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RESEARCH ARTICLE

Physiological changes during yogic relaxation practices

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ABSTRACT

Background: Yogic relaxation practices produce consistent physiological changes. Various studies are on before and after effects of yoga. There is limited study on physiological changes during yoga. **Aim and Objectives:** In this study, we explored physiological changes during two yogic relaxation practices using polysomnography instrument. **Materials and Methods:** Ethical approval for the study was obtained from the Institute Ethics Committee, All India Institute of Medical Sciences, New Delhi. Data were collected in a still, (supine position lying face upwards in Shavasan, before and after performing asanas) for 5 min, 10 min during, 5 min after the yogic relaxation practices (Shavasan and Makrasan). Recording were taken continuously after bio calibration as baseline1, shavasan, baseline2, makrasan, post makrasan. The data of pulse rate, respiratory rate and SPO_2 were analyzed using Statistical Package for the Social Sciences version 20. **Result:** Among 18 participants of age 18–45 years, 11 male and 7 female were participated. Comparison of selected parameters (respiration rate, SPO_2, heart rate [HR]) in different condition (baseline1, shavasan, baseline2, makarasan, post makarasan) was analyzed. Comparison of HR in different condition is highly significant; HR varies in makarasan significantly from baseline1, shavasan and baseline2. SPO_2 changes significantly vay among different conditions. Changes in respiratory rate are not significant in different conditions. Correlation of age with body mass index is significant in post makarasan variable. **Conclusion:** Physiological changes occur differently in two different yogic relaxation practices. Further detailed study with large sample size, blood pressure monitoring and in well-trained individuals will provide more information.

KEY WORDS: Physiological Changes; Shavasan; Makrasan; Heart Rate; Abdominal Breathing

INTRODUCTION

Yogic relaxation techniques produce consistent physiological changes.[1] It has been well documented that yogic techniques for relaxation like shavasan produce psychosomatic relaxation. Abdominal breathing is correlated with relaxation in any relaxation techniques performed. By performing Savitri Pranayama and Shavasan, deep relaxation is achieved and it helps to de-stress in many psychosomatic disorders, irritable bowel syndrome, peptic ulcer and asthma. Researchers also have demonstrated the effectiveness of shavasan in management of hypertension[2,3] and stress.[4,5] A well-performed asanas or posture produces mental balance.

Changes in electroencephalogram (EEG) parameters with yogic exercise have been reported, Practitioner of Bhramari Pranayama have been found to exhibit paroxysmal gamma waves consisting of high-frequency biphasic ripples, with

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increase in theta range (15–35 Hz) activity before, during and after Bharamari pranayama.[6]

An increase in alpha activity of the brain both in occipital and pre-frontal areas during a course of 30 days of Santhi Kriya practice indicating an increase of calmness has been reported.[7] In Kundalini Yoga meditators, study showed more alpha EEG activity during the meditation, and an increase in theta EEG activity immediately after meditation.[8] Furthermore, among the persons practicing the Transcendental Meditation, it has been found that intermittent prominent bursts of frontally dominant theta activity occurred during the meditation, and these bursts were preceded and followed by alpha rhythm.[9]

Performing Sukha pranayama for 5 min reduced HR and blood pressure (BP) in hypertensive patients, possible mechanism can be normalization of autonomic cardiovascular rhythms because of increased vagal modulation and/or decreased sympathetic activity and improved baroreflex sensitivity.[10] The practice of pranayama has been reported to reduce the oxygen consumption.[11] The decreased in oxygen consumption, breathing rate and increased in breath volume has been reported after shavasan and yogic cyclic meditation.[12]

Although various studies are on before yoga and after yoga effects, there is limited study on physiological changes during yoga technique. Hence, the study was planned with an aim to understand physiological changes before, during and after yogic relaxation technique. To achieve this, the objectives of our study were to record different physiological variables during the practice of yogic relaxation using polysomnography, and to record the after effects yogic relaxation technique on various physiological functions using polysomnography.

MATERIALS AND METHODS

Ethical approval for the study was obtained from the Institute Ethics Committee, All India Institute of Medical Sciences, New Delhi. 18 participants both male and female aged 18–45 years (31.94 ± 7.64) who had not previously used yogic relaxation technique were participated. Subjects who have severe cardiovascular, renal, cerebral, mental dysfunction and critically ill patients were excluded from the study. Selected participants were instructed not to drink tea or coffee and have a light breakfast at least two hours before the recording. Subject's age, weight, and height were recorded. Data were collected in supine position in shavasan (before-5min, during-10min and after performing asana-5min). Data were collected in makrasan (before-5min, during-10min, after performing asana-5min). Recording were taken continuously after bio calibration as baseline1, shavasan, baseline2, makrasan, post makrasan as shown in Figure 1.

Anthropometry

Subject's body weight and height was measured. From height and weight data body mass index (BMI) calculated and recorded in subject data form in somnomedics polysomnographic recording before starting the recording.

Equipment

Somnamedics polysomnography (PSG), Somnamedic's thoracic, and abdominal Respiratory Inductive Plethysmography (RIP) were used. The RIP is bands tied around the chest and abdominal regions from which movements of these regions due to breathing were measured. About the equipment and its successful use to the researchers and participants were explained to subjects for their voluntary cooperation. Bio calibration was done before recordings of each subject. Maximum electrode impedance (EEG and Electroculogram [EOG]) was maintained 5KΩ. Electrode impedance is re-checked during recording when any pattern that might be artifactual appears and that part was excluded. Data were exported from PSG software for further analyses in "Polyman" European Data Format + EDF data.

Yogic Relaxation Technique

Shavasana

Participants were given instruction involving awareness of breath. Shavasan begins with instructing the subject to lie down on the back full length like corpse with hands little away from thighs with palm away and heels together toes apart. To start with subjects were instructed to breathe deeply, later the breathing should be fine and slow with no jerky movements to disturb the spine or the body. Concentrate on deep and fine exhalation, in which the nostril do not feel the warmth of breath. Lower jaw should hang loose and not be clenched. Tongue should not be disturbed, and even the pupil of the eyes should be kept completely passive. Relax completely and breath out slowly. Stay in the pose for 10 min.

Makrasan

Subjects were instructed to lie flat on your stomach, raise head and shoulder. Place the hand infront with elbows resting on the ground and rest your head on the palm of your hands. Close eyes and maintain awareness of own breathing process. Maintain this pose.

Test trial was given to subjects prior to actual tests to familiarize the procedure protocol and precautions so as to avoid anxiety during the tests that would have interfered with result. In this way standardization of the experiment was done.

Heart rate (HR) recordings

The initial HR was recorded followed by recordings at three consecutive 1 min intervals, at the 1 min, 2 min, and 3 min mark of the experiment. These values were later averaged for each participant in baseline, shavasan, baseline2, makrasan, post makrasan.

EEG recordings

EEG was recorded using EEG cup electrode. The scalp was prepared using Nuprep skin preparation gel (Weaver and co,USA). Electrode with Ten20 conductive EEG paste (Weaver and co, USA) were placed at F_4,C_4,O_2 and M_1 as to allow display of F_4-M_1, C_4-M_1, O_2-M_1 as recommended electrode. Back up electrode should be placed at F_3, C_3, O_1 and M_2 to allow display of F_3-M_2, C_3-M_2, O_1-M_2. Communications and instructions were done between examiner and participants using two-way intercom. Participants were observed throughout session on video recording.

At the beginning of each set of data collection, the subject was asked to remain still with eyes closed for a 10 s calibration. Frequency (Hz) along with minimum and maximum voltages (µV) were recorded and cross-referenced with standard values to characterize data as normal. Alpha waves were looked for differentiating relaxed and awake state. Minimum and maximum values were recorded to ensure there were no outliers from their respective ranges. So EEG readings were used to confirm a relaxed state.

Electromyography (EMG)

Three electrodes were placed to record chin EMG and two electrodes each placed in left and right leg for leg EMG according to AASM (American academy of Sleep Medicine) manual. EMG is useful in knowing whether muscles are relaxed during relaxation exercises.

Electrocardiography (ECG)

ECG was obtained from lead II.

EOG

EOG from left and right eye was obtained by placing electrode E_1 on1cm below left outer canthus and E_2 on 1cm above right outer canthus.

Data Extraction

EEG records were inspected for artefacts due to body movement and eye movement. Artefacts free data were considered and analyzed spectrally using Fast Fourier Transform analysis. This provided the relative power as a percentage of total power for each band as for alpha (8-12Hz), beta (13–30Hz), delta (0.5–3.5 Hz) and theta (4–7.5 Hz).The actual values of the average amplitude with in a band for a specific period also obtained.

Data Analysis

The data of pulse rate, respiratory rate and SPO_2 were analyzed using Statistical Package for the Social Sciences version 20. Data were presented in mean and standard deviation (SD). Comparison among the selected parameters across time under different conditions was done using repeated measure analysis of variance followed by Bonferroni post-hoc test whenever required. Correlation of the studied variables with age and BMI was done using Pearson correlation. Statistical significant was taken at P-value (2-tailed) < 0.05.

Using Polyman EDF + software to display data exported from somnomedic's Domino PSG software, data were analyzed by identifying variations in patterns of breathing effort from the observation of 1 min screenshots and screen shots for before(5 min), during (10 min) and after (5 min) of yogic relaxation. The software provided screen shots of abdominal and thoracic breathing with adjustable timespans and mV readings. This allowed researchers to visually examine in detail of breathing patterns. We also calculated means of breath rates. To show results in a standard and consistent manner, 1 min screenshots of each subjects from the 3rd min of before and after yogic relaxation and 6th min during yogic relaxation were selected which is median or half way of each phase. Respiratory mode (abdominal/thoracic predominance) and apneic pauses were also noted. The data to the selected EEG during yogic relaxation practices were looked for changes in wave pattern and to confirm subject's relaxation.

RESULT

Among 18 participants of age 18–45 (31.94 ± 7.64) years and BMI (25.34 ± 2.01) Kg/m^2, 11 male and 7 female were presented in Table 1. Table 2 represent comparison of selected parameters(respiration rate,SPO_2, HR) in different condition (baseline1,shavasan,baseline2,makarasan,postmakarasan). Comparison of HR in different condition is highly significant, HR varies in makarasan significantly from baseline1,shavasan and baseline2 in the study. Post makarasan varies significantly from makrasan in HR. SPO_2 significantly varies among different conditions. Respiratory rate is not significant in different conditions. Table 3 represents correlation of age and BMI with selected variable. Correlation of age with BMI is significant in post makarasan variable. Figure 2 represent 1 min screenshot of a subject's breathing pattern from 3rd min of baseline recording. Figure 3 represent 1 min screenshot of same subject's breathing pattern from 6th min of shavasan recording. Figure 4 represent one minute screenshot of same subject's breathing pattern from 3rd min of baseline2 after shavasan. Figure 5 represent 1 min screenshot of same suject's breathing pattern from 6th min of makrasan. Figure 6 represent one minute screenshot of same subject's breathing pattern from 3rd min of post makrasan

Table 1: Age and BMI of the studied subjects (*n*=18)

Parameters	Minimum	Maximum	Mean	SD
Age (years)	18.00	45.00	31.94	7.64
BMI (kg/m2)	18.80	29.00	25.34	2.01

SD: Standard deviation, BMI: Body mass index

Biocalibration	Baseline 1 (5 minutes)	Shavasana (10 minutes)	Baseline 2 (5 minutes)	Makrasana (10 minutes)	Post makrasana (5 minutes)
	35 minutes				

Figure 1: A schematic representation of study design

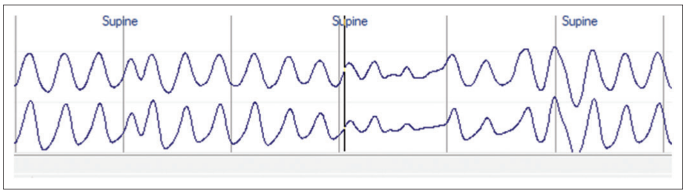

Figure 2: Screenshot of 1 min showing breathing rate and breathing pattern in baseline 1

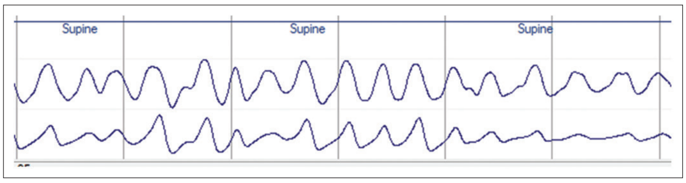

Figure 3: Screenshot of 1 min showing breathing rate and breathing pattern during shavasan

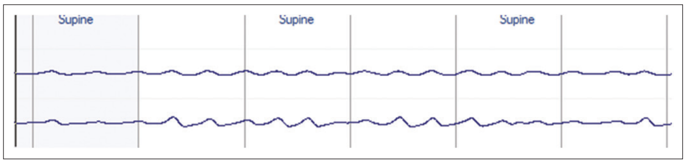

Figure 4: Screenshot of 1 min showing breathing rate and breathing pattern during baseline 2

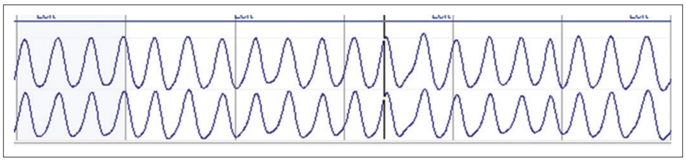

Figure 5: Screenshot of 1 min showing breathing rate and breathing pattern during makrasana

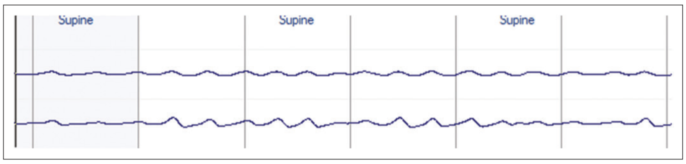

Figure 6: Screenshot of 1 min showing breathing rate and breathing pattern during post makrasan baseline

baseline. Alpha waves were observed during the relaxation practices shows that subjects were in relaxed state.

Table 2: Comparison of selected parameters under different conditions (n=18)

Parameters	Condition	Mean	SD	*P*-value
Respiration rate (per min)	Baseline1	15.18	3.58	0.065
	Shavasana	12.89	3.24	
	Baseline2	14.05	4.69	
	Makrasana	13.36	3.58	
	Post Makrasana	15.23	3.35	
SPO_2 (%)	Baseline1	97.82	0.98	0.041
	Shavasana	98.38	1.84	
	Baseline2	98.02	1.34	
	Makrasana	98.61	1.33	
	Post Makrasana	98.11	1.13	
Pulse rate (per min)	Baseline1	71.17	10.16	<0.001
	Shavasana	70.86	10.41	
	Baseline2	71.89	10.92	
	Makrasana	76.08^#!	11.56	
	Post Makrasana	71.12$	10.73	

Repeated measure ANOVA. $P<0.05$ is indicated by:^,#,!,$ in comparison with baseline1, Shavasana, baseline2 and Makrasana respectively.
SD: Standard deviation

Table 3: Correlation of age and BMI with selected variables (n=18)

Parameters	Condition	Age (years)	BMI (kg/m2)
Respiration rate (per min)	Baseline1	−0.165	−0.265
	Shavasana	−0.168	−0.029
	Baseline2	−0.043	−0.156
	Makrasana	0.079	0.032
	Post Makrasana	−0.595**	−0.428
SPO_2 (%)	Baseline1	−0.228	−0.406
	Shavasana	0.044	−0.011
	Baseline2	−0.104	−0.167
	Makrasana	0.101	−0.073
	Post Makrasana	−0.115	−0.276
Pulse rate (per min)	Baseline1	−0.015	0.254
	Shavasana	−0.112	0.249
	Baseline2	−0.163	0.261
	Makrasana	−0.217	0.307
	Post Makrasana	−0.177	0.258

Pearson correlation r-values are given.***P*-value=0.009, BMI: Body mass index

DISCUSSION

HR changes vary in makarasan significantly from baseline1, shavasan and baseline2 in the study. SPO_2 significantly varies among different conditions. HR changes and SPO_2 changes at the time of performing the asanas and after performing the asanas as observed in this study is significantly different. Respiratory rate is not significant in different conditions.

Correlation of age with BMI is significant in post makarasan variable.

It is further observed that HR changes and SPO_2 changes are significantly different in shavasana from makrasan. Due to higher stress response to makrasan in opposite to shavasan, this response may be due to increased sympathetic response because of relative difficulty in performing and maintain the posture as there is occurrence of abdominal compression while performing it. Satnarayan *et al*. observed decrease in respiratory rate, amplitude after practice when compared to before practice of santhi kriya which is of total 50 mins duration and last 10 mins they practiced shavasan. They observed ECG, pulse rate and BP before and after santhi kriya practice as compared to before practice and data of EEG parameters are identical in both left and right hemisphere of brain.[7] Arambula *et al*. observed noticeable difference that is decrease in respiratory rate during meditation from pre- and post-baseline periods, abdominal breathing patterns become more pronounced and enhanced alpha EEG activity during meditation.[8] In our study, we observed no significant difference in respiratory rate during shavasan and makrasan from baselines. It could be due to the reason that subjects were not trained yogic relaxation practioner whereas in the study done by Arambula *et al*. The subject is well trained practioner. In our study, we observed abdominal breathing patterns become more pronounced during yogic relaxation in comparison to pre-baseline and post-baseline. Abdominal breathing pattern may play a major role than breathing rate comparison for which further detailed study is required. As there is limited studies on physiological changes during yoga and no study on physiological changes during yogic relaxation practices.

Many problems were encountered with this study that may have led to bias in results of how during yogic relaxation physiological changes occur. Change in posture from shavasan to makrasan lead to changes in electrode impedance, though electrode impedance are rechecked during recording when any pattern that might be artifactual appears and that part were excluded. Sample size was small. Analysis of breathing patterns was limited to visual analysis of graphs. Measure of BP, metabolic rate measure may help further in understanding physiological process during relaxation practice. This will help explain further the contradictory findings of physiological correlation with relaxation

CONCLUSION

Physiological changes occur differently in two different yogic relaxation practices. Complete and accurate picture of physiology during relaxation practices can be obtained with further studies with larger sample size and in well-trained subjects.

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