# YOGA BASED GUIDED RELAXATION REDUCES SYMPATHETIC ACTIVITY IN SUBJECTS BASED ON BASELINE LEVELS

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**Summary:** 35 male volunteers with ages ranged from 20 to 46 yrs were studied in two sessions, of yoga based guided relaxation and supine rest. Assessments of autonomic parameters were made in 15 subjects, before, during and after the practices, whereas oxygen consumption and breath volume were recorded in 25 subjects, before and after both types of relaxation. A significant decrease in oxygen consumption and increase in breath volume were recorded after guided relaxation (paired t test). There were comparable reductions in heart rate and skin conductance level during both types of relaxation. During guided relaxation the power of the low frequency component of the heart rate variability spectrum reduced, whereas the power of the high frequency component increased, suggesting reduced sympathetic activity. Also subjects with a base line ratio of LF/HF >0.5 showed a significant decrease in the ratio after guided relaxation, while subjects with a ratio < 0.5 at baseline showed no such change. The results suggest that sympathetic activity decreased after guided relaxation based on yoga, depending on the base line levels.

## INTRODUCTION

A number of reports have described the physiological changes associated with diverse relaxation techniques (Harding, 1996; Smith, Amutio, Anderson, & Aria, 1996; Broms, 1999). Relaxation guided by instructions has been shown to be more effective in reducing physiological arousal than a control session of supine rest (Sakakibara, Takeuchi, & Hayano, 1994). Also, after exercise the heart rate and blood pressure returned to the baseline level sooner, when subjects practiced guided relaxation compared with recovery after rest while supine or seated (Bera, Gore, & Oak, 1998). Specific relaxation techniques may be more effective for certain persons, based on their psychophysiological characteristics (Weinstein & Smith, 1992), and isometric "squeeze" relaxation has been found to be more likely to induce relaxation compared to meditation, for individuals who have difficulty focusing and less developed stress coping strategies (Weinstein & Smith, 1992).

However, most reports describe post relaxation effects on a group level, regardless of individual differences at base line. Also, most instructions to relax make use of imagery (Rickard, Collier, McCoy, Crist, & Weinberger, 1993) and breathing (Toivanen, Lansimies, Jokela, & Hanninen, 1993). With this background, the present study was conducted to assess whether the present subjects who had a group mean of 30.2 months experience of yoga practice, showed greater reduction in physiological arousal after "Guided relaxation" (with instructions) as compared to "Supine Rest" (without instructions). This was considered interesting as both practices (i.e., relaxation with instructions and rest in the supine position are considered to be relaxing by yoga practitioners). Also yoga practice is believed to help reach a state in which external instructions to relax are no longer necessary. Guided relaxation was based on yoga, with breath awareness and chanting, as is usual in yoga practice (Nagendra & Nagarathna, 1988). (ii) As a second aim, subjects were categorized as two groups, based on their baseline levels of LF/HF ratio of the heart rate variability components, which indicate the cardiac autonomic control, and the changes of the two categories of subjects after guided relaxation are presented separately.

## METHOD

### Subjects

The subjects were 35 male volunteers, with ages ranging from 20 and 46 years (M = 27.5, SD = 4.7 yr.) and with an average of 30.2 months (SD = 25.7) of experience with yoga practice. All the subjects had completed a residential course in yoga (i.e., for five and a half months) at the residential yoga center. Subsequently, they were staying on at the center for varying durations to participate in other activities and to carry on practicing yoga, which included both shavasana and "guided relaxation". As it was not possible to record autonomic variables and oxygen consumption simultaneously, with the equipment used by us, these two assessments were made in separate sessions. For some subjects this number of sessions was too cumbersome, hence one assessment (i.e., autonomic variables or oxygen consumption) was made. Hence the autonomic variables were recorded in 15 subjects before, during, and after Guided relaxation and similarly for Supine Rest; in 25 subjects, the oxygen consumption was recorded before and after Guided Relaxation and before and after Supine Rest. There were 5 subjects who had recordings of both autonomic variables and oxygen consumption.

**Design**

Subjects were studied in two separate relaxation sessions, viz., guided relaxation and supine rest. The two sessions were on different days at the same time of the day. For half the subjects, alternately, the guided relaxation session was on the first day with the supine rest session the next time. The order was reversed for the remaining subjects. Each session took 20 minutes and consisted of 3 periods, viz., Before (5 minutes), Test (10 minutes), and After (5 minutes). For analysis, the Test period was divided as two, During 1 and During 2, each of 5 minutes. The subjects were sitting at ease before and after the Test periods, and supine during the Test periods This change in posture (i.e., sitting before and after, compared with supine, during), was chosen as the supine posture is one the positions chosen for relaxation by yoga practitioners, and being in the supine position would hence have been similar to supine rest.

**Assessment**

The oxygen consumption was recorded with a closed circuit Benedict-Roth apparatus (INCO, Ambala, India) using the standard method (Mountcastle, 1980). The subject breathed into an oxygen tank from which exhaled carbon dioxide was excluded by absorption in sodium hydroxide. The subjects were asked to breathe into the mask, which covered their nose and mouth. Recordings were made before and after, but not during test periods.

A 4-channel polygraph (Medicaid Systems, Chandigarh, India) was used to record the electrocardiogram (EKG), respiration, finger plethysmogram and skin conductance level. EKG was recorded using standard limb lead I configuration. The EKG was digitized using a 12 bit analog-to-digital convertor (ADC) at a sampling rate of 500 Hz. The data recorded were visually inspected off-line and only noise free data were included for analysis (Raghuraj, Ramakrishnan, Nagendra, & Telles, 1998). The R waves were "identified" and used to obtain a point event series of successive R-R intervals, from which the beat to beat heart rate series was computed.

Skin conductance level was recorded using Ag/AgCl disk electrodes with electrode gel, placed in contact with the volar surfaces of the distal phalanges of the index and middle fingers of the left hand. A low-level DC preamplifier was used and a constant voltage of 0.5V was passed between the electrodes. Respiration was recorded using a nasal thermistor attached to the more patent nostril. Finger plethysmogram was recorded placing the photoplethysmograph on the volar surface of the distal phalanx of the index finger of the right hand.

**Guided relaxation technique**

The guided relaxation technique lasts for 10 minutes and is done in 5 phases of step-wise relaxation, detailed below (Nagendra & Nagarathna, 1988). (i) Relaxing from the tip of the toes to the waist, mentioning each part of the body specifically, followed by chanting the syllable "A", the first part of the syllable "Om" (Chinmayananda, 1984), (ii) relaxing from the waist to the neck, followed by chanting the syllable "U", the middle part of "Om". (iii) Relaxing the head and neck, followed by chanting "M", the last part of "Om". (iv) Letting the body `collapse" on the ground with a feeling of "letting go", chanting AUM. (v) Allowing oneself to feel apart from one"s physical body with a feeling of expansion by merging with a limitless expanse such as the sky or ocean. This is practiced slowly and with instructions about relaxation and awareness of physical and mental sensations. Throughout the practice the eyes are closed.

### Supine rest

During supine rest, the subject lies supine with the legs apart, arms away from the sides of the body, and eyes closed. This session lasts 10 minutes, as for guided relaxation. In traditional yoga practice, all yoga postures are meant to be practiced with relaxation (i.e., not contracting muscles during the posture) and with a mental state which is calm and "expanded". To reach the latter state, the subject initially visualizes a limitless expanse such as the sky or the ocean. While this is true for all yoga postures (e.g., those practiced while standing or seated), it is especially true for shavasana (the supine rest posture). Hence subjects could be expected to anticipate feeling relaxed in this posture.

### Data Extraction

The end expiratory points of the respirogram obtained from Benedict-Roth apparatus were joined as a slanting line, the slope of which gave the difference between initial and final volumes of oxygen in the tank in a given period, which was approximately 3-4 minutes in most cases.

The following data were extracted from the polygraph records: the breath rate (in cycles per minute) was calculated by counting the breath cycles in 60 second epochs, continuously. The skin conductance level (in micro siemens) and finger plethysmogram amplitude (in mm) were sampled at 20 second intervals. Values averaged across each of the periods (before, test, after) of a session, were used for analysis.

Frequency domain analysis of heart rate variability data was carried out for the 5-minute recordings Before, During the Test period (During 1 and 2) and After the sessions. The mean heart rate was obtained from this record. The mean values were removed from the heart rate series to obtain the heart rate variability values. The heart rate variability power spectrum was obtained using Fast Fourier Transform. The power in heart rate variability series in the following specific frequency bands was studied, viz., the very low frequency band (0 - 0.05 Hz), low frequency (LF) band (0.05 - 0.15 Hz), and high frequency (HF) band (0.15 - 0.50 Hz). The low frequency and high frequency values were expressed as normalized units, which represent the relative value of each power component in proportion to the total power minus VLF component (LF norm = LF/(total power-VLF) X100; HF norm = HF/(total power-VLF) X100) (Task force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, 1996).

## ANALYSIS

The t-test for paired data was used to assess the significance between Before values and those recorded During (During 1, During 2) and After. In the case of oxygen consumption and breath volume, comparisons were between Before and After values. The Wilcoxon paired signed ranks test was used to study changes in LF/HF, for subjects with baseline LF/HF >0.5 (Group I) and for those with baseline LF/HF £ 0.5 (Group II), separately

## RESULTS

The group means (± SEMs) obtained in the two sessions are given in Tables 1 and 2.

### Oxygen consumption, breath volume

The paired t-test showed a 25.2% decrease in oxygen consumption after guided relaxation (p<.001). Breath amplitude increased by 15.0%, after guided relaxation (p<.01).

**Autonomic measures and breath rate**

The paired t-test showed significant differences during guided relaxation compared to the respective Before values for the following parameters, (i) skin conductance level reduced by 35.6%, ($p<.05$);

**TABLE 1**

Means and Standards error of the means (SEMs) of Oxygen Consumption and Breath volume before and after guided relaxation and supine rest (n = 25)

| VARIABLES | GUIDED RELAXATION | | | | SUPINE REST | | | |
|---|---|---|---|---|---|---|---|---|
| | Pre | | Post | | Pre | | Post | |
| | M | SEM | M | SEM | M | SEM | M | SEM |
| 1. Oxygen Consumption (ml/min ) | 768.8 | 55.1 | 574.9 † | 42.5 | 618.1 | 66.3 | 573.4 | 58.7 |
| 2. Breath Volume (ml) | 906.2 | 57.0 | 1042.3* | 59.0 | 949.7 | 59.2 | 1009.9 | 64.2 |

*p<.02, † p<.01, paired t -test, "After" compared to "Before"

**TABLE 2**

| Subjects with base line ratio of > 0.5 | | | | Subjects with base line ratio of < 0.5 | | | |
|---|---|---|---|---|---|---|---|
| Guided Before | Relaxation After | Supine Before | Rest After | Guided Before | Relaxation After | Supine Before | Rest After |
| .73 | .24 | .54 | .83 | .47 | 1.27 | .41 | .44 |
| .60 | .38 | .68 | .52 | .49 | .55 | .49 | .36 |
| 3.17 | .54 | .77 | 1.47 | .48 | .59 | .30 | .38 |
| .82 | .24 | .72 | .68 | .41 | .33 | .32 | .30 |
| .76 | .47 | .59 | .26 | .44 | .42 | .46 | .43 |
| .94 | .40 | .65 | .64 | .50 | .22 | .34 | .52 |
| .51 | .50 | .73 | .57 | | | .50 | .32 |
| .61 | .42 | .69 | .46 | | | | |
| .53 | .78 | | | | | | |

(ii) heart rate reduced by 9.7%, ($p<.001$); (iii) low frequency component reduced by 15.5%, ($p<.05$), (iv) high frequency component increased by 9.8%, ($p<.05$). During supine rest compared to the preceding period significant changes occurred in: (i) skin conductance level reduced by 27.0%, ($p<.01$); (ii) heart rate decreased by 6.5%, ($p<.01$), also finger plethysmogram amplitude reduced by 25.8%, After supine rest compared to Before ($p<.01$). The Wilcoxon paired signed ranks test showed a significant decrease in the LF/HF ratio after guided relaxation, for subjects with baseline LF/HF >0.5 (Group I) (p<.05(1); n=9).

## DISCUSSION

The reduction in heart rate and skin conductance levels during both guided relaxation and supine rest, are similar to another report of physiological relaxation during supine rest and guided relaxation (Bera, Gore, & Oak, 1998). The changes in the HF power values suggest that during guided relaxation, cardiac vagal activity is increased (Hayano, Taylor, Yamada, Mukai, Hori, Asakawa, Yokoyama, Watanabe, Takata , & Fujinami, 1993). A decrease in finger plethysmogram amplitude is suggestive of increased peripheral vasoconstriction related to increased sympathetic vasomotor tone (Delius & Kellerova, 1971), which occurred after supine rest, as the After recording was made while seated erect, compared to the supine position, during the Test period. The fact that the same change did not follow the Test period for guided relaxation may be attributed to decreased sympathetic tone after guided relaxation. This decrease in sympathetic tone may be speculated to reduce the magnitude of reflex augmentation in sympathetic activity occurring as a reflex postural readjustment. The change in posture from sitting to supine may also explain the decrease in the low frequency power during supine rest as compared to before. Hence the decrease in the power of the low frequency component during guided relaxation, may also, in part be due to the change in posture. Hence the change in posture in three states, i.e., Before (sitting), During (supine), and After (sitting), also makes it difficult to interpret the results, conclusively. The decrease in oxygen consumption and increase in breath amplitude following guided relaxation suggest that this practice reduces physiological arousal as has been found during Transcendental Meditation (Wallace, 1970; Wallace, Benson, & Wilson, 1971).

When the subjects were subdivided based on their baseline LF /HF ratio (LF/HF > 0.5 or LF/HF < 0.5) which suggested higher or lower sympathetic activity, respectively, (Malliani et al., 1991), a significant difference was found in the changes after guided relaxation and supine rest. Following guided relaxation subjects with baseline LF /HF > 0.5 showed a significant decrease in the LF /HF ratio, whereas the same subjects showed no change after supine rest. Also, subjects with LF /HF < 0.5 at baseline showed no change in this ratio after guided relaxation. This suggests that the practice of guided relaxation may be most effective in reducing sympathetic tone in subjects with higher levels at base line.

In summary, both guided relaxation and supine rest reduce physiological arousal, with changes in a larger number of autonomic measures following guided relaxation. The findings are limited by factors such as the fact the two types of measurements (oxygen consumption and autonomic) were not recorded in all subjects; also the guided relaxation technique has a number of components (muscle relaxation, imagery etc.), which makes it difficult to understand which component influences the result). However, in spite of these limitations the results suggest that instructions to relax (as in guided relaxation) do facilitate relaxation even in subjects who are trained through yoga practice to be able to relax without external instructions. Hence the relaxation effects of yoga practice would be expected to be augmented by guiding instructions.

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