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Effect of pranayama on physiological variables among different age categories

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Abstract
This investigation was conducted to determine the effect of Anuloma Viloma pranayama on physiological variables among females of different age category. To accomplish the purpose of the study, ninety (90) female subjects were selected with age ranging between 21 to 35 years from greenwood academy and ITBP campus in lalkuan, Uttarakhand. They were further classified into three groups of 30 females each group based on their age Group 1: 21 to 25 years, Group 2: 26 to 30 years, and Group 3: 31 to 35 years each constitutes thirty (30) subjects. The investigator selected pulse rate, systolic blood pressure, diastolic blood pressure, vital capacity, resting respiratory rate, and breath-holding time. The independent variable selected in the present study was Anuloma Viloma pranayama which was administered daily for three months. For the present study pretest—posttest randomized group design was used which consists of groups with respect to different ages on physiological variables. To analyze the effect of pranayama on the different age groups the Analysis of Covariance (ANCOVA) was applied. When F is significant Scheffe S post hoc test was applied. Based on the findings of the study, it can be concluded that Anuloma Viloma pranayama training induces positive changes in the bodys cardiorespiratory adaptation, as confirmed by the improvement in all groups.

Keywords: Anuloma Viloma Pranayama, Vagal Tone

Introduction
In ancient days pranayama means breathing exercise. It has been identified and recorded pranayama as control of energy and expansion of energy (Slovak 2000) [34]. Prana means all forms of energy such as cosmic energy, mental and physical energy, etc. It is loosely translated as breath. Ayama controls. Hence, Pranayama is control of breath, the discipline of breath or rhythmic control of breath.

The three main steps of pranayama are Inhaling, Retaining the breath., Exhaling. If the breath is controlled in turn, it calms down the mind and simultaneously keeps the senses motionless. Pranayama raises the practitioner to that state of silence rarely experienced in normal everyday life. It is much more important to keep sound health. During pranayama practice, make use of the diaphragm fully by drawing the air into the lowest and largest post of the lungs. The studies give evidence to the regular practice of pranayama the respiratory efficiency is improved, the vital capacity of the lungs is increased, and during kumbhaka, there is a slowing down of heart rate. Yoga exercises become more comfortable and powerful when inhalation and exhalation flow freely. Breathing through the nose also warms and filters the air further reducing its impact on the nervous system. Normal breathing oxygenates the blood and removes the noxious by-products of metabolism and respiration. Controlled yoga breathing (pranayama) when appropriately practiced accelerates this process. The subtle flowing of air into and out of the nose also stimulates a relaxation response, which directly affects the brain and nervous system.

By voluntarily controlling breathing patterns, it is possible to influence autonomic nervous system functions, including heart rate variability and cardiac vagal tone (Roukema, 1999; Lehrer *et al*., 1999; Slovak, 2000) [36, 34, 35]. It has been proved that practicing yoga and pranayama has revitalized humans from stress-related mental and physical disorders (Becker, 2000; Benson, 1996) [2, 4]. Yogic breathing provides a unique and powerful tool for adjusting imbalances in the autonomic nervous system and thereby influencing a broad range of mental and physical disorders (Slovak, 2000) [34].

By Reducing sympathetic and increasing parasympathetic nervous system activity pranayama can show various therapeutic actions. It is possible to influence autonomic nervous system functions, including heart rate variability and cardiac vagal tone (Roukema, 1999; Lehrer *et al*., 1999; Slovak, 2000) [36, 34, 35].

There are many methods of pranayama is available. Anulom Vilom is one of the methods of Pranayama in which breathing exercises are used for improving physical and mental health. Anulom Viloma pranayama is also known as Nadi Siddhi pranayama. It has the potential to cure several internal body diseases with allopathic medicine. The practitioners can experience joy and full of happiness with a positive approach to their life. While practicing anulam vilom pranayama certain specifications must be followed like starting with the left nostril and closing the right nostril with the right-hand thumb to block the inhalation through the right.

Breathing exclusively through the right nostril several times a day, for a month can significantly increase baseline oxygen consumption by 37% whereas breathing through the left nostril alone produces a smaller increase (Anand *et al*., 2013) [26]. Right nostril breathing perhaps increases metabolism by increasing the adrenaline output from the adrenal medulla (increasing basal oxygen consumption and heart rate). Reduced mental stress or arousal cause an increase in galvanic skin resistance and reduced sympathetic tone to palmar sweat glands and cutaneous blood vessels. Nadisuddhi Pranayama practice for four weeks caused a decrease of the heart rate, as well as systolic and diastolic blood pressure levels.

Today the lifestyle of young women has drastically changed due to inactive due to modernization. Due to a decline in physical activity levels results they are more prone to diseases and young age mortality.

To minimize the effect pranayama can be administered to improve their lifestyle. Pranayama includes breath practices where there is no body movement except the breathing apparatus itself. Several research suggests that simple breathing techniques can increase the oxygen absorption rate in the blood. Individuals who are restricted in their movement due to health problems may have access to some of the benefits traditionally reserved for those who do not exercise vigorously. However, the efficacy of pranayama on physiological variables is yet to be explored. Hence, in this present study, the effect of Anuloma Viloma pranayama on physiological variables (pulse rate, systolic blood pressure, diastolic blood pressure, resting respiratory rate, breath holding time, and cardiovascular endurance among females of different age categories.

Materials and Methods

Participants

To accomplish the purpose of the study, ninety female subjects were selected randomly with ages ranging between 21 to 35 years. These working female subjects were selected from Greenwood public school and ITBP campus, Lalkuan, Uttarakhand who were novices in pranayama. These subjects were further classified into three groups based on their age as follows: Group 1: 21 to 25 years, Group 2: 26 to 30 years, and Group 3: 31 to 35 years. Each group constitutes thirty (30) subjects. The selected subjects all gave the willingness to participate in this study. After getting their consent, 90 healthy female subjects were medically examined and found they were free from diseases. Written consent was obtained prior to initial data collection which clearly explains the nature of the study, the training program for the training group, and the variables in which they will be tested.

Procedure & Data Collection

In this study, the collection of physiological variables was collected from female subjects of three different age groups before and after pranayama training for three months on the selected physiological variable, the three months of Anuloma villoma pranayama were performed by the subjects. Anuloma Viloma pranayama practice was administered daily in the morning between 06:00 am to 07:00 am for three months and 5 days a week. Pre-test & post-test of the physiological variable taken before & after 3 months of pranayama intervention, the selected physiological variable included in the study as the dependent variable was pulse rate, systolic blood pressure, diastolic blood pressure, vital capacity, resting respiratory rate, and breathing hold time.

The pulse rate was measured using the number of beats per minute, systolic blood pressure and diastolic blood pressure were measured using a stethoscope, and sphygmomanometer, and vital capacity was measured using a dry spirometer. The way of doing each test was demonstrated and explained to the subjects by the researcher. Subjects were verbally motivated to exhibit their maximum performance in the test.

Statistical analysis: Analysis of Covariance (ANCOVA) was administered in the present study. When F is significant Schaffer S post hoc test was applied. The changes within each group were assessed through paired t-tests. The level of confidence was fixed at 0.05 to test the significance. The data was analyzed in the computer system by using the statistical package for social science (SPSS) version 20.

Results

Table 1: Descriptive statistics and t ratio of selected physiological variables

Variable	Groups	Mean & SD of pretest	Mean & SD of Post-test	MD	t
Pulse Rate	21-25	67.50±4.21	65.96±4.04	1.54	4.246 (p=0.000)
	26-30	68.10±3.78	64.66±3.34	3.44	7.647 (p=0.000)
	31-35	71.10±3.76	68.79±3.39	2.34	7.602 (p=0.000)
Systolic Blood Pressure	21-25	117.5±3.12	114.9±3.40	2.6	7.01(p=0.000)
	26-30	119.2±3.82	114.7±3.43	4.5	9.44 (p=0.000)
	31-35	119.2±3.82	115.7±4.93	3.4	5.84 (p=0.000)
Diastolic blood pressure	21-25	79.10±3.78	77.66±3.34	1.44	4.17 (p=0.000)
	26-30	77.50±4.21	75.96±4.10	1.54	4.24 (p=0.000)
	31-35	78.90±3.44	77.77±4.31	1.54	3.86 (p=0.005)
Vital Capacity	21-25	2218.5±14.21	2327.9±14.10	109.4	80.11 (p=0.000)
	26-30	2169.1±13.78	2231.67±13.34	62.57	39.35 (p=0.000)
	31-35	2180.1±15.22	2254.73±18.23	74.6s3	44.52 (p=0.000)
Respiratory Rate	21-25	22.10±3.78	18.66±3.34	3.44	7.64 (p=0.000)
	26-30	20.50±4.21	17.96±4.04	2.54	7.01 (p=0.000)

	31-35	22.63±2.72	19.13±3.05	3.5	9.47 (p=0.000)
Breath holding time	21-25	68.50±5.71	77.65±4.04	9.15	26.21 (p=0.000)
	26-30	69.12±4.80	71.66±5.14	2.54	4.67 (p=0.000)
	31-35	69.10±3.76	71.76±3.39	2.66	5.71 (p=0.000)
Cardiovascular efficiency	21-25	45.50±6.15	50.96±5.14	5.46	20.07 (p=0.000)
	26-30	44.35±3.78	48.66± 3.34	4.31	12.39 (p=0.000)
	31-35	43.48±3.76	47.76± 3.93	4.28	8.18 (p=0.000)

In given table no. 1 descriptive statistics and t ratio of selected physiological variables is given, which shows that p value is less than significant of 0.05 ($p< 0.05$) in every in case all the selected Variable. Which indicate that there were significant differences were seen in pre-test & post-test of Pulse rate, Systolic & Diastolic Blood pressure, vital capacity, respiratory rate, breath holding capacity & cardiovascular efficiency among all the age group.

Pulse rate, systolic blood pressure, diastolic blood pressure, & resting respiratory rate found to be low in 26-30 years compared to 21-25 years and 31-35 years. While Vital capacity & Breath holding time found to be high in 21-25 years compared to 26-30 years and 31-35 year.

Table 2: Result of ANCOVA

Variable	F-statistics	
Pulse Rate	F= 5.350	p = 0.006
Systolic Blood Pressure	F = 3.281	p = 0.042
Diastolic Blood Pressure	F= 2.880	p = 0.062
Vital Capacity	F = 63.39	p = 0.000
Resting Respiratory Rate	F = 6.897	p = 0.000
Breath Hold Time	F= 83.20	p = 0.000

*Level of Significance = 0.05

In given Table 2. The Result of ANCOVA shows that the p value is less than 0.05 in case of results all the variable which indicates that the main effect of Anuloma Viloma pranayama training was significant on all the physiological variables.

Discussion

The significant decrease in resting pulse rate and systolic blood pressure after three months of anuloma viloma pranayama training on age category of 21 to 25 years, 26 to 30 and 31 to 35 years in the present study is in accordance with the findings of other studies on physiological effects of yoga practice (pranayama) in healthy individuals (Bharshankar, *et al*., 2003, p. 202) [21].

In the present study, a highly significant reduction in pulse rate and systolic blood pressure can be "attributed to modulation of autonomic activity with parasympathetic predominance and relatively reduced sympathetic tone, therefore this autonomic modulation in yoga is mediated through modification of breathing patterns which triggers various central and autonomic mechanisms as well as mechanical and hemodynamic adjustments causing both tonic and phasic changes in cardiovascular functioning" (Raghuraj, *et al*. 1998, p. 467-472) [37]. "Slow breathing induces a generalized decrease in the excitatory pathways regulating respiratory and cardiovascular systems. Respiration and cardiovascular systems have similar control mechanisms in humans and alteration in one system will modify the functioning of the other" (Joseph, *et al*. 2005, p. 335-44) [38].

The reduction in diastolic blood pressur occurred as a result of Anuloma viloma pranayama training for three months in all three age groups of females. "During slow and deep breathing lung inflates to the maximum. This stimulates pulmonary stretch receptors which bring about withdrawal of sympathetic tone in skeletal muscle blood vessels leading to widespread vasodilatation and decrease in peripheral resistance and thus decrease diastolic blood pressure". "While practicing pranayama one concentrates on the act of breathing which removes attention from worries and "de-stresses" him. This stress-free state of mind evokes relaxed responses in which parasympathetic nerve activity overrides sympathetic activity". In the present study breath holding time decreased significantly in all three age group female. Bhargava and his colleague (1998) states that "a statistically significant increase in breath holding time after the pranayama practice" (p. 257). The same study explained that "during pranayama training, regular inspiration and expiration for longer duration would lead to the acclimatization of central and peripheral chemoreceptors for both hypercapnia and hypoxia" (Joshi & Joshi, 1998, p. 67) [29]. "Adaptation of the stretch receptors of the chest, the bronchial walls, and the alveoli increase the synchronization between the lung tissue and the cortex, and the prolonged inhalation in pranayama leads to an increased breath holding time" (Bhargava, Gogate & Mascarenhas, 1982, p. 43; Joshi, *et al*. 1992, p. 105) [20, 30].

In the present study the Anulom Vilom pranayama showed significant improvement in vital capacity which is supported by the study conducted by Pramanik, *et al*. (2009, p. 193) [39]. Pranayama increases frequency and duration of inhibitory neural impulses by activating pulmonary stretch receptors during above tidal volume inhalation as in Hering Bruer reflex, which bring about withdrawal of sympathetic tone in the skeletal muscle blood vessels, leading to widespread vasodilatation, thus causing decrease in peripheral resistance and thus decreasing the diastolic blood pressure (Pramanik, *et al*. 2009, p. 193) [39].

Anulom Vilom pranayama also showed significant improvement in vital capacity and maximal ventilator volume. In a study of patients practicing "slow deep breathing likely results in overstretching of pulmonary stretch receptors, chronic manipulation results in vagus blockage, thereby vagal manipulation is decreased. This also leads to conditioning or learning of a pattern of breathing with ample tidal volume and a slow rate".

The study of effects of yogic training on Cardiovascular efficiency of male students and reported daily one hour of yogic training improved cardiovascular efficiency of the subjects. Udupa *et al*. (2003, p. 27) [22] conducted a study to see the effects of Pranayams training on Cardiac Function of young persons; they found Pranayams Training modulates ventricular performance by increasing Parasympathetic Activity and decrease Sympathetic Activity. Mohan *et al*. (2005, p. 313) [33] in their study worked to find out the effects of Slow and Fast Pranayams on Cardiorespiratory function and concluded that different types of Pranayams produce different physiological response in normal young persons. Abraham (2000) [40] investigated the effects of different pranayams techniques on cardiorespiratory endurance and reported no significant relationship between Pranayams and Cardiorespiratory endurance his findings are contradicts our findings.

The efficacy of Anuloma Viloma pranayama training on

selected physiological variables would differ significantly among female of different age category. Anuloma viloma pranayama training for three months on different age group female significantly improved vital capacity, breath holding time, resting respiratory rate and cardiovascular efficiency in 21 to 25 years and pulse rate and systolic blood pressure in 25 to 30 years female. Thereby research hypothesis is accepted and null hypothesis is rejected at 0.05 level of confidence. In this study with an exemption on diastolic blood pressure for which null hypothesis is accepted and the research hypothesis is rejected.

Conclusions

The present study have shown Anuloma Viloma pranayama administered daily for three months significantly altered physiological variables. The dependent variables, pulse rate ($p< 0.05$) by 5.05% and systolic blood pressure ($p< 0.05$) by 3.77% found low in 26 to 30 years female. The Scheffe S post hoc test revealed the same and elicited group differences between 21 to 25*31 to 35 years and between 26 to 30-31 to 35 years age group female. However resting respiratory rate decreased significantly in ($p< 0.05$) by 15.56% decreased significantly but vital capacity ($p< 0.05$) by 4.93%, breath holding time ($p< 0.05$) by 13.35% and cardiovascular efficiency ($p< 0.05$) by 12% increase in 21 to 25 years group female. The post hoc test displayed similar result and proved the difference between the groups. Based on the findings of the study, it can be concluded that Anuloma Viloma pranayama training induces positive changes in the bodys cardiorespiratory adaptation, as confirmed by the improvement in all groups. It can be assumed that among the many factors affecting the health of the female, the capability of maintaining the health is one of the key components at present. Although, three months of Anuloma Viloma pranayama training have obvious contributions to selected criterion variables, who require both a high aerobic capacity to reproduce multiple high-energy outputs. This study suggests that improvements in physiological variables may provide an 62 advantage for women fraternity to maintain and enhance health through practicing Anuloma Viloma pranayama

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