

Logan College of Chiropractic Research

**The Effect of Abdominal Breathing on Heart Rate
Variability**

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ABSTRACT

Objective: This study was designed to determine if abdominal breathing techniques increase heart rate variability (HRV).

Setting: The experiment was conducted in the research lab of Logan College of Chiropractic.

Methods: Fourteen consenting asymptomatic participants (11 males and 3 Females; mean age 28.6) were given instructions for abdominal breathing. A 5-minute HRV was performed prior to the instructions. The participants were allowed to practice the breathing techniques for 5 minutes and then continue to practice as a second 5 minute HRV was performed.

Results: The low frequency portion of HRV (sympathetic component) was significant ($p=.037$). The HRV total power approached significance ($p=.059$).

Conclusion: Abdominal breathing techniques increase HRV low frequency and total power. HRV is a well-known correlate of sympathetic tone thus, it is reasonable to conclude that sympathetic tone was also decreased. Abdominal breathing may be useful as conservative treatment for conditions caused by or exacerbated by stress, anxiety, and increased sympathetic tone.

Key Indexing Terms: Yoga, Breathing Techniques, HRV, Heart Rate Variability

INTRODUCTION

Stress can be defined as a condition or circumstance, which disturbs the normal physiological equilibrium (homeostasis) of an individual.¹ It can also be thought of as a perturbation of the body's homeostasis.¹ It is well known that stress and health are closely linked in humans. Stress comes in both acute and chronic varieties. Both kinds can induce body-mind disorders.² Anxiety, dizziness, sleeplessness, nervousness; muscle cramps are a few examples. Hypertension and peptic ulcers have also been linked to stress.³ Over time stress can deplete the immune system rendering the person vulnerable to infection and malignancy.^{4,5}

People have found various ways of coping with stress. Prescription medications, over-the-counter drugs, alcohol, and illegal substances are frequently utilized to reduce the negative effects of stress and anxiety, but have counterindications and side effects. The best treatments for stress seem to be natural means that can be incorporated into a person's activities of daily living. Physical exercise has benefits for both the mind and body. Meditation, biofeedback, yoga, proper rest, and a balanced diet have all been shown to reduce stress.

Yoga incorporates elements of exercise, stretching, breathing and meditation. Yoga breathing was studied on asthmatics in the United Kingdom. The experimental group showed improvement in two weeks.⁷ At six months they had reduced the use of rescue inhalers by two puffs per day.⁷ There was no change in the control group. The study concluded that breathing technique could improve symptoms and reduce bronchodilator usage in asthmatic patients.⁷ More studies are needed with quantitative measures rather than only subjective.

HRV is the measure of variation between heartbeats. Healthy individuals at rest will demonstrate periodic variation in the intervals between R waves on an EKG. This is known as respiratory sinus arrhythmia (RSA), and it fluctuates with respiration. The heart rate accelerates during inspiration and decelerates during expiration. RSA is predominantly mediated by respiratory gating of parasympathetic efferent activity to the heart. Vagal efferent impulses to the SA node primarily occur during expiration and are attenuated or absent during expiration.

Because of this relationship reduced HRV has been used as an indication of reduced vagal activity. Studies have shown that mental loading, making complex decisions and public speaking, have caused a decrease in HRV.⁸ It has also been shown to decline with age even though resting heart rate does not.⁹ HRV has also been shown to diminish in response to a decrease in efferent vagal tone and reduced beta-adrenergic responsiveness. In contrast to the aforementioned regular exercise has been shown to increase HRV, presumably via increasing vagal tone.¹⁰

The HRV spectrum contains three major components: the high frequency (0.18-0.4 Hz) component, which is synchronous with respiration and is identical to RSA. The second is a low frequency (0.04 to 0.15 Hz) component that appears to be mediated by both the

vagus and cardiac sympathetic nerves.¹¹ The total power of a signal, integrated over all frequencies, is equal to the variance of the entire signal.

METHOD

Research Design

This was a pilot study to determine if abdominal breathing techniques stimulate the parasympathetic nervous system. The low frequency component of HRV is directly correlated with the vagus nerve and the parasympathetics pertaining to the heart. In this study the vagus is used as an indicator of systemic activity. The high frequency reading is of no consequence due to the fact that it is changed with respiration. The total power will be utilized as an indication of variance of the entire signal.

Subject Selection

Subjects were recruited from the student body of Logan College of Chiropractic. The examiners posted flyers on bulletin boards and the volunteers were contacted. Subjects selected were both male and female between the ages of 21-40 years of age. Exclusionary criteria included CPOD, asthma, chronic bronchitis, or any other restrictive or obstructive breathing disorders. They could not have symptoms compatible with the diagnosis of respiratory infection. Finally, hypertensive subjects and those having previous instruction in breathing techniques were excluded.

Instrumentation

A Bio Tech Heart Rhythm Scanner 2.0 software was used for the ECG/HRV measure in the current study.

Procedure

The institutional Review Board of Logan College of Chiropractic approved this investigation. The participants were required to sign consent prior to the study. When the paper work was in order, participants were instructed to lie supine for five minutes with their eyes closed. Next, a five-minute HRV was preformed. The subjects were then given instruction in abdominal breathing. The subject's hands were placed on their abdomen throughout the duration of the test. Five minutes of successful abdominal breathing were required before another 5 minute HRV was performed. The second HRV was administered as the subjects continued to practice the breathing techniques. The data was then entered into a Microsoft Excel spreadsheet.

Data Collection and Analysis

The data of interest in this study are the low frequency and the total power. The natural logs of these numbers are also utilized. The logs provide a statistically significant way to focus on the median data. Following the HRV, the data was entered into a Microsoft Excel spread sheet

RESULTS

N=14	HF	lnHF	LF	lnLF	TP	lnTP
MEAN	419.8071	5.4786	496.0786	6	1187.457	6.857143
ST-D	496.7148	1.0851	291.5384	0.727	828.1848	0.643333
P-VALUE	0.588473	0.3406	0.037484	0.032	0.059035	0.028392

The results showed no significant change in high frequency and a significant change in low frequency and its natural log. Total power approached significance at the .05 level; however, the natural log shows a statistically significant change.

DISCUSSION

Breathing techniques in this experiment caused statistically significant changes in the HRV of asymptomatic subjects. The response is expected to be greater when the subjects present with clinical signs and symptoms of anxiety.

The subjects were allowed five minutes of breathing before the five minute HRV scan. The maximum abdominal breathing time was ten minutes. The researchers expect that if twenty minutes were allowed of abdominal breathing the results would have been more favorable. The Total Power may have been significant if longer breathing periods were given or the sample size were larger.

Traditional Yoga and many other meditation techniques are preformed in the sitting position. It is uncertain if the postural variance will modify the effectiveness of the techniques used in this study. Future research should be done in this area utilizing a longer breathing period between HRV analyses.

In future experiments background sensory stimulation should be controlled. The lab used in this experiment was high in noise and disruption. When doors would slam and bells would ring the HRV of the subject would change dramatically as the sympathetic nervous system was stimulated.

CONCLUSION

Our hypothesis that abdominal breathing may reduce sympathetic tone is supported by the HRV data. The significant change in the low frequency and almost significant change in the total power indicate a more parasympathetic state.

Our results agree with other studies, some of which have used other measures besides HRV. Based on our results, breathing lowers sympathetic tone and by extension can be used to treat conditions caused or complicated by stress, anxiety, and increased sympathetic efferent tone. Breathing is free, effective, and has no side effects. It should be considered as a conservative alternative treatment to the aforementioned conditions or in tandem with pharmacological case management.

Other studies have found breathing exercises improve objective measures such as vital capacity, anti-oxidant levels, and fasting blood glucose. Subjective measures such as,

better sleep, less anxiety, and decreased pain were also improved. Even though there is consensus among studies that breathing helps reduce conditions related to overactive and stressed sympathetics, more research is needed.

Future studies should combine different types of breathing techniques, postural variations, and different lengths of breathing exercise. It may also be beneficial to combine breathing exercises with meditation, guided imagery, and biofeedback. Our study showed a general impact decreasing the activity of the sympathetic nervous system. Future research should focus on how breathing techniques may effect specific diseases known to be caused or exacerbated by stress, anxiety, and increased sympathetic tone.

REFERENCE

- [1] Stedman's Medical Dictionary. 27 ed. Lippincott Williams and Wilkins. 2000;1708
- [2] Gross C, Hen R. Genetic and environmental factors interact to influence anxiety. *Neurotox Res.* 2004;6(6):493-501.
- [3] Christensen NJ. Psychosocial stress and catecholamines: their relationship to ageing, duodenal ulcer, hypochondriasis and hypertension. *Pharmacol Toxicol.* 1988;63 Suppl 1:24-6.
- [4] Glaser R. Stress-associated immune dysregulation and its importance for human health: a personal history of psychoneuroimmunology. *Brain Behav Immun.* 2005 Jan;19(1):3-11.
- [5] Parker J, Klein SL, McClintock MK, Morison WL, Ye X, Conti CJ, Peterson N, Nousari CH, Tausk FA. Chronic stress accelerates ultraviolet-induced cutaneous carcinogenesis. *J Am Acad Dermatol.* 2004 Dec;51(6):919-22.
- [6] Parati G, Steptoe A. Stress reduction and blood pressure control in hypertension: a role for transcendental meditation? *J Hypertens.* 2004 Nov;22(11):2057-60
- [7] Cooper S, Osborne J, Newton S, Harrison V, Thompson Coon J, Lewis S, Tattersfield A. Effect of two breathing exercises (Buteyko and pranayama) in asthma: a randomised controlled trial. *THORAX.* 2003 AUG Vol. 58(8) Pgs. 674-9
- [8] Kawachi I, Sparrow D, Vokonas PS, Weiss ST. Decreased heart rate variability in men with phobic anxiety. *Am J Cardiol* 1995; 75: 882-885
- [9] Offerhaus RE. Heart rate variability in psychiatry. In: RJ Kitney, Rompelman O (eds). *The Study of Heart Rate Variability.* Oxford: Oxford University Press, 1980: 225-238.
- [10] Sloan RP, Shapiro PA, Bigger T Jr, Bagiella E, Steinman RC, Gorman JM. Cardiac autonomic control and hostility in healthy subjects. *Am J Cardiol* 1994; 74: 298-300.
- [11] Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology. Heart rate variability: standards of measurement, physiological interpretation and clinical use. *Circulation* 1996; 93: 1043-65.