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BREATHING THROUGH A PARTICULAR NOSTRIL CAN ALTER METABOLISM AND AUTONOMIC ACTIVITIES

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Abstract : There is increasing interest in the fact that breathing exclusively through one nostril may alter the autonomic functions. The present study aimed at checking whether such changes actually do occur, and whether breathing is consciously regulated. 48 male subjects, with ages ranging from 25 to 48 years were randomly assigned to different groups. Each group was asked to practice one out of three *pranayamas* (viz. right nostril breathing, left nostril breathing or alternate nostril breathing). These practices were carried out as 27 respiratory cycles, repeated 4 times a day for one month. Parameters were assessed at the beginning and end of the month, but not during the practice. The 'right nostril *pranayama*' group showed a significant increase, of 37% in baseline oxygen consumption. The 'alternate nostril' *pranayama* group showed an 18% increase, and the left nostril *pranayama* group also showed an increase, of 24%. This increase in metabolism could be due to increased sympathetic discharge to the adrenal medulla. The 'left nostril *Pranayma*' group showed an increase in volar galvanic skin resistance, interpreted as a reduction in sympathetic nervous system activity supplying the sweat glands. These results suggest that breathing selectively through either nostril could bave a marked activating effect or a relaxing effect on the sympathetic nervous system. The therapeutic implications of being able to alter metabolism by changing the breathing pattern have been mentioned.

Key words: yogic breathing, unilateral nostril breathing, oxygen consumption, autonomic function

INTRODUCTION

The nasal cycle is an ultradian rhythm during which the patency and functional efficiency of the right and left nares changes alternately with an average periodicity of about 2 to 3 hours when awake (1,2). The link between the sympathetic and parasympathetic divisions of the autonomic nervous system and the nasal cycle, has been worked out by experiments on humans (2,3) and in non-human species, as well (4). Whether breathing through a particular nostril could selectively activate either division of the autonomic nervous system, has been tested by studying the effects of forced unilateral nostril breathing on autonomic activities. Werntz and colleagues (5) correlated right nostril dominance with the 'activity phase' of the basic rest activity cycle. This has been validated by the work of Backon (6) which showed that forced right nostril breathing significantly increases blood glucose levels, whereas left nostril breathing lowers it.

The ancient Indian science of *Yoga* makes use of voluntary regulation of the breathing to make respiration rhythmic, and to calm the mind. This practice is called *Pranayama*. Some varieties of *Pranayama* require the paractitioner to inhale and exhale through one nostril

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selectively. These *Yogic* practices provide an opportunity to study the effects of selective nostril breathing carried on effortlessly for prolonged periods. When each respiratory cycle is completed through the right nostril excusively, the practice is called *Surya Anuloma Viloma Pranayama*, which means 'heat generating breathing practice', and when completed throught the left nostril alone, the practice is called *Chandra Anuloma Viloma Pranayama*, which means a 'heat dissipating or cooling breathing practice'. In *Nadisuddhi Pranayama* (which means 'purification of subtle energy paths'), inhalation and exhalation are through alternate nostrils for successive respiratory cycles. These names were given based on the subjective experiences of the ancient sages.

The present study has been carried out to assess whether practicing any one of the three *Pranayamas* described above, for a month, would cause changes in baseline metabolic and autonomic activities.

METHODS

Subjects : The subjects had come to the Vivekananda Kendra *Yoga* Research Foundation, Bangalore, India, to receive one month's training in *Yoga*. The study was explained to the subjects, and their signed informed consent was taken according to the ethical principles of the Indian Council of Medical Research, New Delhi, India. There were two groups with 24 subjects in each (i.e. a total of 48 subjects). All of them were males, with ages ranging from 25 to 48 years (Mean 34.07, SD 5.9 years).

The first group was randomly sub-divided into two groups. Both groups were given the customary training in *Yoga* (detailed below). In addition to this training, based on a random allocation, one group was asked to practice 27 respiratory cycles through the right nostril, repeated 4 times during the day (the *Surya Anuloma Viloma Pranayama* group or 'S' group). The other group practiced 27 respiratory cycles through alternate nostrils (the *Nadisuddhi Pranayama* group or 'N' group). repeated 4 times during the day. These practices were continued throughout the one month of training. The other group was similarly randomly divided as two groups. For these groups also, in addition to the customary training in *Yoga*, one group was asked to practice 27 respiratory cycles through the left nostril, 4 times a day, (the *Chandra Anuloma Viloma* or 'C' group) whereas the other group completed 27 respiratory cycles through alternate nostrils (the *Nadisuddhi Pranayama* or 'N' group, which had the same pranayama practice as the 'N' group of the first batch). This design was chosen as the 'N' group was considered as a control for both the 'S' and the 'C' groups.

Parameters : In both groups the following parameters were assessed at the beginning and at the end of the one month period viz. Galvanic skin resistance (GSR) and stethographic record of respiration using a 4 - channel portable polygraph (Lafayette, USA). The GSR was measured using specially designed metal plates placed in contact with volar surfaces of the ring and the index fingers. Oxygen consumption using the closed - circuit Benedict - Roth apparatus (INCO, India) was measured at 4.00 a.m. before the daily schedule began. Since the training camps were residential it was possible to keep several factors constant, such as the diet and meal times.

Design of the study and statistical assessment : Following their arrival at the *Yoga* training centre, subjects were given a day to get used to the routine, and then the initial assessments were made. After a month of *Yogic* training, the assessments were repeated. The initial and final values were compared for significant differences using the non-parametric paired signed rank test (of Wilcoxan). No assessments were made during the *Pranayama* practice.

Training in YOGA : All four groups of subjects received the same regular *Yoga* training. This consisted of different *asanas* (physical postures), *Pranayama* (voluntary regulation of breathing), meditation, devotional sessions, and lectures on the theory and philosophy of *Yoga*. The pranayama practice of the regular schedule consisted of nine rounds of *Nadisuddhi Pranayama*, as well as other varieties involving slow, deep respiration, but without manipulating the nostrils, as is required for *Surya Anuloma Viloma* and *Chandra Anuloma Viloma*.

In addition, according to their random allocation to different groups, subjects were asked to practice

one of the following *Pranayamas* (voluntary regulation of breathing) : (1) *Surya Anuloma Viloma Pranayama* (both inhalation and exhalation through the right nostril), (2) *Chandra Anuloma Viloma Pranayama* (both inhalation and exhalation through the left nostril), and (3) *Nadisuddhi Pranayama* (inhalation and exhalation through alternate nostrils). Subjects were asked to practice which ever *Pranayama* was specifically assigned to them, as 27 respiratory cycles, repeated 4 times everyday, throughout the one month of training.

RESULTS

Effects of Surya Anuloma Viloma Pranayama (right nostril breathing or 'S' group) and Nadisuddhi Pranayama (alternate nostril breathing or 'N' group) : The 'S' group showed a statistically significant ($P<0.05$, Wilcoxan's paired signed rank test) increase of 37% in baseline levels of oxygen consumption. However, the 'N' group did not show such a significant change (i.e. a 19%, non-significant increase was observed).

Both groups showed a comparable and significant reduction in body weight ranging from 4.2 to 5.1%, ($P<0.001$, Wilcoxan's paired signed rank test). Also, both groups showed a significant increase in heart rate at the end of a month ($P<0.001$, Wilcoxan's paired signed ranks test). The volar galvanic skin resistance (GSR) and respiratory rate did not alter in either group (Table I).

Effects of Chandra Anuloma Viloma Pranayama (Left nostril breathing or 'C' group) and Nadisuddhi Pranayama (alternate nostril breathing or 'N' group) : Both 'C' and 'N' groups showed an increase in baseline oxygen consumption (by 24% and 17%, respectively), though this was not statistically significant for either group ($P>0.01$, Wilcoxan's paired signed rank test).

The 'C' group showed a statistically significant increase in volar galvanic skin resistance (GSR), ($P<0.05$, Wilcoxan's paired signed rank test). In contrast the 'N' group did not show such a change. In contrast, the 'N' group showed a significant incrase in heart rate ($P<0.001$) while the 'C' group did not change. Both groups showed a comparable (ranging from 3.8 to 2.6%)

TABLE I : This table gives a summary of the effects of 'S' Group and 'N' Group *pranayamas*.

	Parameter	*'S' Group Right Nostril Pranayama (12 subjects)*		*'N' Group Alternate Nostril Pranayama (12 subjects)*	
		Initial values	*Final values*	*Initial values*	*Final values*
1	Oxygen consumption (ml/min STPD)	443.8 ±15.3	608.1* ±17.6	464.3 ±16.0	553.3 ±14.3
2	Body weight (kg)	54.4 ±2.4	52.1** ±2.1	58.7 ±3.2	55.7** ±3.0
3	Volar galvanic skin resistance (Kilohms)	104.7 ±18.7	103.0 ±19.8	113.7 ±20.0	110.0 ±14.8
4	Respiratory rate (breaths per minute)	14.9 ±1.3	15.1 ±1.2	15.4 ±1.6	15.4 ±1.8
5	Heart rate (beats per minute	62.2 ±4.4	68.2** ±2.8	63.0 ±2.8	67.5** ±1.9

Values are mean ± S.E.M. (Standard error of mean). Statistical significance of final values compared with initial values has been indicated with asterisks, as follows : * = $P < 0.05$, ** = $P < 0.001$, Wilcoxan's non-parametric paired signed rank test.

TABLE II : This table gives a summary of the effects of 'C' Group and 'N' Group *pranayamas*.

	Parameter	*'C' Group Right Nostril Pranayama (12 subjects)*		*'N' Group Alternate Nostril Pranayama (12 subjects)*	
		Initial values	*Final values*	*Initial values*	*Final values*
1	Oxygen consumption	438.2 ±13.9	538.8 ±15.6	453.8 ±16.2	529.0 ±18.1
2	Body weight (kg)	60.30 ±1.60	58.00* ±1.70	56.7 ±2.8	55.2 ±2.6
3	Volar galvanic skin resistance (Kilohms)	90.8 ±18.5	222.5* ±47.3	90.5 ±10.6	93.7 ±14.7
4	Respiratory rate (breaths per minute)	17.1 ±1.1	15.8 ±1.2	14.8 ±0.9	13.8 ±1.2
5	Heart rate (beats per minute)	64.0 ±2.1	67.3 ±3.2	65.0 ±0.9	69.1** ±1.6

Values are Mean ± S.E.M. (Standard error of mean). Statistical significance of final values compared with initial values has been indicated with asterisks, as follows: * = P<0.05, ** = P<0.001, Wilcoxan's non-parametric paired signed rank test.

and significant (P<0.05, Wilcoxan's paired signed rank test) reduction in body weight. Neither group showed change in respiratory rate (Table II).

DISCUSSION

The present study has shown that breathing exclusively through the right nostril several times a day, for a month can significantly increase the baseline oxygen consumption by 37%, whereas repeated breathing through the left notsril alone, or through alternate nostrils produces a smaller increase, which was not statistically significant. Neither respiratory rate nor galvanic skin resistance changed with right nostril or alternate nostril breathing. In contrast, breathing through the left nostril exclusively, repeated four times a day for a month produced a significant increase in the baseline level of volar galvanic skin resistance (GSR), suggestive of reduced sympathetic activity to the palmar sweat glands. Alternate nostril breathing repeated regularly for one month did not have this effect.

All 3 types of *Pranayamic* practice caused a reduction in body weight (Mean 2.27, SD 0.61 kg). Since we had noted that previous groups of Yoga course participants had a similar percentage reduction in body weight, we attributed this reduction to their change in diet (a vegetarian diet devoid of saturated fat), as well as increased physical activity. We did not correlate their reduction in weight with any one of the three types of Pranayama practices, specially.

We can speculate that right nostril breathing increases metabolism perhaps by increasing the out put of adrenaline from the adrenal medulla, (reflected in the significant increases in baseline oxygen consumption and heart rate) while sympathetic output to the sweat glands does not change (stable GSR). In contrast left nostril breathing produced a marked decrease in sympathetic activity to the sweat glands whereas other subdivisions did not change as much (relatively smaller changes subdivisions did not change as much (relatively smaller changes in baseline oxygen consumption and heart rate).

An interesting point is that in the same group (i.e. left nostril group) subjects, there was an increase in oxygen consumption (suggestive of increased sympathetic discharge to the adrenal medulla), and an increase in galvanic skin resistance (suggestive of reduced sympathetic tone to the palmar sweat glands and cutaneous blood vessels). This apparent disparity can be explained by the fact that each target of

sympathetic innervation receives its own outflow, and the factors influencing it may differ from one part of the body to another. Hence the traditional concept of diffuse sympathetic tone cannot be maintianed (7). It is also known that the sympathetic outflow to palmar sweat glands and cutaneous blood vessels change with the mental state (7). Since these nerves influence the GSR, we may speculate that reduced mental stress or arousal caused the increase in GSR, while some other (unknown) factor altered the sympathetic nervous system outflow to the adrenal medulla, to produce an increase in oxygen consumption.

The exact mechanism by which nostril breathing influences the function of the autonomic nervous system is not known, though it has been speculated (2) that this is through a neural reflex mechanism in the superior nasal meatus.

Further work is necessary to understand the mechanism, as well as to record changes during the actual practice. However, at this stage one may suppose that the effect of these pranayama practices can be used for therapeutic advantage. For example, several rounds of *Surya Anuloma Viloma Pranayama*, could be used to increase metabolism, in over weight persons, while the effects of the other two *prayanamas* would not be as marked.

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