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Effects of pranayama practices on hormonal variable changes among PCOS women

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Abstract
The research sought to explore the impact of pranayama on hormonal changes among women with polycystic ovarian syndrome. Thirty participants aged 25 to 35 were randomly selected from the Thanjavur region of Tamil Nadu for the study. They were divided into two equal groups: The Control Group and the Experimental Group (Pranayama). Training sessions were conducted for twelve weeks, five days a week. The control group received no intervention and remained separate throughout the study. The dependent variable chosen was Total testosterone levels. Pre and post-tests were administered before and after the intervention respectively. The collected data was analyzed using covariance analysis (ANCOVA). The findings indicated that twelve weeks of yoga pranayama led to significant changes in selected hormonal variables.

Keywords: PCOS, Testosterone, Androgen, Pranayama

Introduction

The term Yoga is often misconstrued. Many believe it solely pertains to physical exercises or Asanas, involving stretching positions aimed at uniting the body and mind. While yoga institutes worldwide emphasize breathing techniques or pranayama, these exercises, though beneficial for the body and mind, do not solely define Yoga. Yoga represents a state of being where we disconnect from the worldly and connect deeply with the divine. Although some define Yoga as the union of body, mind, and soul, such explanations can lead to further confusion. In essence, Yoga is simple.

PCOS (Polycystic Ovarian Syndrome) is a hormonal disorder predominantly affecting reproductive-aged women. It's a prevalent health concern among adolescents and young women, affecting approximately one in ten women of reproductive age. The reproductive system's functionality relies on a complex interplay of five hormones: estrogen, gonadotropin-releasing hormone, follicle-stimulating hormone, progesterone, and luteinizing hormone. Imbalances in these hormones can lead to the development of PCOS or Polycystic Ovarian Disease (PCOD) in women of reproductive age.

The causes of PCOS are not clearly defined; however, contributing factors may include excess androgen production and insulin overproduction. Excessive androgen production by the ovaries can result in hirsutism and acne, while insulin overproduction, often due to insulin resistance, can lead to increased androgen synthesis, potentially hindering ovulation.

Symptoms of PCOS include polycystic ovaries, excessive facial or body hair, and irregular menstruation cycles. PCOS causes ovaries to develop clusters of small, pearl-like cysts, disrupting normal ovarian function. Increased androgen levels in PCOS patients contribute to these symptoms.

The impact of androgens on PCOS is significant, with hyperandrogenism being a defining characteristic. Women with hyperandrogenic syndrome are more likely to experience persistent anovulation, infertility, and early pregnancy loss. Obesity rates among individuals with hyperandrogenic syndrome are increasing, with associated risks of insulin resistance, metabolic syndrome, type 2 diabetes, and cardiovascular disease.

Therapies for PCOS focus on regulating hormonal imbalances and managing symptoms. Yoga therapy has shown promise in improving PCOS symptoms by regulating the neuroendocrine axis, reducing stress, and harmonizing hormonal profiles. Pranayama, a fundamental aspect of Ashtanga yoga, involves breath control and extends beyond mere breathing exercises.

It influences the flow of prana, or life force energy, in the body's energy channels, promoting health and vitality. Pranayama regulates respiratory impulses, impacting the autonomic nervous system and aiding in the prevention and treatment of various illnesses, including those affecting homeostasis such as obesity, hypertension, and diabetes.

Androgen impact on PCOS

The Androgen Excess Society (AES) defines polycystic ovary syndrome (PCOS) as the most common androgen-excess condition in women, with a focus on hyperandrogenism. Women with hyperandrogenic syndrome are more likely to experience persistent anovulation, infertility, and early pregnancy loss. Obesity rates among people with hyperandrogenic syndrome are growing. Individuals with insulin resistance and metabolic syndrome are at a higher risk of developing type 2 diabetes and cardiovascular disease. Non-obese women with PCOS have impaired insulin sensitivity and hyperandrogenemia.

Even without biochemical proof of IR, aberrant vascular function has been seen. Hyperandrogenic syndrome may result in higher IR than predicted based on age and BMI. The processes behind this occurrence are not well understood. While hyperandrogenemia may have a role, other variables may also contribute. Metformin therapy in PCOS patients has been shown to affect both insulin and androgenic parameters, suggesting that insulin resistance plays a role in hyperandrogenemia.

Oral contraceptives have been shown to reduce androgenic characteristics in PCOS patients, but have not consistently improved insulin levels. Testosterone (T) increases the chance of developing dyslipidemia. Some research has shown no linkage between PCOS and hyperandrogenemia, whereas others have found a link to hyperinsulinemia. Obesity, more than other features of PCOS, has been linked to decreased insulin sensitivity.

Pranayama on PCOS

Yoga therapy offers potential benefits for PCOS by modulating the neuroendocrine axis, enhancing reproductive function, and reducing stress. It has been observed to lower levels of catecholamines and aldosterone in urine, decrease serum testosterone levels, and increase cortisol excretion, thereby suggesting improvements in hormonal profiles. Moreover, yoga has been shown to alleviate stress by increasing alpha waves in the brain and lowering blood cortisol levels. It serves as a comprehensive mind-body treatment, effectively reducing anxiety symptoms in PCOS patients.

Pranayama, often defined as breath control, encompasses more than simply introducing extra oxygen into the lungs. Rooted in the combination of 'prana' meaning 'vital energy' or 'life force' and 'Ayama' meaning 'expansion', pranayama influences the flow of prana in the nadis or energy channels of the pranayama kosha or energy body. As a fundamental principle of Ashtanga yoga, pranayama involves extending and shortening the breath cycle, promoting health and longevity. By regulating respiratory impulses, pranayama can help prevent and treat conditions affecting the autonomic nervous system's homeostatic state, including obesity, hypertension, and diabetes. Furthermore, normal rhythmic breathing appears to mitigate the severity of psychosomatic illnesses.

Four aspects of pranayama

Pooraka or inhalation.
Rechaka or exhalation.
Antar kumbhaka or internal breath retention.
Bahir kumbhaka or external breath retention.

Practices of pranayama incorporate these aspects of breathing, with advanced stages involving spontaneous breath retention (kevala kumbhaka). During kevala kumbhaka, the fluctuation of prana ceases, allowing for a higher vision of reality. While breath retention (kumbhaka) is central to pranayama, it requires gradual control over respiration. Therefore, initial emphasis is placed on inhalation and exhalation to strengthen the lungs and balance the nervous and pranic systems in preparation for kumbhaka. These practices influence the flow of prana in the nadis, fostering physical and mental stability.

A. Nadi Shodhan Pranayama

Nadi shodhana involves alternate nostril breathing, inhaling, and exhaling through individual nostrils in slow, continuous cycles. This practice helps balance male and female energies in the body, addressing the root cause of PCOS, and establishing harmony among hormone levels.

B. Bhramari

Bhramari pranayama, involving deep breathing and humming while covering the ears, aids in calming anxiety and panic, providing relief from the mental toll of PCOS.

Materials and Methods

The present study utilized a parallel-arm controlled pilot trial design to assess the outcomes of participants randomly assigned to either the experimental group (yoga and conventional care) or the wait-listed control group (conventional care alone), with randomization conducted at a 1:1 allocation ratio.

Out of the 52 volunteers initially assessed for eligibility, a total of 30 participants met the inclusion criteria and were included in the study. These participants were randomly allocated to either the wait-listed control group (n = 15, mean age ± SD, 50.76±1.27 years) or the yoga group (n = 15, mean age ± SD, 46.35±2.65 years). The selection of participants was facilitated through collaboration with instructors from three reputable schools in the Thanjavur area. Eligible individuals fell within the age range of 25 to 35 years.

Socio-demographic information, personal history, menstrual history (including cycle length, menstrual bleeding volume, dysmenorrhea severity, and last menstrual period), and past therapeutic interventions were collected through inquiries and review of medical records. Total testosterone levels were measured at baseline and after two months for both the experimental and control groups, comprising a total of 30 participants.

Yoga intervention

Nadi shodan

To performed *Nadishodhana Pranayama* for 20 min during the practice participants were asked to sit in *"Sukhasana"*. The participants were then instructed to perform the following steps: Assume *Nasikagra Mudra* in the right hand and Chin/Gyan Mudra in the left hand. Inhale & exhale slowly & deeply with both nostrils. Inhale slowly and quietly through the left nostril while closing the right. At the

end of the inhalation, Keep the left nostril closed and exhale through the right as slowly as possible. After exhaling completely, inhale slowly and quietly through the right nostril. Close the right nostril and then open the left nostril and exhale slowly and silently. Inhale through the same nostril and continue.

Bharamari

To performed *Bhramari Pranayama* for 20 min. Participants were asked to sit in *"Sukhasana"*. The eyes must be closed during this process to cut off external inputs of sounds and sight, to internalize the consciousness. *Sanmukhi mudra* will be adopted so that the sensation of vibration on the facial region is experienced by placing the fingers on the different regions of the face. Inhalation and exhalation should be through the nostrils, slowly and deeply. While exhaling, the participants will have to produce a sound (humming sound) like a bumble bee strictly through nasal airways, keeping the oral cavity closed by the lips, and ears closed by fingers. The procedures of both Nadi Shodhana and Bhramari Pranayama were demonstrated by a qualified Yoga expert.

Statistical analysis

To examine the information the collected data was statistically analyzed using Analysis of Covariance (ANCOVA) to look for any noteworthy variations in the designated dependent variables between the groups before and following the training session. A significance level of 0.05 was used for testing in all cases.

Results

The results of the analysis of covariance on the pre and post-tests were collated and are shown in tables.

Table 1: Analysis of co-variance of the pre-test and test means of the yoga practice and control group in total testosterone

Group	Yoga	Control	Source of variance	Sum of squares	DF	Mean square	'F' Ratio
Pre Test Mean	73.88	74.36	Between	1.733	1	1.733	0.396
SD	2.10	2.08	Within	122.777	28	4.385	
Post-test Mean	70.89	76.52	Between	237.952	1	237.952	52.96*
SD	2.04	2.22	Within	125.804	28	4.493	
Adjusted Post-test mean	74.12	73.70	Between	198.047	1	198.047	42.37*
			Within	110.483	28	4.056	

*Significant at 0.05 level of confidence

It is inferred from Table 1 results that the pre-test mean score on Yoga practice is 73.88, control group is 74.36. Therefore, it is inferred that the obtained calculated 'F' value is 0.396 for the Pre-Test mean score. Therefore the framed research hypothesis is rejected. It is inferred that there is no significant difference between the pre-test means of the total testosterone. However, the Post-test mean score on Yoga practices is 70.89 and the control group is 76.52. Therefore, it is evident that the obtained 'F' value is 52.96 for the Post-Test mean score. Therefore the framed research hypothesis is accepted. Further, the above table taking into consideration of the adjusted post-test mean score on Yoga practice is 74.12, control group is 73.70. Therefore, it is evident that the calculated 'F' value is 42.37. Therefore the framed research hypothesis is accepted. It is inferred that there is a significant difference between the adjusted post-test means of the total testosterone.

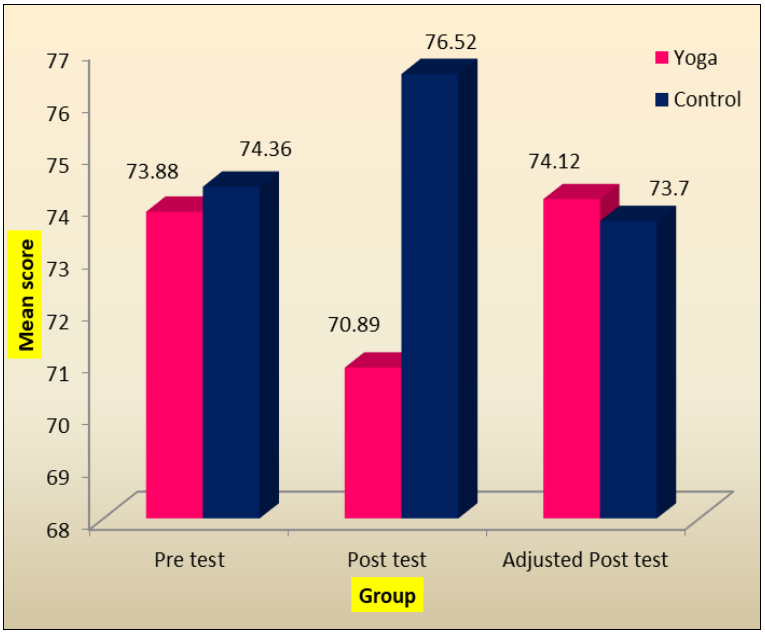

Fig 1: Difference between the adjusted post-test means of the total testosterone

Discussion

A significant etiology behind PCOS is believed to be the imbalance in the hypothalamic-pituitary-ovarian axis. Women with PCOS often exhibit abnormally high levels of GnRH pulse, LH pulse frequency, and amplitude, with hypothalamic GnRH neurons functioning as a central

regulator of LH synthesis. This dysregulation promotes hyperandrogenemia, ovarian dysfunction, and metabolic disorders in PCOS women by enhancing androgen synthesis in ovarian theca cells. Moreover, GnRH neurons contribute to the aberrant neuronal-reproductive-metabolic circuits that underlie the pathogenesis of PCOS. Insights into the central control of GnRH neurons via the gut-brain axis, mediated by the gut microenvironment, offer novel perspectives on the pathophysiology and therapy of PCOS.

Androgens are known to regulate the HPA axis by activating androgen receptors (ARs). They can also influence the HPA axis by reducing estrogenic metabolites, which bind estrogen receptors in the brain and periphery. Androgens exert various neurobiological effects, including modulation of hypothalamus function. These activities are partially mediated by androgenic modulation of the hypothalamic/pituitary-adrenal (HPA) and hypothalamic/ pituitary-gonadal axis, influencing critical neurobiological processes such as autonomic and neuroendocrine function, eating and metabolism, stress-related behaviors, and reproductive behaviors.

Nadi shodhana pranayama reduces breathing by stimulating the olfactory nerves located in the roof of the nasal cavity. This stimulation is transmitted to the olfactory bulbs near the cribriform plate, connecting to the frontal brain regions, which are in turn linked to the hypothalamus.

Bhramari pranayama stimulates the vagus nerves and activates the parasympathetic nervous system. The vagus nerves, which are the longest pair of cranial nerves (CNXs) and part of the parasympathetic nervous system, play crucial roles in regulating heart rate, breath rate and depth, and digestive tract function. Stimulating the vagus nerves through humming, singing, chanting, and other means activates the rest, digest, and restore aspects of the autonomic nervous system.

Bhramari pranayama (Bhr. P) is a pranayama technique accessible to everyone, with no evidence of varied physiological consequences in the current era of advancing scientific discoveries in yoga. The term "Bhramari" originates from Sanskrit, meaning "wasp" reflecting the humming sound produced during expiration, resembling a flying wasp. The parasympathetic dominance induced by Bhr. P affects blood pressure and heart rate in healthy individuals immediately after five minutes of practice. They are following Bhr. P practice, individual's exhibit a high-frequency paroxysmal gamma wave pattern associated with high-level cognitive function and perceptual tasks. However, further research on the effects of Bhr. P is warranted.

Conclusion

The study focused on examining the effects of pranayama techniques on hormonal well-being and total testosterone levels in women diagnosed with polycystic ovary syndrome (PCOS).

To encapsulate, the practice of yoga contributes to the improvement reduction in the severity of PCOS by reducing levels of testosterone and free T, reducing the severity of hirsutism, norming menstrual cycles, and increasing insulin sensitivity, thus, a complex and common lifestyle disease such as PCOS and other systematic disorders associated with it is best managed by yoga a mind-body energy medicine technique and it is a profound science that unravels and unlocks the internal pharmacy.

This leads the hypothalamus to receive disordered information, resulting in hypothalamic pituitary adrenal dysfunction. The controlled breathing pattern of Nadi Shodhana Pranayama regulates the HPA axis

Overall, these findings suggest that the modified Pranayama techniques, specifically designed for individuals with PCOS, were successful in improving Hormonal well-being and reducing Total Testosterone. By addressing both the psychological and physiological aspects of the condition, these interventions hold promise as complementary approaches to managing PCOS.

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