

Immediate Effects of OM Chanting on Heart Rate Variability Measures Compared Between Experienced and Inexperienced Yoga Practitioners

Abstract

Background: Chanting “OM” is a form of meditation that has numerous health benefits. However, the neurophysiological mechanisms underpinning its effect are surprisingly scarce. The present study aimed to investigate the effect of OM chanting on autonomic modulation, using heart rate variability (HRV), on experienced yoga practitioners and yoga naïve persons. **Methods:** This prospective study included 19 yoga practitioners (9 females and 10 males; group mean age \pm standard deviation [SD]; 25.9 ± 3.2 years) and 17 yoga naïve persons (8 females and 9 males; group mean age \pm SD; 24.8 ± 3.6 years) of both sexes and similar age range. Both the groups were assessed for HRV indices (time and frequency domain measures) before and after loud OM chanting for 5 min. **Results:** Baseline comparison using Mann–Whitney U test between groups showed yoga practitioners had significantly increased high frequency (HF) power ($P < 0.029$) than nonyoga practitioners, signifying a state of tranquility before the chanting of OM. After 5 min of loud chanting of OM, a comparison between groups assessed using Wilcoxon Signed Ranks test revealed: HF Power, a component of the parasympathetic nervous system, was further amplified with a significantly increase ($P < 0.001$) in the yoga practitioners group compared to nonyoga practitioners. Furthermore, this increase in HF power was positively correlated with the years of experience in yoga. **Conclusion:** The present study showed that a brief chanting of OM (5 min) might enhance parasympathetic nervous system activity, promote relaxation, and provide calmness. Further, this experience may be achieved effectively in individuals experienced in yoga than nonyoga practitioners.

Keywords: Autonomic nervous system, heart rate variability, OM chanting, yoga experience

Introduction

Yoga is an ancient way of life and spiritual science (universal, unsectarian, and unaltered phenomena that facilitate homeostasis in an individual) intended to promote health and wellbeing.^[1] In yoga philosophy, Om is considered a sacred syllable or “mantra,” which is contemplated as a universal sound, the seed of all words without reference to any specific religion or God. OM (pronounced as AUM) is the combination of three consonants: A, U, and M. It is the syllable of the past, the present, and the future, signifying the creation, maintenance, and destruction of this universe.^[2] In ancient Indian scriptures, OM is considered the most powerful of all the mantras with positive and beneficial effects on human beings.^[3] It is considered a primordial cosmic sound and the totality of all sounds, removing entire psychological pressure and worldly thoughts.^[4] Chanting

OM is a form of meditation (different mantras used to focus the mind), which is practiced either mentally or with loud repetition. Loud chanting of OM exerts an influence or effect through sound vibrations that resonate on specific parts of the body, creating numerous physical and psychological benefits – paving the way for an inward journey-an experience that is quiet, pleasant, calming, and balancing.^[5] Chanting of OM reduces anxiety and depression, facilitating better states of relaxation conducive to improved mental and physical health.^[6]

Although OM has been used in spirituality for centuries, scientific research with quantifiable physical measures started to expand in the 1990s when laboratories explored the effects of OM meditation on human beings by investigating various parameters such as

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electroencephalograph, neuroimaging, evoked potentials, and other methods.^[6,7,8] These studies have suggested that chanting OM could produce numerous physiological changes such as increased awareness, sensitivity to sensory transmission, improved concentration, reduced stress levels, heart rate, blood pressure, and skin resistance.^[3,9-11]

Chanting “OM” produces a vibratory sensation in the ears, which spreads through the auricular branch of the vagus nerve, stimulating the vagal centers and producing an effect similar to that of the technique vagal stimulation.^[12] Modern technology and brain imaging methods such as functional magnetic resonance imaging (fMRI) have made it possible to look at the physiological responses produced by the recitation of OM. More advanced studies using functional near-infrared spectroscopy showed that the vibrations produced during chanting OM-deactivates the prefrontal cortices, suggesting that it has a stimulating effect on the auricular branch of the vagus nerve in the ear canal.^[13] Furthermore, analysis using fMRI has shown deactivation of the amygdala, anterior cingulate gyrus, hippocampus, insula, orbitofrontal cortex, parahippocampal gyrus, and thalamus. Suggesting Om chanting could be an added therapy for depression and epilepsy.^[12]

Chanting OM at six breaths per minute had shown a robust and synchronous increase in the cardiovascular rhythms, with enhanced Baroreflex sensitivity.^[14] These six breaths per minute had shown increased mental alertness, even while being physiologically relaxed (shown by the reduced heart rate). Furthermore, practitioners with more than 10 years of experience in meditation had shown a trend toward reduced oxygen consumption with enhanced sensory information processing speed.^[10]

Despite this, scientific research on chanting OM is surprisingly scarce. The neurophysiological mechanisms underlying the claimed beneficial effect of OM are yet to be defined conclusively. Heart rate variability (HRV), a noninvasive tool to assess autonomic nervous system (ANS) modulation, has applications to concede the neurocardiac regulation and is consequently being used in the field of research to underpin the neurophysiological mechanisms of various neurological and psychiatric disorders.^[15] Although the effects of OM meditation have been established, the neurophysiological changes for loud chanting of OM are yet to be explored. Hence, the present study aimed to assess the immediate (before and after) effect of chanting OM on ANS modulation, using HRV measures.

Methods

Study population

Thirty-six participants (average group age \pm standard deviation [SD]; 25.5 ± 3.4 years) who belonged to two categories: (i) Yoga practitioners ($n = 19$; 10 males and 9 females; group average age \pm SD; 25.9 ± 3.3 years) and (ii) naïve to yoga persons ($n = 17$; 9 males and

8 females; group average age \pm SD; 24.9 ± 3.6 years) took part in the study. This study was planned as an exploratory pilot study deemed adequate to explore the differences between groups at two-time points of HRV. The yoga practitioners had an average experience of 7.7 ± 1.9 years (ranged between 5 and 11 years) and were practicing yoga for an average of 60 ± 15.4 min/day for 5 days/week on an average. The participants of the yoga group were yoga graduates who got trained in the following aspects of traditional yoga: postures (asana), voluntarily regulated breathing techniques (pranayama), guided relaxation, meditation, and philosophical principles of yoga such as Yama and Niyama. Naïve to yoga persons (who had no experience in yoga) were students, residents, and staff nurses working in health-care global (HCG) Ltd, Bangalore, South India. Both the groups were trained on how the OM chanting should be done. Each cycle of OM chanting was 10 seconds, wherein 4 s were for inhalation followed by 2 s each of AA, UU, and MM, respectively. This was not measured for compliance but was provided as a guiding instruction to all subjects of both groups. Subjects did 5 min of OM chanting, approximately 30 cycles of chanting in total.

For inclusion in the study, the participants had to (i) be willing to take part in the study, (ii) be in the age range between 20 and 35 years, (iii) have at least 6 months of yoga experience, and (iv) have normal health based on a routine clinical check-up. Participants with no prior experience in yoga were included in the naïve to yoga group.

For exclusion, participants with a history of any systemic and mental illness, regular use of medication for any diseases, chronic smoking, and alcoholism were excluded from the study. All the participants were individually explained about the study, and their signed informed consent was obtained. The institutional ethics committee approved the study, and the participation was voluntary. No incentives were given to participants for participating in the study. Table 1 shows the demographic details of the participants.

Design and study setting

This study is a two-group pretest-posttest design to compare the HRV changes in participants with and without prior experience in yoga. The study was carried out in the department of complementary and alternative medicine, HCG, South India. The participants were informed about the study, and their queries were answered. All participants were asked to perform loud chanting of OM for 5 min, and their assessments were taken before and after the chanting. OM chanting was performed by inhaling through both nostrils, and while exhaling a-ā-u-ū-m-(ng) was chanted at a rate of 6 breaths/min.

The knowledge about the yoga experience was based on these questions in the sociodemographic data sheet:

Table 1: The demographic details of the participants

Information	Experienced Yoga group	Novice to yoga group
Number of participants (females)	19 (9)	17 (8)
Age (years), mean±SD	25.9±3.3	24.9±3.6
Years of education (range)	12-17	12-16
Experience of yoga practice (years), mean±SD	7.7±1.9	Not applicable

SD: Standard deviation

(i) Do you have any experience of yoga practice? (ii) If your answer was yes to the previous question, then please specify (a) the span of yoga experience in months/years, (b) regularity of yoga practice/week, and (c) duration of yoga practice/day.

Heart rate variability

HRV was used as the assessment tool in this study. HRV is a noninvasive marker of health used to assess neurocardiac regulation of the heart by measuring the R-R interval (QRS peak) of an electrocardiogram (ECG). HRV reflects the balance between the sympathetic and parasympathetic activity of the heart.^[16] HRV recording was carried out under all standardized conditions. The participants were made to lay on the bed, and Ag/AgCl pregelled electrodes were placed according to the standard limb lead II configuration for recording an ECG. Data were acquired at the sampling rate of 1024 Hz using Power lab 16 channels data Acquisition System, AD instruments, Australia. The data were stored and were analyzed offline using an automated program that allowed visual checking of the raw ECG and breathing signals.

Data extraction

An artifact-free 5 min ECG segment was taken for analysis to obtain both time domain and frequency domain parameters of the HRV using HRV Analysis Software (Lab chart pro version 8, AD instruments, Australia). The time-domain analysis was average heart rate beats per minute, the mean of the intervals between adjacent QRS complexes or the instantaneous HR (RR Intervals), SD of RR Intervals (SDNN) in milliseconds, the square root of the mean of the sum of the squares of differences between adjacent normal-to-normal (NN) intervals (RMSSD) in milliseconds, the number of interval differences of successive NN intervals >50 ms (NN50), and the percentage of such NN50 over the recorded segment of 5 min (pNN50). Frequency domain parameters were total power, low-frequency power (LF power) in ms^2 , high-frequency power (HF power) in ms^2 , sympathovagal balance-LF/HF ratio.

Statistical analysis

Data were analyzed using IBM SPSS (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp). Shapiro–Wilk test was performed to check the normality of the data. Baseline comparison

between groups was performed using Mann–Whitney U test. Wilcoxon Signed Ranks Test was used to assess the before and after effect of OM chanting within groups. Spearman’s rank correlation test was done to assess the correlation between years of experience in yoga practice with HRV changes.

Results

The Shapiro–Wilk test showed that the data were not normally distributed. Therefore, a nonparametric test, namely Mann–Whitney U-test, was used to compare the two groups.

Baseline-group comparison

Baseline comparison between groups using Mann–Whitney U test has shown that there were no significant differences between groups except for HF Power ($U = 92.5, P = 0.029$), a component of the efferent vagal (parasympathetic) activity. This increase in HF power at baseline compared to the novice group asserted that regular yoga practitioners exhibit an increased vagal tone at rest than nonyoga practitioners. Table 2 shows the baseline comparison between groups.

Within-group comparison

When compared for the before and after effect of OM chanting on experienced and novice participants, using Wilcoxon signed ranks test have shown that five minutes of OM chanting has shown significant improvement ($Z = -3.823, P < 0.001$) in HF Power in the experienced yoga participants compared to nonexperienced participants. Except for HF Power, there were no significant differences in the HRV measures. Table 3 shows the before and after effect of OM chanting on experienced yoga participants vs. nonexperienced participants.

Correlation analysis

The HF power of the yoga group was associated with years of experience in yoga using Spearman’s rank correlation test. The results showed that HF Power was positively correlated ($r = -0.748, P < 0.001$) with years of experience in yoga, indicating that participants with maximum years of experience in yoga tend to relax faster than an individual with fewer years of experience/nil experience. Figure 1 shows the correlation of HF Power with years of experience in yoga.

Table 2: Baseline comparison between groups

Variable/baseline parameters	Baseline comparison (Mann-Whitney U test)			
	Experienced (n=19)	Novice (n=17)	U	P
	Median (Q1-Q3)			
BPM	72.2 (69.8-76.7)	68.2 (63.9-76.3)	114.0	0.132
SDNN (ms)	45.8 (37.1-73.6)	58.9 (39.9-68.2)	149.5	0.704
RMSSD (ms)	41.1 (28.3-63.5)	44.6 (29.8-54.2)	157.5	0.899
pRR50 (%)	16.2 (8.5-34.8)	22.9 (8.6-34.4)	156.5	0.874
Total power (ms ²)	2183 (998-7490)	3556 (1586-4653)	144.5	0.590
LF power (ms ²)	585.7 (283.5-912.5)	691.6 (305.6-1213.8)	147.5	0.657
HF power (ms ²)	1294.9 (998.1-1892.8)	777.5 (440.3-1321.5)	92.5	0.029*
LF/HF	0.8 (0.6-1.3)	0.8 (0.6-0.9)	148.5	0.680

* $P < 0.05$ was considered significant. All values are in the median and interquartile range. RR interval: The distance between subsequent R-wave peaks in ECG, BPM: Beats per minute, SDNN: Standard deviation of RR intervals, RMSSD: The square root of the mean of the sum of the squares of differences between adjacent RR intervals, pRR50 (%): Proportion derived by dividing and NN50 by the total number of RR intervals, LF: Low frequency, HF: High frequency, LF/HF: Ratio of low frequency to high frequency, ECG: Electrocardiogram

Table 3: Before and after effect of OM chanting on experienced yoga participants versus nonexperienced participants

Parameters	Group	Wilcoxon Signed ranks test		Z	P
		Before	After		
		Median (Q1-Q3)			
BPM	Experienced	72.2 (69.8-76.7)	76.9 (69.4-79.9)	-1.771	0.077
	Novice	68.2 (63.9-76.3)	69.2 (63.2-73.7)	-1.113	0.266
SDNN (ms)	Experienced	45.8 (37.1-73.6)	43.7 (37.9-93.7)	-1.892	0.059
	Novice	58.9 (39.9-68.2)	63.0 (40.2-66.3)	-0.213	0.831
RMSSD (ms)	Experienced	41.1 (28.3-63.5)	34.9 (29.6-58.8)	-0.845	0.398
	Novice	44.6 (29.8-54.2)	41.6 (29.1-61.7)	-0.166	0.868
pRR50 (%)	Experienced	16.2 (8.5-34.8)	12.8 (9.9-37.1)	-1.087	0.277
	Novice	22.9 (8.6-34.4)	23.6 (9.1-40.5)	-0.308	0.758
Total power (ms ²)	Experienced	2183 (998-7490)	4264 (1426-5387)	-0.885	0.376
	Novice	3556 (1586-4653)	3780 (1439-4079)	-1.018	0.309
LF power (ms ²)	Experienced	585.7 (283.5-912.6)	659.5 (344.4-930.7)	-0.121	0.904
	Novice	691.6 (305.6-1213.8)	796.8 (419.5-1126.5)	-0.024	0.981
HF power (ms ²)	Experienced	1294.9 (998.2-1892.8)	2295.9 (1925.9-3484.3)	-3.823	<0.001*
	Novice	777.5 (440.3-1321.5)	896.5 (446.3-1943.8)	-1.207	0.227
LF/HF	Experienced	0.8 (0.6-1.3)	1.1 (0.5-1.5)	-0.483	0.629
	Novice	0.8 (0.6-1)	0.6 (0.5-1.4)	-0.213	0.831

* $P < 0.05$ was considered significant. All values are in the median and interquartile range. RR interval: The distance between subsequent R-wave peaks in ECG, BPM: Beats per minute, SDNN: Standard deviation of RR intervals, RMSSD: The square root of the mean of the sum of the squares of differences between adjacent RR intervals, pRRx (%): Proportion derived by dividing and NN50 by the total number of RR intervals, LF: Low frequency, HF: High frequency, LF/HF: Ratio of low frequency to high frequency, ECG: Electrocardiogram

Discussion

The present study intended to assess the immediate effect of OM chanting on ANS modulation using HRV measures revealed that five minutes of loud OM chanting could significantly increase the HF Power (a component of vagal nerve activity) in experienced yoga practitioners compared with novice practitioners. However, it is essential to note that the HF Power of the experienced practitioners at the baseline was noticeably higher than those of the nonexperienced practitioners. Since it is usually thought that yoga practitioners have a relaxed state of mind than those who do not practice yoga, these results are suggestive evidence that regular practice of yoga bestows

calmness by modulating the ANS toward parasympathetic dominance.

The significant rise in HF Power (a component of the parasympathetic nervous system) after the chanting of OM might be due to the following effects. (i) The vibratory sensation of OM stimulating vagal centers and modulating ANS toward parasympathetic tone. (ii) The respiratory frequency of the chanting (i.e.,) six breaths per minute could increase the respiratory sinus arrhythmia—a reflection of higher parasympathetic activity, and (iii) the years of experience in the practice of yoga and its preexposed benefits on ANS.

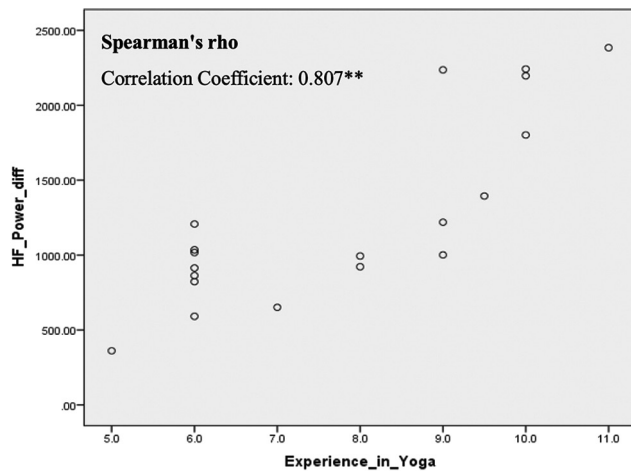


Figure 1: Showing the correlation of high-frequency power with years of experience in yoga

The vibratory sensation of OM

Effective chanting of OM is associated with the experience of vibratory sensation around the vocal cords (during the production of sound) and ears (during the perception of sound), expected that these vibratory sensations are transmitted through laryngeal and auricular branches of the vagus nerve, stimulating vagal centers, causing limbic (hypothalamo-pituitary-adrenal axis) deactivation and ANS modulation toward parasympathetic dominance.^[12] These effects, similar to vagus nerve stimulation,^[17] could alter the neurotransmitters and electrical signals, modulating the activity of the autonomic centers in the brain associated with classical 3F (freeze, flight and/or fight) response in favor of rest and digest.^[12] The result of the present study is also suggestive of improved vagal nerve function reflected as increased HF power.

Respiratory frequency of the chanting OM

Various physiological processes in the human body have a rhythmic nature which occasionally becomes synchronized and enhances the body's efficacy for better health. When the heart rate and the breath synchronizes, HRV rises to its most significant level. This resonance in heart rate and breath occurs when the breathing happens with a frequency of 0.1 Hz, or about six breaths per minute.^[18]

The HF component of HRV, also termed as a respiratory band (0.15–0.40 Hz), is primarily linked to parasympathetic activity.^[19] During inhalation, the cardiovascular center inhibits vagal outflow, and during exhalation, it restores vagal outflow via the release of acetylcholine.^[20] A slow respiratory rate (six breath/min) generally has beneficial effects on cardiovascular and respiratory function and increases respiratory sinus arrhythmia (reflection of higher parasympathetic or rest-and-digest activity).^[21]

In the present study, OM chanting is performed with a respiratory frequency of six breaths per minute. The

chanting begins at the expiratory phase of breathing (i.e.), more time is given for the exhalation time, restoring vagal outflow resulting in higher HF power. During the chanting of OM, this slow breathing pattern was found to stimulate cardiac ANS activity by increasing the HF power without LF/HF ratio changes. Suggesting that the HF oscillations coincide with the respiration frequency (i.e., six breaths per min, 0.1 Hz), whereas LF oscillations are thought to correspond to cardiac feedback mechanisms that are independent of respiration.^[22] Furthermore, further investigations suggest that HRV (peaked around RSA) is maximized when respiration is slowed to ~6 breaths per min.^[23] Moreover, literatures have shown that lower HF power is associated with stress, panic, anxiety, or worry. The modulation of vagal tone helps maintain the dynamic autonomic regulation essential for cardiovascular health, and a deficient vagal inhibition is implicated in increased morbidity.^[24]

Years of experience in yoga

Similar to our results, numerous studies on yoga asserted that regular yoga practitioners exhibit an increased vagal tone at rest compared to nonyoga practitioners.^[16,25] Furthermore, studies have reported that yoga practitioners tend to exhibit reduced LF power and increased HF power during and after the practice of different meditative states. Moreover, advanced meditation practitioners have reported increased HF power during periods of meditation compared to baseline eyes closed.^[26] A study on slow yoga breathing in regular yoga practitioners reported improved time-domain measures, with no change in frequency measures compared to baseline.^[27] On the other hand, we have seen no significant changes in the time domain parameters, which could be related to subjective differences in the study population or the design of the yogic intervention. In addition, we correlated the increase in HF power with years of yoga experience in yoga and found the results were positively correlated, signifying regular yoga practice could make a person achieve a state of calmness or relaxation in a shorter time.

Limitations of the study

The present study noted no significant changes in time-domain measures, preferably due to low statistical power, which might not have detected changes in the time domain parameters. Maybe more prolonged practice/long-term effects with a larger sample size might be required to uncover changes in time-domain parameters. Furthermore, this study was conducted in healthy volunteers, limiting the application of its findings to pathological conditions. Having a control condition of chanting neutral sound with known respiratory frequency could have removed the effects of breathing frequency. Further, additional assessments, such as continuous BP monitoring, baroreceptor sensitivity, photoplethysmography, imaging techniques, and galvanic skin resistance, would

have given a better understanding of the comprehensive state of the ANS. The present study assessed only the HRV differences, whereas it did not assess its underlying mechanisms with the above-mentioned advanced measures of cardiovascular regulation. Furthermore, it is worth analyzing and reporting respiratory rate changes along with HRV, using a respiratory belt transducer that might help understand the modulation of respiratory pattern postchanting of OM. Hence, future studies are being suggested to validate its precise mechanisms of neurocardiac regulation and physiological effects with a larger sample size, using advanced techniques.

Conclusion

The OM chanting consisting of the three letters A, U, and M covering the whole process of articulation has shown to enhance parasympathetic nervous system activity (high HF power), promoting relaxation and calmness. This increased relaxation and calmness are associated with years of experience in yoga practice. Hence, evidencing uttering OM could provide instantaneous relief by modulating the ANS toward vagal modulation.

Credit authorship contribution statement

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Ethical statement

This research was reviewed and approved by the institutional review board of HealthCare Global Hospital, Bangalore, India (registration number HIEC/24/21/05).

Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Ethical clearance

Study No: HIEC/24/21/05, HCG INSTITUTE ETHICS COMMITTEE (REG. NO): EC/NEW/INST/2020/1217).

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Conflicts of interest

There are no conflicts of interest.

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