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STUDY OF PSYCHOLOGICAL, EMOTIONAL AND MINDFULNESS STATUS IN AGE-MATCHED ANAPANASATI MEDITATORS AND NON-MEDITATORS AS TRACKED USING NONINVASIVE TOOLS-ELECTROPHOTONIC IMAGING

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Abstract

The aim of the current study is to explore the status of energy pattern, stress and psychological well-being in age-matched meditators (M) and non-meditators (NM) as assessed by Electrophotonic Imaging and psychological measures.

There were 93 subjects consisting of 45 meditators (practicing meditation from last 6 months and longer (mean months of practice 61.18± 50.08, daily 1.63±2.14hours) and 48 non-meditators. There were total 88 participants where 43 meditators (male and female, mean age 32.64±7.09years) and 45 non-meditators (mean age 30.31±6.45years) in the study. Assessment done using Electrophotonic Imaging (EPI), Self-control Scale (SCS), Emotion Regulation Questionnaire (ERQ), Freiburg Mindfulness Inventory (FMI) and General Health Questionnaire (GHQ).

Meditators revealed lower stress, disorderliness at energy level in comparison to non-meditators on EPI parameters. Self-control score, scores of mindfulness and general health was significant and highly significant respectively in meditators as compared to non-meditators. Emotional regulation score was positive where reappraisal and suppression scores were found contributory in current research but not significant.

Psychophysiological status of meditators showed less stress, less suppression and positive emotion regulation in comparison to non-meditators. In conclusion, meditators exhibited better self-control, better energy availability, mindfulness and good health.

Key words: Meditation, EPI, Self-control, Emotion-regulation, Mindfulness, Health.

Introduction

Meditation has witnessed a lot of changing processes in India which in turn has given a novel techniques for practice such as Buddhist techniques of Vipasana and Zen. (1) Different meditation techniques have been in fashion for getting concentration, internal equanimity, good health status and positive feeling of wellbeing. Various tools and techniques are used to minimize tension, anxiety, fear, anger, hatred and so on.(2) In scientific domain the main focus is centered to see the effect of meditation on psychosomatic level only. The various techniques of meditation has always been very vital means to reduce stress and provide overall health and well-being..(1)

Research findings have shown that Mindfulness meditation was very effective to give positive impact to cope with psychosomatic disorders. Mindfulness and insight is known as one of the Buddhist meditation in Pali literature as "satipatthana-vipassana".(2) Anapanasati meditation is one of the well-known techniques in Theravada School of Buddhism popularized as initial stage of Vipassana. In Anapanasati meditation the main concentration is given on the incoming and outgoing of breath. This breath is continuously witnessed and watched through the entire process of practice. Research shows that this way of practice induces quietude and steadiness of mind.(3,4)

Studies have shown that duration of months, years and even 5 to 7 days of meditation practices can provide benefits of attention and positive effect in brain activity.(5,6) Another study exhibits greater improvement in attention, anxiety, depression, anger and fatigue and significant reduction in stress after 20 minutes daily for 5 days of meditation.(6) Electrophysiological studies showed increased theta activity in meditators which is indication of heighted attention, decreased activity and less thought contents.(7–9) Research findings show that traditional therapies including meditation play vital role to cope with concerns related to well-being of people.(2,3,10–14)

The current study aims at the issues related to energy pattern, stress and psychological status and well-being in age-matched meditators (M) and non-meditators (NM) using Electrophotonic Imaging and psychological measures. First, study anticipates that people who regularly practice meditation would demonstrate psychologically more benefit than non-meditators. Second, it was expected that meditators and non-meditation would exhibit different values of the Electrophotonic Imaging parameters related to energy level and general health in the two groups. Third, it was assumed that activation coefficient (stress), integral area (general health) and entropy (disorderliness of energy) values will reduce in meditators as compared with non-meditators.

Application of Electrophotonic Imaging (EPI)

Electrophotonic Imaging (EPI) and Gas Discharge Visualization (GDV) are the terms known for the same device used in the investigation of human energy field. It gives psychophysiological information of human system.(15) In its application, electrons are drawn out of the body. It is seen that characteristics of electron emission in a human body, varies dynamically in different situations unlike homeostatic state, which is a slow acting system.(16) In EPI investigation, low electrical current at high voltage and high frequency is applied to the fingertip for less than a millisecond as a stimulant to draw electron from the body. In response to the applied stimulation, there is a formation of glow around the finger, captured by a CCD camera. The image taken by camera is called GDV gram.(17,18) The images of EPI can be quantified and reproduced in several areas of scientific exploration. The images derived from the fingers of both the hands' have of information regarding health of an individual. If an image is not symmetric, it indicates some disorder in a related area or organ of the human body.(19) Some changes in the images are seen according to the person's psychemotional state. Images bearing health information are analyzed by the inbuilt software of EPI. Interpretation is based on acupuncture meridian theory.(20) EPI measurement is done two times: with filter and without filter. This gives information related to physiological (with filter) and psychophysiological (without filter) functioning of human system.(18) The measurement of EPI readings has a variability

range of 4.1-6.6 % for healthy individual(19) and about 8-10% for metallic object. (21) EPI application is noninvasive, safe and gives quick assessments and analysis.(18)

Materials and Methods:

The study consists of 93 subjects: 45 meditators and 48 non-meditators. Subjects were recruited from Pyramid Valley International, Bangalore, India. Subjects were divided into two groups: meditators practicing from 6 months and longer (mean months of practice 61.18±50.08, daily 1.63±2.14 hours) and non-meditators who were not practicing any meditation. Meditators were practicing anapanasati meditation which includes focusing on one's respiration. Non-meditators were not practicing any form of meditation or relaxation practices. The subjects, after excluding outliers, were 88 in analysis. The meditating group consisted of 43 members (male and female, mean age 32.64±7.09 years) and 45 non-meditators (mean age 30.31±6.45 years) were part of analysis in the study. The outliers' criteria were: only without filter measurement and defective images, ill health issues or extreme values in EPI parameters or in psychological measures. Only age-matched meditators and non-meditators (24 to 45years) were part of this study. Subjects gave signed informed consent for their participation voluntarily in the study.

The study was approved from the Institutional Ethical Committee. The cross-sectional research design was followed and data were collected using Electrophotonic Imaging (EPI) and four questionnaires namely; Self-control Scale (SCS), Emotion Regulation Questionnaire (ERQ), Freiburg Mindfulness Inventory (FMI) and General Health Questionnaire (GHQ. The questionnaires were coded to avoid undue psychological effect over the participants. Blood pressure and pulse rate were measured for both groups M and NM before performing test.

Inclusion criteria were; healthy volunteers, age range from 24 to 45 years, both genders and willing to participate in the study. Subjects were allotted in meditators or non-meditators group based on the information given by them in demographic form. Exclusion criteria were set for the subjects with missing fingers or cut of fingers, smoked or taken alcohol on test day, having any disease or on prescription drugs.

Demographic sheets were given to get self-reported health status, age, meditation practice experience and assigning in the groups. Nostril dominance was checked manually by keeping finger close to the nose and asking subject to breathe out at the time of measurement.

Procedure

The measurements were carried out two times in a day morning (7 to 10 Am) and evening (4 to 7 PM) during three days of meditation retreats. Meditators were asked to come for the recordings before start of meditation while non- meditators were assessed when they came to visit the Centre. The same frequency of measurements were applied for meditators and non-meditators during three days. An adequate cares were taken to avoid undue influence on psychological part of the subjects who participated in the study. The images of all 10 fingers were taken twice: with filter and without filter. The test was done after three hours of meal intake. To observe the possible variability in atmospheric temperature and humidity a hygrometer (Equinox, EQ 310 CTH) was kept in the room to register during data collection. During the measurements, the subjects were asked to stand on an electrically isolated surface and remove all the metallic objects they wear that are not used for 24 hours. They were guided how to place the tip of the finger on the dielectric glass. Calibration of the instrument was performed before starting measurement. An alcoholic solution was used to clean the surface of the glass between testing of each subject.

Four questionnaires administered in the study after EPI measurement include Self-Control Scale (13 items), Emotion Regulation Questionnaire (10 items), Freiburg Mindfulness Inventory (8 items) and

General Health Questionnaire (5 items). Blood pressure and pulse rate was measured using HEM-7132 automatic blood pressure monitor.

Measurements

EPI Parameters

1. Activation Coefficient (AC, normal range 2 to 4 in healthy individuals): stress parameter obtained by taking with and without filter readings. 2. Integral Area (IA, range between -0.6 to +1 in healthy individuals): index of general health in EPI assessment. 3. Integral Entropy (IE, range 1 to 2 in normal individual): evaluation of disorderliness of energy in the body.(22,23)

Self-Control

Self-control is a capacity to change and adapt oneself for better and optimal performance so as to integrate the self with the world outside.(24) It includes controlling thoughts, emotions, impulses and performances.(25) A 13 items shorter version self-control scale (SCS) is used in this study which is constructed by Tangney et al. as Basic self-control scale (BSCS).(26) It is multi factor version of BSCS used for predicting self-reported effectiveness and behavioral outcome. Reliability and validity of SCS has been established by Tangney et al in two studies. They found adequate internal high reliability for SCS in both the studies with alpha=.83 and .85 respectively. Test retest reliability score was reported to be found .87 for SCS.(26)

Emotion Regulation

Emotion regulation is a process by which one influences which emotions one has and how one experiences and expresses them. (27) Emotion Regulation Questionnaire (ERQ) consists of 10 items corresponding two strategies of emotion regulation namely; cognitive reappraisal (6 items) and expressive suppression (4 items). Instructions ask subjects, in particular, how they regulate and manage their emotion in different situations. These 10 self-report items are rated based on 7-point-Likert scale which starts from strongly agree to strongly disagree. 10 items (version) of ERQ is reported having high internal consistency and 2-month test retest reliability.(28)

Mindfulness

Mindfulness is a state where one pays complete attention to the present moment and is aware completely of internal and external experiences without being judgmental to what is happening.(29) It refers to the process of regulating attention to bring quality of non-judgmental awareness to the experiences and gaining insight into the nature of one's mind.(30) Freiburg Mindfulness Inventory-8 (FMI) is employed to track mindfulness in meditators and non-mediators. This is short form of 14 items FMI used for those who are without any previous understanding of mindfulness.(31) Statements are evaluated using four point Likert scale starts from 1 (strongly disagree) to 4 (strongly agree). Short version of FMI constitutes a consistent and reliable scale which is used to evaluate several important aspects of mindfulness.(32,33)

General Health

General Health Questionnaire is designed by Goldberg is an effective tool to detect any psychiatric illness.(34) It is simple, easy to use and has high validity. Shamasunder et al. found shorter version GHQ 5-items better discriminators, effective screening tool as compared to 12-items GHQ while studying 882 patients. It has 82.9% sensitivity, 95.8% specificity and 8.3% overall misclassification rate for a cutting score of ½ to use potentially GHQ-5.(35)

Results

Between group results of EPI parameter

Table -1 shows results of AC where there is not much difference between M and NM groups but stress is less in meditators as compared to non-meditators. At the physiological level, in meditator

group at both sides of the body, higher mean values of health index is highly significant (IAWL $p<0.004$ and IAWR $p<0.001$) as compared to non-meditators. At physiological level, observation of energy disorderliness at both side of the body in M group was more in comparison to NM but not significant. At psychophysiological level, health parameter in M group has significantly higher mean values (IANL $p<0.02$ and IANR $p<0.03$) as compared to NM. Disorderliness of energy in the body system was lower in M group as compared to NM.

Table-1 Presents Between Group mean values of EPI parameters

Type of Measurement	Variable	M mean±sd	NM mean±sd	*p-value*
Physiological (With Filter)	AC	3.01±0.80	3.13±1.04	0.54
	IAWL	0.54±0.12	0.47±0.13	0.004**
	IAWR	0.57±0.12	0.48±0.13	0.001**
	IEWL	1.95±0.11	1.93±0.16	0.47
	IEWR	1.93±0.16	1.91±0.13	0.50
Psychophysiological (Without Filter)	IANL	0.20±0.18	0.08±0.29	0.02*
	IANR	0.21±0.17	0.12±0.20	0.03*
	IENL	1.83±0.21	1.86±0.17	0.40
	IENR	1.84±0.16	1.85±0.17	0.72

***P<0.05, **p<0.001, M= meditator, NM=non-meditator, AC=activation coefficient, IAWL=integral area with filter left, IAWR=integral area with filter right, IEWL=integral entropy with filter left, IEWR=integral entropy with filter right. IANL=integral area no filter left, IANR=integral area no filter right, IENL=integral entropy no filter left, IENR=integral entropy no filter right.**

Between Groups Scores of Psychological Well-Being

Table-2 shows meditators have significant high self-control ($p<0.01$) score as compared to non-meditators. As per our hypothesis high self-control in meditators is indicative of better self-discipline, positive well-being, and better work performance and less impulse control problems in comparison to non-meditators.

Emotion Regulation Questionnaires (ERQ, Table-2) results indicate that score of cognitive reappraisal was more and expressive suppression less in meditators in comparison to non-meditators. Though these results of ERQ are not significant yet they show positive psychological well-being in meditators.

Freiburg Mindfulness Inventory (FMI, Table-2) yielded highly significant (FMI, $p<0.001$) higher score in meditators in comparison to non-meditators. Higher score in meditators showed more attentional performance and present moment awareness as compared to non-meditators.
General Health Questionnaire (Table-2) demonstrated highly significant (GHQ, $p<0.001$) lower score in meditator which indicates better health in them as compared to non-meditators.

Table-2 Presents Difference between Group Scores of Psychological Measures

Psychological Measures	Variable	M mean±sd	NM mean±sd	*p-value*
SCS	Self-Control	46.14±5.53	42.82±6.45	0.01*
ERQ	Reappraisal	27.65±6.44	27.31±7.24	0.81
	Suppression	16.19±5.36	17.29±5.23	0.33
FMI	Mindfulness	24.42±4.26	20.67±5.82	0.001**
GHQ	Health	10.05±2.38	14.38±2.08	0.001**

***P<0.05, **p<0.001, M= meditator, NM=non-meditator, SCS=Self-control Scale, ERQ=Emotion Regulation Questionnaire, FMI=Freiburg Mindfulness Inventory , GHQ=General Health Questionnaire**

Mean value of Blood Pressure and Pulse rate

Table-3 exhibits difference of systolic & diastolic blood pressure and pulse rate in meditators and non-meditators. There was no significant difference in the measurement of SYS, DYS and PR between groups.

Table -3 presents between group mean value of blood pressure and pulse rate				
Measurement	**Variable**	**M mean±sd**	**NM mean±sd**	***p-value***
Blood pressure	SYS	119.35±12.05	118.62±13.07	0.79
	DYS	80.81±9.05	77.31±10.10	0.09
Pulse Rate	PR	78.74±10.95	79.78±8.96	0.63
SYS=systole, DYS=diastole, PR=pulse rate				

Discussion

In the last four decades' evidence based scientific approach is being carried out on different meditation techniques to observe impact over body and mind using EEG and ECG. (36–38) The present study is an attempt to quantify the difference in meditators and non-meditators at the physiological and psychophysiological level using objective and subjective measures namely; EPI and four questionnaires (SCS, ERQ, FMI and GHQ). Meditation has been used as an effective tool for the spiritual growth which brings peace, concentration, health, harmony and happiness.(39) Activation coefficient (AC) is the measurement of stress level and values are obtained by comparing with and without filter readings. AC is related to sympathetic and parasympathetic functioning of the body system. Stress parameter (AC) in this study demonstrated less stress in meditators but the result was not significant. Earlier studies also showed reduction in stress after intervention of integrated yoga module and anapanasati meditation using EPI.(40,41) A recent study on long term anapanasati meditators and naive meditators reported that long meditators displayed lesser values of AC as compared to naive meditators. (42) It also reported that by quieting of the sympathetic activities and activation of parasympathetic after meditation practice reduces stress and anxiety due to decreased physiological activities.(43)

At the physiological and psychophysiological levels, health parameter (IA) values were unexpectedly higher in meditators as compared to non-meditators. This was statistically significant but clinically this difference was within the normal range of IA. Another study with pre-post design reported reduction in integral area values after 5 days of anapanasati meditation. Study concludes that reduction in IA could be due to less availability of electron and free radical in the body after meditation.(40) In one study IA values were found more in healthy people as compared to asthmatic patients.(44) A recent study found that increased IA values in immediate assessment after cyclic meditation and supine rest is good for psychophysiological health.(41) Existence of disorderliness in the energy in the body was more in the meditators at the physiological level compared to non-meditators. This could be possibly due to two reasons namely; immediate EPI test after filling questionnaires and participating in the test after listening lecture session during retreat program.

At the psychophysiological level, parameter related to energy disorderliness was lower in meditator which demonstrates less chaos in the subtle energy of meditators in the body. More entropy in the system indicates existence of larger disorderliness which may lead to disease condition. (40,41,45,46)

Self-control has been used in the previous studies to measure cognitive and behavioral characteristics, task performance, ability to solve one's problems, positive outcome and attentional performance.(26,47–54) Studies reported that meditation practices including mindfulness were considered to develop capacity of effective and attention self-regulation processes related to executive performance. They may enhance self-control in volitional behavior and regulation of stress and reactivity.(55–58)The current study measured the differential scores in meditators and non-meditators. Meditators showed higher significant scores in comparison to non-meditators. Here higher

self-control is indicative of meditators' better positive mental health, ability to regulate affect and feel confident. This finding is in consistent with earlier research reporting positive relationship between self-control and emotional responses.(26,49)

Emotion regulation is a process by which individuals influence which emotions they have when they have them and how they experience and express them.(27) Gross has formulated two strategies to regulate emotions, namely; cognitive reappraisal- considered as a knowledge and goal-oriented strategy and expressive suppression- body based and goal-oriented.(28) ERQ is employed to study both aspects of emotion regulation: appraisal and suppression in participants without prior experiences of mindfulness.(59) Present study found higher scores of reappraisal and lower scores of suppression in meditator. Higher score of reappraisal is very suggestive in the sense that anapanasati meditation may be an effective tool to enhance abilities of emotion regulation. Reappraisal is that process through which negative emotions are reframed in a more benign and positive meaning.(60) Mindfulness meditation training has been effective in behavioral and physiological aspects of emotional regulation.(61) Another study reports that mindfulness training is associated with 'bottom-up' emotion regulation in long-term meditators whereas 'top-bottom' emotion regulation in short-term practitioners.(62) Lower score of expressive suppression in meditators demonstrates that body-based response modulation was positively better than non-meditators.

Mindfulness, which originated in Eastern meditation practices, is said to be a way of paying attention.(63) In this practice, one brings one's full attention to the present experiences on a moment-to-moment basis. Mindfulness training is related to psychological and physiological perspective.(64,65) It decreases negative impacts and reduces time duration to overcome negative effect.(66) Mindfulness is employed to treat various anxiety disorder and as a predictor of day-to-day behavioral and adaptation aspects to stressful situations.(66–69) This study explores mindfulness by administering Freiburg Mindfulness Inventory (FMI) in meditators and non-meditators. Higher score of FMI was highly significant in meditator which shows higher attention in comparison to non-meditators.

General Health questionnaire is used here to detect psychiatric disorders.(35) Meditators exhibited lower scores which was highly significant whereas non-meditators score was higher in compression. Lower score is indication of good health while higher score is considered to indicate presence of distress. Identification of mental disorder is very important issue in health care.(70) The studies reported here focused to observe the differences in electrophotonic imaging parameters that are related to physiological well-being in subjects.

Physiological measurement like blood pressure and pulse rate was not contributory to study. Meditators and non-meditators were healthy subjects as per measurement. The difference values of SYS, DYS and PR were not significant between groups.

Strength of the Study

The strength of the study can be summed up in the following as below:

a) Perhaps the first study to use subjective and objective tools on anapanasati meditation to track differential changes in meditators and non-meditators.
b) The results of EPI measurements and psychological measures are observed and discussed separately in order to avoid subjective influences in case of questionnaire intervention.

Limitation of the Study

Limitation of the study is subjective demographic reporting and assessment time was the same for EPI and psychological measures. Current study is specific to type of meditation practice. Study accounts education, gender, and socioeconomic status as limitations which may influence

psychological outcome. These factors may motivate subjects to meditate and contribute to psychological status.

Further study may consider some biochemical parameters to establish correlational observation for the variables of stress, health and disorderliness of energy in the system using EPI. To get repeatability of results similar studies must be carried out. Assessment timing should be entirely different for carrying out such objective and subjective experiments in meditators to avoid undue confounding effect over EPI investigation.

Conclusion

At the psychophysiological level, stress and disorderliness of energy in the system was found to be less in meditators. Anapanasati meditation has been beneficial for psychological well-being. Psychological measures have shown highly significant results for mindfulness and general health in meditators. Self-control was found to be significant in meditators as compared to non-meditators which in turn help in regulation of stress, coordination, better performance and reactivity. In summary, overall results of meditators demonstrated improvement both physically and psychophysiologically in comparison to non-meditators.

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