Budzynski, 1972).

VII. CONCLUSION

All these results give a valuable contribution in understanding the brain dynamics. However, despite all the advances due to the development of new techniques and experiments, is still very little what we know about this topic. The attempts to understand the dynamics of the brain by analyzing the EEG is like trying to understand the conversations occurring in a building by analyzing a sound recorded from far away. Divergent stages and apartments are making divergent tasks, and we are not able to get inside and see what is going on. The EEG, the sound recorded from far away, is still one of our main tools to access to one of the most unknown and complex systems in nature, "One of the Still Elusive Treasures of Science".

ACKNOWLEDGMENT

We mention our deep sense of gratitude to University Grants Commission for Junior Research Fellowship and also we would like to express our heartfelt thanks to all the children those who participated in our research, their parents, school authorities, neuro-physician and technicians.

REFERENCES

[1] Aftanas, L. I., & Golosheikine, S. A. Human anterior and frontal midline theta and lower alpha reflect emotionally positive state and internalized attention: high-resolution EEG investigation of meditation. Neuroscience Letters 2001;310:57–60.

[2] Aftanas, L. I., & Golosheikine, S. A. Non-linear dynamic complexity of the human EEG during meditation. Neuroscience Letters 2002;330:143–146.

[3] American Psychiatric Association (APA). Diagnostic and Statistical Manual of Mental Disorders- Text Revision (4th ed.). Washington DC: American Psychiatric Association, 2000.

[4] Anand, B., Chhina, G. S., & Singh, B. Some aspects of electroencephalographic studies in yogis. Electroencephalography and Clinical Neurophysiology 1961;13: 452–456.

[5] Arambula, P., Peper, E., Kawakami, M., & Gibney, K. H. The physiological correlates of Kundalini yoga meditation: A study of a yoga master. Applied Psychophysiology and Biofeedback 2001;26:147–153.

[6] Asada, H., Fukuda, Y., Tsunoda, S., Yamaguchi, M., & Tonoike, M. Frontal midline theta rhythms reflect alternative activation of prefrontal cortex and anterior cingulated cortex in humans. Neuroscience Letter 1999;274:29–32.

[7] Ballinger, D., & Heine, P. Relaxation training for children: A script. Ophea Journal, Spring 1991;31-33.

[8] Banquet, J. P. EEG and meditation. Electroencephalography and Clinical Neurophysiology 1972;33:454.

[9] Banquet, J. P. Spectral analysis of the EEG in meditation. Electroencephalography and Clinical Neurophysiology 1973;35:143–151.

[10] Barry, R.J., Clarke, A.R., Johnstone, S.J., Magee, C.A., Rushby, J.A. EEG differences between eyes-closed and eyes-open resting conditions. Clin Neurophysiol 2007;118:2765-2773.

[11] Batty, M.J., Bonnington, S., Tang, B-K, Hawken, M.B., Gruzelier, J.H. Relaxation strategies and enhancement of hypnotic susceptibility: EEG neurofeedback, progressive muscle relaxation and self-hypnosis. Brain research Bulletin 2006;71:83-90.

[12] Benson, H. The relaxation response. New York, William Morrow and Company, Inc., 1975.

[13] Berger, H. Uber das electrenkephalogramm des menschen. Archiv fur Psychiatrie und Nervenkrankheiten 1929;87:527–570.

[14] Bianciardi, M., Fukunaga, M., van Gelderen, P., Horovitz, S.G., de Zwart, J.A., Duyn, J.H. Modulation of spontaneous fMRI activity in human visual cortex by behavioral state. Neuroimage 2009;45:160-168.

[15] Brandeis, D., Michel, M.C., Amzica, F. From neuronal activity to scalp potential fields. In: Michel, M.C., Koenig, T., Brandeis, D., Gianotti, L.R.R., Wackermann, J. (Eds.), Electrical Neuroimaging. Cambridge Unversity Press, New York, 2009;1-24.

[16] Budzynski, T. "Biofeedback and twilight states of consciousness", in *Consciousness and self-regulation*, vol. 1, G. Schwartz & D. Shapiro (Eds.), New York: Plenum, 1976, pp. 131-141..

[17] Budzynski.T.H., Stoyva.J.M., "Biofeedback techniques in behavior therapy", in *Biofeedback and Self Control* D. Shapiro, T.X. Barber, L., V. Dicara, J. Kamiya, N.B. Miller, & J.M. Stoyva (Eds.), Aldine, Chicago 1972, pp. 437-459.

[18] Cajochen, C., Wyatt, J.K., Czeisler, C.A., Dijk, D.J. Separation of circadian and wake duration-dependent modulation of EEG activation during wakefulness. Neuroscience 2002;114:1047-1060.

[19] Campbell, I.G., Feinberg, I. Longitudinal trajectories of non-rapid eye movement delta and theta EEG as indicators of adolescent brain maturation. Proc Natl Acad Sci U S A 2009;106:5177-5180.

[20] Canteros, J. L., Atienza, M., Stickgold, R., & Hobson, J. A. Nightcap: A reliable system for determining sleep-onset latency. Sleep 2002;25:238–245.

[21] Chabot, R.J.,di Michele, F., Prichep, L.,& John, E. R The clinical role of computerized EEG in the evaluation and treatment of learning and attention disorders in children and adolescents. The.

Journal.of.Neuropsychiatry.and.Clinical. Neurosciences 2001;13(2):171D86.

[22] Chabot, R. J., Orgill, A. A., Crawford, G., Harris, M. J., & Serfontein, G. Behavioral and electrophysiologic predictors of treatment response to stimulants in children with attention disorders.Journal.of.Child.Neurology 1999;14(6):343.

[23] Chan E. The role of CAM in ADHD. J Dev Behave Pediatr 2002;19(2):313-26.

[24] Chang, J. Using relaxation strategies in child and youth care practice. Child and Youth Care Forum 1991;20(3):155-169.

[25] Cooper, N. R., Burgess, A. P., Croft, R. J., & Gruzelier, J. H. Investigating evoked and induced electroencephalogram activity in task-related alpha power increases during an internally directed attention task. Neuroreport 2006;17:205–208.

[26] Cooper, N. R., Croft, R. J., Dominey, S. J. J., Burgess, A. P., & Gruzelier, J. H. Paradox lost? Exploring the role of alpha oscillations during externally vs. internally directed attention and the implications for idling and inhibition hypotheses. Int Job satisfaction Psychophysiol 2003;47:65–74.

[27] Corby, J. C., Roth, W. T., Zarcone, V. P., & Kopell, B. S. Psychophysiological correlates of Tantric Yoga meditation. Archives of General Psychiatry 1978;35:571–577.

[28] Crawford, J. R., & Garthwaite, P. H. Investigation of the single case in neuropsychology: Confidence limits on the abnormality of test scores and test score differences. Neuropsychologia 2002;40:1196-1208.

[29] Crawford, J. R., & Howell, D. C. Comparing an individual's test score against norms derived from small samples. The Clinical Neuropsychologist 1998;12:482-486.

[30] Dendato, K. M., & Diener, D. Effectiveness of cognitive/relaxation therapy and study skills training in reducing self-reported anxiety and improving the academic performance of test-anxious students. Journal of Counseling Psychology 1986;33:131-135.

[31] De W Vos, S.J. & Schepers, J.M. Kognitiewe en persoonlikheidskorrelate van aandaggewing. Journal of Industrial Psychology 1993;19(3):23-29.

[32] Donney VK, Poppen R. Teaching parents to conduct behavioural relaxation training with their hyperactive children. J Behav Ther Exp Psychiatry 1989;20:319-25.

[33] Drew, Theta Brain Waves- A Guide To Understanding, 2008, Retrieved from http://4mind4life.com.

[34] Dunn, B. R., Hartigan, J. A., & Mikulas, W. L. Concentration and mindfulness meditations: Unique forms of consciousness?

[35] Applied Psychophysiology and Biofeedback, 1999;24(3):147–165.

[36] Dynn F.M, Howell R.J. Relaxation training and its relationship to hyperactivity in boys. J Clin Psychology 1982;38:92-100.

[37] Egner, T., Strawson, E., Gruzelier, J.H. EEG signature and phenomenology of alpha/theta neurofeedback training versus mock feedback. Applied Psychophysiology and Biofeedback 2002;27(4):261-270.

[38] Elson, B. B., Hauri, D., & Conis, D. Physiological changes in Yoga meditation. Psychophysiology 1977;14:52–57.

[39] Feindler, E, Marriott, S., & Iwata, M. Group anger control training for junior high school delinquents. Cognitive Therapy and Research 1984;8(3):299-311.

[40] Fenwick, P. B., Donaldson, S., & Gillis, L. Metabolic and EEG changes during TM: An explanation. Biological Psychology 1977;5:101–118.

[41] Fluellen, J. Developing mindful learner's model: A 21st century ecological approach. Paper presented at the world future society general assembly. Washington, DC, 1996.

[42] Fox, M.D., Snyder, A.Z., Vincent, J.L., Corbetta, M., Van Essen, D.C., Raichle, M.E. The human brain is intrinsically organized into dynamic, anticorrelated functional networks. Proc Natl Acad Sci U S A 2005;102:9673-9678.

[43] Fuchs, T., Birbaumer, N., Lutzenberger, W., Gruzelier, J. H., & Kaiser, J. Neurofeedback Treatment for Attention-Deficit/Hyperactivity Disorder in Children: A Comparison Wtih Methylphenidate. Applied Psychophysiology and Biofeedback, 2003;28(1):1-12.

[44] Giedd, J.N., Blumenthal, J., Jeffries, N.O., Castellanos, F.X., Liu, H., Zijdenbos, A., Paus, T., Evans, A.C., Rapoport, J.L. Brain development during childhood and adolescence: a longitudinal MRI study. Nat Neurosci 1999;2:861-863.

[45] Gogtay, N., Thompson, P.M. Mapping gray matter development: implications for typical development and vulnerability to psychopathology. Brain Cogn 2010;72:6-15.

[46] Gogtay, N., Giedd, J.N., Lusk, L., Hayashi, K.M., Greenstein, D., Vaituzis, A.C., Nugent, T.F., 3rd, Herman, D.H., Clasen, L.S., Toga, A.W., Rapoport, J.L., Thompson, P.M. Dynamic mapping of human cortical development during childhood through early adulthood. Proc Natl Acad Sci U S A 2004;101:8174- 8179.

[47] Goldbeck L, Schmid K. Effectiveness of autogenic relaxation training in children and adolescents with behavioural and emotional problems. J Am Acad Child Adolesc Psychiatry 2003; 42(9):1046-1054.

[48] Goldman, R. I., Stern, J. M., Engel, J., Jr., & Cohen, M. S. Simultaneous EEG and fMRI of the alpha rhythm. NeuroReport, 2002;13: 2487–2492.

[49] Green, J.D., Arduini, A.A. "The hippocampus". Physiol Rev 1964;44(6):561–608.

[50] Gregg D. Jacobs & Richard Friedman. EEG Spectral Analysis of Relaxation Techniques. Applied Psychophysiology and Biofeedback 2004;29(4):245-254.

[51] Gruzelier.J.H., Egner.T, Critical validation studies of neurofeedback., Child and Adolescent Psychiatr Clinics of North America (2005); 14:83-104.

[52] Harrison, L. J., Manocha, R., & Rubia, K. Sahaja Yoga Meditation as a Family Treatment Programme for Children with Attention Deficit-Hyperactivity Disorder. Clinical Child Psychology and Psychiatry 2004;9(4):479-497.

[53] Hasselmo, ME; Eichenbaum H. Hippocampal mechanisms for the context – dependent retrieval Neural Networks 2005;18 (9):1172–90.

[54] Hebert, R., & Lehman, D. Theta bursts: An EEG pattern in normal participants practicing the Type of Management technique. Electroencephalography and Clinical Neurophysiology 1977;42:397–405.

[55] Hirai, T. Psychophysiology of Zen. Igaku Shoin: Tokyo, 1974.

[56] Hobson, J. A., Pace-Schott, E. F., & Stickgold, R. Consciousness: Its vicissitudes in waking and sleep. In M. Gazzaniga (Ed.), The new cognitive neurosciences. Cambridge, MA: MIT Press, 2000; 1341–1354.

[57] Hollup., Are Holen., Svend Davanger., & Oyvind Ellingsen. Increased theta and alpha EEG activity during nondirective meditation. The Journal of Alternative and Complementary Medicine 2009;15(11):1187-1192.

[58] Ishii, R., Shinosaki, K., Ukai, S., Inouye, T., Ishihara, T., Yoshimine, T., Hirabuki, N., Asada, H., Kihara, T., Robinson, S. E., & Takeda, M. Medial prefrontal cortex generates frontal midline theta rhythm. NeuroReport 1999;10:675–679.

[59] Jacobs, G. D. The ancestral mind. New York: Viking,2003.

[60] Jacobs, G. D., & Friedman, R. EEG spectral analysis of relaxation techniques. Applied Psychophysiology and Biofeedback 2004;29:245–254.

[61] Jacobs, G. D., & Lubar, J. F. Spectral analysis of the central nervous system effects of the relaxation response elicited by autogenic training. Behavioral Medicine 1989;15:125–132.

[62] Jensen, O., Gelfand, J., Kounios, J., & Lisman, J. E. Oscillations in the alpha band, 9–12 Hz increase with memory load during retention in a short-term memory task. Cereb Cortex 2002;12:877–882.

[63] Johann M Schepers. The Construction and Evaluation of an Attention Questionnaire. SA Journal of Industrial Psychology 2007;33 (2):16-24.

[64] John, E.R., Prichep, L.S., Kox, W., Valdes-Sosa, P., Bosch-Bayard, J., Aubert, E., Tom, M., di Michele, F., Gugino, L.D. Invariant reversible QEEG effects of anesthetics. Conscious Cogn 2001;10:165-183.

[65] John Gruzelier, "Theta Synchronisation of Hippocampal and Long Distance Circuitry in the Brain: Implications for EEG-Neurofeedback and Hypnosis in the Treatment of PTSD", in *Novel Approaches to the Diagnosis and Treatment of Posttraumatic Stress Disorder by Nato security through science series E: Human and societal Dynamics*, vol. 6, M.J. Roy, Ed. IOS Press, Netherlands 2006, pp. 13-22.

[66] Kasamatsu, A.,&Hirai, T. An EEG study on the Zen meditation. Folia Psychiatrica Neurologica Japanica 1966;20:315–336.

[67] Khilnani S, Field T, Hernandez-Reif M et. al. Adolescents with ADHD. Adolescence 2003;38(152):623-38.

[68] Kiselica, M., Baker, S., Thomas, R., & Reedy, S. Effects of stress inoculation training on anxiety, stress, and academic performance among adolescents. Journal of Counseling Psychology 1994;41:335-342.

[69] Klein SA, Deffenbacher JL. Relaxation and exercise for hyperactive impulsive children. Percept Mot Skills 1977;45:1159-62.

[70] Klimesch, W. EEG alpha and theta oscillations reflect cognitive and memory performance: a review and analysis. Brain Res Brain Res Rev 1999;29:169-195.

[71] Klimesch, W., Doppelmayr, M., Schwaiger, J., Auinger, P., & Winkler, T. 'Paradoxical' alpha synchronization in a memory task. Cogn Brain Res 1999;7:493–501.

[72] Kubota, Y., Sato, W., Toichi, M., Murai, T., Okada, T., & Hayashi, A. Frontal midline theta rhythm is correlated with cardiac autonomic activities during the performance of an attention demanding meditation procedure. Cognitive Brain Research 2001;11: 281–287.

[73] Kutz, I., Borysenko, J., & Benson, H. Meditation and psychotherapy: A rationale for the integration of dynamicpsychotherapy, the relaxation response, and mindfulness meditation. American Journal of Psychiatry 1985;142:1–8.

[74] Lagopoulos., Jian Xu., Inge Rasmussen., Alexandra Vik., Gin. S. Malhi., Carl F. Eliassen., Ingrid E. Arntsen., Jardar G. Saether., Stig Aftanas, L. I., & Goloecheikine, S. A. Human anterior and frontal midline theta and lower alpha reflect emotionally positive state and internalized attention: high-resolution EEG investigation of meditation. Neuroscience Letters 2001;310:57-60.

[75] Lagopoulous, J., Xu,J., Rasmussen, I., Vik, A., Malhi, G.S., Eliassen, C.F., Arntsen, I.E., Saether, J.G., Hollup, S., Holen, A., Davanger, S., Ellingsen, O. Increased theta and alpha EEG activity during nondirective meditation. J Altern Completment Med 2009;15(11):1187-1192.

[76] Lazar, S. W., Bush, G., Gollub, R. L., Fricchione, G. L., Khalsa, G., & Benson, H. Functional brain mapping of the relaxation response and meditation. NeuroReport 2000;11(7):1581–1585.

[77] Lee, M. S., Bae, B. H., Ryu, H., Sohn, J. H., Kim, S. Y., & Chung, H. T. Changes in alpha wave and state anxiety during Chun Do Sun Bup Qi-training in trainees with open eyes. American Journal of Chinese Medicine 1977; 25: 289–299.

[78] Leva.R.A, Modification of hypnotic susceptibility through audiotape relaxation training: preliminary report, Percept. Mot. Skills 1974;99:872–874.

[79] Llinas, R., Ribary, U., Contreras, D., Pedroarena, C., The neuronal basis for consciousness. Philos Trans R Soc Lond B Biol Sci 1998;353:1841-1849.

[80] Llinas, R.R., Ribary, U., Jeanmonod, D., Kronberg, E., Mitra, P.P. Thalamocortical dysrhythmia: A neurological and neuropsychiatric syndrome characterized by magnetoencephalography. Proc Natl Acad Sci U S A 1999;96:15222-15227.

[81] Llinas, R., Urbano, F.J., Leznik, E., Ramirez, R.R., vanMarle, H.J. Rhythmic and dysrhythmic thalamocortical dynamics: GABA systems and the edge effect. Trends Neurosci 2005;28:325-333.

[82] Maquet, P. Functional neuroimaging of normal human sleep by positron emission tomography. Journal of Sleep Research 2000;9:207–231.

[83] Margolis, H. Relaxation training: A promising approach for helping exceptional learners. International Journal of Disability, 1990;37(3):215-234.

[84] Maria Hernandex-Reif, Tiffany M. Field, Eric Thimas. Attention Deficit Hyperactivity Disorder: Benefits from Tai Chi, Tai Chi: Pilot Study 2001;5(2):120-123.

[85] Marx, E., Deutschlander, A., Stephan, T., Dieterich, M., Wiesmann, M., Brandt, T. Eyes open and eyes closed as rest conditions: impact on brain activation patterns. Neuroimage 2004;21,1818-1824.

[86] Marx, E., Stephan, T., Nolte, A., Deutschlander, A., Seelos, K.C., Dieterich, M., Brandt, T. Eye closure in darkness animates sensory systems. Neuroimage 2003;19:924-934.

[87] McCormick, D.A., Bal, T. Sleep and arousal: thalamocortical mechanisms. Annu Rev Neurosci 1997;20:185-215.

[88] Napoli, M. Stress management and reduction of aggression in grade school children. In M. Martinez (Ed.), Prevention and control of aggression and the impact on its victims). Boston: Kluwer Academic/Plenum Publishers, 2002;169-172.

[89] Norlander, T., Moas, L., & Archer, T. Noise and stress in primary and secondary school children: Noise reduction and increased concentration ability through a short but regular exercise and relaxation program. School Effectiveness and School Improvement 2005;16(1):91-99.

[90] Pfurtscheller, G. Functional brain imaging based on ERD/ERS. Vision Res 2001;41:1257-1260.

[91] Pagano, R. R., Rose, R. M., Stivers, R. M., & Warrenburg, S. Sleep during transcendental meditation. Science 1976;191:308–310.

[92] Pan, W., Zhang, L., & Xia, Y. The difference in EEG theta waves between concentrative and non-concentrative qigong states: Power spectrum and topographic mapping study. Journal of Traditional Chinese Medicine 1994;14:212–218.

[93] Peck, H. L., Kehle, T. J., Bray, M. A., & Theodore, L. A. Yoga as an intervention for children with attention problems. School Psychology Review 2005;34(3):415-424.

[94] Pizzagalli, D. A., Oakes, T. R., & Davidson, R. J. Coupling of theta activity and glucose metabolism in the human rostral anterior cingulate cortex: an EEG/PET study of normal and depressed subjects. Psychophysiology 2003;40:939–949.

[95] Powell, L., Gilchrist, M., & Stapley, J. A journey of self-discovery: An intervention involving massage, yoga and relaxation for children with emotional and behavioural difficulties attending primary schools. European Journal of Special Needs Education 2008;23(4):403-412.

[96] Olbrich, S., Mulert, C., Karch, S., Trenner, M., Leicht, G., Pogarell, O., Hegerl, U., EEG–vigilance and BOLD effect during simultaneous EEG/fMRI measurement. Neuroimage 2009; 45:319-332.

[97] Rael Cahn. B., & John Polich. Meditation States and Traits: EEG, ERP, and Neuroimaging Studies. Psychological Bulletin 2006;132(2):180–211.

[98] Raichle, M.E., MacLeod, A.M., Snyder, A.Z., Powers, W.J., Gusnard, D.A., Shulman, G.L. A default mode of brain function. Proc Natl Acad Sci U S A 2001;98:676-682.

[99] Raichle, M.E., Snyder, A.Z. A default mode of brain function: a brief history of an evolving idea. Neuroimage 2007;37:1083-1090.

[100] Ray, W. J., & Cole, H. W. EEG alpha activity reflects attentional demands, and beta activity reflects emotional and cognitive processes. Science 1985;228:750–752.

[101] Raymer R, Poppen R. Behavioural relaxation training with hyperactive children. J Behav Ther Exp Psychiatry 1985;16:309-16.

[102] Rechtschafen, A., & Kales, A. A manual for standardized terminology, techniques, and scoring for sleep stages of human participants. Los Angeles: Brain Information Service/Brain Research Institute 1968.

[103] Robert Myers. ADHD kids helped by relaxation techniques, 2010. Retrieved December 2, 2012, from the Empowering Parents-Child Behavior Help 2010 website: http://www.empoweringparents.com.

[104] Ryan,M. An innovative violence-prevention program in teaching young children skills for life: Lesson 1-Self-control. The Arizona Republic, 2000;22-23.

[105] Sadaghiani, S., Scheeringa, R., Lehongre, K., Morillon, B., Giraud, A.L., Kleinschmidt, A. Intrinsic connectivity networks, alpha oscillations, and tonic alertness: a simultaneous electroencephalography/functional magnetic resonance imaging study. J Neurosci 2010;30:10243-10250.

[106] Sadato, N., Nakamura, S., Oohashi, T., Nishina, E., Fuwamoto, Y., Waki, A., & Yonekura, Y. Neural networks for generation and suppression of alpha rhythm: A PET study. NeuroReport 1998;9:893–897.

[107] Satterfield, J. H., Cantwell, D. P., Saul, R. E., Lesser, L. I., & Podosin, R. L. Response to stimulant drug treatment in hyperactive children: Prediction from EEG and neurological findings. J. Autism.Child.Schizophr 1973;3(1):36-48.

[108] Satterfield, J.H., Lesser, L. I., & Podosin, R. L. Evoked cortical potentials in, hyperkineticchildren. California.Medicine 1971;115(3):48.

[109] Schacter, D. The hypnagogic state: A critical review of the literature. Psychological Bulletin 1976;83:452–481.

[110] Sergeant, J. The cognitive-energetical model: An empirical approach to Attention Deficit Hyperactivity Disorder. Neuroscience & Biobehavioral Reviews 2000;24:7-12.

[111] Shillingford, J., & Shillingford-Mackin, R. Enhancing self-esteem through wellness programs. The Elementary School Journal 1991; 91:457-466.

[112] Stigsby, B., Rodenburg, J. C., & Moth, H. B. EEG findings during mantra meditation: A controlled, qualitiative study of experienced meditators. Electroencephalography and Clinical Neurophysiology 1981;5:434–442.

[113] Steriade, M., McCormick, D.A., Sejnowski, T.J. Thalamocortical Oscillations in the Sleeping and Aroused Brain. Science 1993;262:679-685.

[114] Sympathetic Nervous System. *Psychology Glossary*. Retrieved from http://www.alleydog.com

[115] Travis, F. Eyes open and TM EEG patterns after one and eight years of TM practice. Psychophysiology 1991;28:58.

[116] Vanderwolf, C.H. "Hippocampal electrical activity and voluntary movement in the rat". EEG Clin Neurophysiol 1969;26 (4):407–418.

[117] Wallace, R. K. Physiological effects of transcendental meditation. Science 1970;167:1751–1754.

[118] Wallace, R. K., Benson, H.,&Wilson, A. Awakeful hypometabolic state. American Journal of Physiology 1971;221:795–799.

[119] Warrenburg, S., Pagano, R. R., & Hlastala, M. A comparison of somatic relaxation and EEG activity in classical progressive relaxation and transcendental meditation. Journal of Behavioral Medicine 1980;3:73–93.

[120] West, M. A. Meditation and the EEG. Psychological Medicine 1980;10:369–375.

[121] *What is the function of the various brainwaves?* Retrieved from http://www.brainwave-research-institute.com

[122] Younger, J., Adriance, W., & Berger, R. J. Sleep during transcendental meditation. Perceptual and Motor Skills 1975;40:953–954.

[123] Zylowski L, Ackerman DL, Yang MH, et. al. Mindfulness meditation training in adults and adolescents with ADHD: a feasibility study. J Atten Disord 2008;11(6):737-746.

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