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"The Impact of Various Yoga Asanas on anthropometric measurements and Respiratory Efficiency in Young overweight and obese Volunteers"

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ABSTRACT:

Background: Numerous chronic illnesses and lifestyle problems pose a hazard to human health. It was shown that stress and an unhealthy lifestyle were important contributors to all of these disorders, especially obesity. Breathing patterns can be affected by pressure, sleep deprivation, and overwork. Through yoga therapy's comprehensive, holistic approach, one may overcome a variety of life's illnesses with a focus on body and mind cleansing. Therefore, the current investigation was done to determine how yoga therapy may help obese people.

Materials and Methods: The study took place at the Department of Physiology, Index Medical College, which is part of the Faculty of Medicine and Health Sciences at Malwanchal University. 150 overweight or obese individuals of 18-30 years of age were recruited for the study. The study subjects was segmented into yoga group (n=75) received yoga therapy for 10 weeks with routine lifestyle and diet, and control group (n=75). They were assessed on the bases of their parameters on the day one and after 10 weeks of yoga intervention.

Results: Assessment of the case group (performed yoga) and the control group (didn't perform yoga), revealed a significant reduction in mean value of body weight, BMI, WC, HC and WHR in yoga group after 10 weeks. Additionally Yoga group also showed significant increases in Tidal volume, Inspiratory Reserve Volume, ERV, Forced vital capacity and breath holding time and significant decline in respiratory rate.

Conclusion: Yoga therapy offers significant benefits in maintaining overall health by regulating BMI, enhancing respiratory efficiency, and improving biochemical roles of the body. It proves to be particularly useful in overcoming the complications associated with obesity. Moreover, yoga can be advocated as an alternative therapy for respiratory diseases.

Key words: Yoga therapy, BMI, Respiratory efficiency

INTRODUCTION

The most common challenging risk factor in modern sedentary civilization is obesity. Obesity is a multifaceted syndrome in modern era, which has arisen as one of the widespread lifestyle disorders especially for the urban society. An increased body mass index leads to obesity and it is the fifth leading risk for death worldwide. The various disease mainly cardiovascular diseases (CVD), Type II DM, Osteoarthritis, Obstructive Sleep Apnea (OSP), different cancer types, etc are associated with excessive body weight[1,2]. Adipocyte hypertrophy and hyperplasia, stress, and inflammation within the adipose tissue are all symptoms of obesity, which is characterized as an excessive accumulation of fat as a result of positive energy balance, which results from energy intake exceeding energy expenditure[3]. In India, 30-65% population is overweight or obese. As per the epidemiological data, young peoples are more susceptible towards overweight and obesity and are also at risk for number of lifestyle disorders which is estimated to increase every year in south Asia including India[4,5,6]. Impaired health and the risk of morbidity from several pathologies may increase due to obesity[2]. Research on the connections between obesity and other chronic disorders is being carried out and is helping to develop strategies for the prevention and treatment of overweight and obesity[7].

Pulmonary functions are indicative of the respiratory efficiency, exercise capacity and reflect the health condition of the individual. In the recent times, health care students had and will continue to face the risk of exposure to Covid infection, which affects the lungs primarily, thus making the assessment of pulmonary functions very much needed in the present scenario. Pulmonary function tests (PFTs) serve as a valuable tool for health assessment and can also act as a predictor of survival rates to some extent. PFTs are influenced by lifestyle factors such as regular exercise and non-exercise activities. They offer both qualitative and quantitative assessments of pulmonary function in patients with obstructive and restrictive lung diseases. These tests typically describe lung volumes and capacities. It's widely recognized that pulmonary function may vary based on physical characteristics such as age, height, body weight, and altitude. In assessing lung function, basic measurements include volume, flow, pressure, and chemical analysis of respired gas under various circumstances. Modern equipment integrates sensors into semi or fully automated devices, making them relatively easy to use and providing processed results online or with minimal delay. Traditional methods typically measured these attributes directly but were slower and often required manipulative skill. Nevertheless, with proper setup by dedicated and trained personnel, traditional methods could yield accurate results[10]. Spirometers are utilized to measure vital capacity, dynamic lung volumes, and flows, as well as total lung capacity and its subdivisions[11]. Modern spirometers which are PC based combine the features of speed, accuracy etc and can be used in a variety of research settings. Spirometry plays a pivotal role in screening, diagnosing, and monitoring respiratory diseases, and its use is increasingly advocated in primary care practice[12]. The existing study aimed to access valuable properties of various yoga assanas on anthropometric parameters and pulmonary function test.

MATERIALS AND METHODS:

Study setting & participants: This study took place in the department of Physiology, Index Medical College under Faculty of Medicine and Health Science Malwanchal University. The institutional ethical committee granted ethical approval. Every subject was given enough time to read the information page, and any questions they had were addressed. Each participant completed an informed consent form after being fully briefed about the study's intervention and evaluations.

Recruitment and sampling: Based on the criteria for inclusion and exclusion, 150 overweight or obese participants were included in it observational case control research. 75 people participated in a ten-week yoga program that included standard yoga poses under the supervision of a yoga instructor, while the remaining 75 people acted as the control group.

Inclusion and exclusion criteria: The inclusion criteria were the participants' age range of 18 to 30 years, gender, and status as overweight or obese (BMI of ≥25.0 kg/m2). Subjects with acute diseases (such as appendicitis, influenza, etc.), recent trauma and injury, cardiovascular illness, and women who were menstruating, pregnant, or nursing were among the exclusion criteria.

Study Design: In this investigation, a single group pre-post study design was used. Every participant in the yoga group who was recruited received a five-minute Sharir Sanchalan session. After that, for a total of thirty minutes, a variety of asanas were practiced, including Ardha Paschimottan asana, Chakrasana, Bhujangasana, Sarvangasana, Matsyasana, Dhanurasana, and Padmasana. After that, there was a 20-minute Pranayam session that included Kapal Bhati, Bhastrika, Right Nostril Breathing, Alternate Nostril Breathing, and a 5-minute meditation period.

All the parameters were recorded and analyzed at the beginning of their course and after 10 weeks of the regular pranayama practice. They were carefully examined to look the changes in anthropometric parameters (weight, BMI, WC, HC, WHR) and respiratory parameters (Respiratory Rate, Tidal Volume, Forced Vital Capacity and Breath-Holding Time).

Methodology:

Anthropometric measurement: BMI was assessed by dividing weight in kilogram by height in square meter. Height was measured without shoes in a standing position with relaxed shoulders and arms hanging freely using a fixed Stadiometer. The weight of each subject was measured to the nearest 0.1 kilograms using an Omron digital body weighing scale (HN-283 model), calibrated from 0 to 120 kg. Waist circumference was measured at a halfway point horizontally between the lower edge of the ribs and the top of the hip bone. Hip circumference was measured at the point of maximum hip prominence.

Respiratory Parameters: In the clinical setting, respiratory rate (breaths per minute) was assessed through visual inspection. The subject was instructed to lie supine in the examination room, with the chest and abdomen exposed. Breathing frequency was observed by monitoring the movement of the abdominal wall from the foot end position for one minute. The final measurement was determined by averaging three readings obtained at five-minute intervals.

Tidal volume represents the amount of air exchanged during normal breathing. Forced vital capacity (FVC) was measured using the computerized spirometer RMS Medispiror Helios 702. Before the actual recording, all subjects were familiarized with the spirometer. The procedure for FVC recording was explained to the subjects, who were then asked to practice it. Once they were comfortable with the procedure, subjects began by breathing normally. They were instructed to inhale deeply, exhale forcefully and rapidly through the mouthpiece attached to the transducer until no more air could be exhaled, and then to inhale deeply again while keeping the mouthpiece in place until their lungs were fully inflated. A tight seal was ensured between the lips and the mouthpiece of the spirometer, and a nose clip was applied to seal the nostrils. Three readings were taken, and the highest reading was selected as the final result. Breath-holding time was measured in seconds from the moment of holding the breath after a quiet expiration until the subject voluntarily released the breath, using a stopwatch. Subjects were seated comfortably and asked to hold their breath by pinching their nose closed with their thumb and index finger, while keeping their mouth closed.

STATISTICAL ANALYSIS:

Dependent sample t-test was taken to examine differences in typical quantitative variables between each measurement period, that is, before and after the yoga intervention. The Impaired T-test was taken to inspect the alterations for all normal quantitative variables between the yoga and control groups. For all parameters, the mean ± standard deviation was employed. P-values were considered statistically significant if they were less than.05.

RESULTS:

A total of 150 overweight or obese subjects belonging to two groups (Group I who performed 10 weeks yoga, N=75; Group II who didn't performed yoga, N=75) were recruited to the study. After 10 weeks of yoga intervention 62 subjects in group I and 69 subjects in Group II completed study. Although there were differences in some baseline characteristics, these differences did not reach statistical significance. Hence evaluation and comparison were made between 62 subjects of yoga group and 69 subjects of control group at baseline and after 10 weeks of yoga program. Yoga group showed significant decline in mean value of weight, BMI, WC, HC and WHR after 10 weeks of yoga intervention but no significant change was seen in control group. Comparison between yoga and control group after 10 weeks showed significantly deduction in mean values of weight, BMI and SBP in yoga group (Table 1). Significant improvement was also seen in pulmonary parameters in yoga group after 10 weeks. After comparison with control group insignificant changes were seen in yoga group after 10 weeks (Table 2).

Table 1: Comparison of mean values of Anthropometric parameters of Yoga and control at baseline, after 10 weeks in over weight subjects.

Study Subjects	**Parameters**	**Baseline Mean ± SD**	**After 10 weeks Mean ± SD**	***Paired t Test (P value)***
Case	Weight (Kg)	73.6±7.7	68.5±7.1	*.000*

(N=62)				
Control (N=69)		72.1±7.9	72.4±7.7	*.175*
Unpaired t test (P value)		*.248*	*.003*	
Case (N=62)	BMI (Kg/m^2)	27.1± 1.4	25.2±1.3	*.000*
Control (N=69)		26.7±1.6	26.8±1.6	*.153*
Unpaired t test (P value)		*.192*	*.000*	
Case (N=62)	Waist Circumference (cm)	94.2±6.8	90.7±6.4	*.000*
Control (N=69)		92.9±6.1	92.9±6.4	*.844*
Unpaired t test (P value)		*.249*	*.050*	
Case (N=62)	Hip Circumference (cm)	103.0±7.3	100.6±7.4	*.000*
Control (N=69)		102.7±7.4	101.9±8.2	*.297*
Unpaired t test (P value)		*.872*	*.327*	
Case (N=62)	Waist Hip Ratio	.9±.6	.9±.05	*.044*
Control (N=69)		.9±06	.9±.06	*.879*
Unpaired t test (P value)		*.058*	*.354*	

"P> 0.05 # not significant, P< 0.05* significant, P<0.001&P < 0.0001*** highly significant"**

Table 2: Comparison of mean values of cardiovascular and respiratory parameters of Yoga and control at baseline, after 10 weeks in over weight subjects.

Study Subjects	**Parameters**	**<u>Baseline</u> Mean ± SD**	**<u>After 10 weeks</u> Mean ± SD**	***Paired t Test (P value)***

Case (N=62)	Respiratory Rate	17.2±2.2	15.4±2.1	*.000*
Control (N=69)		15.2±2.2	15.5±2.3	*.058*
Unpaired t test (P value)		*.000*	*734*	
Case (N=62)	Tidal Volume	489.1±13.0	502.9±21.4	*.000*
Control (N=69)		490.3±13.54	492.1±14.8	*.015*
Unpaired t test (P value)		*.609*	*.001*	
Case (N=62)	***IRV***	2913.1±245.4	3019.6±244.7	.000
Control (N=69)		2914.2±279.1	2918.0±279.5	.860
Unpaired t test (P value)		*.981*	*.025*	
Case (N=62)	***ERV***	826.1±58.6	852.9±61.6	.000
Control (N=69)		829.1±67.3	832.0±67.6	.082
Unpaired t test (P value)		*.781*	*.050*	
Case (N=62)	***FVC***	4228.4±274.5	4375.5±269.2	.000
Control (N=69)		4233.6±306.7	4242.2±318.6	.694
Unpaired t test (P value)		*.916*	*.009*	
Case (N=62)	***BHT***	33.5±2.8	35.9±2.5	.000
Control (N=69)		33.9±2.8	33.9±2.9	.835
Unpaired t test (P value)		*.404*	*.000*	

"P> 0.05 # not significant, P< 0.05* significant, P<0.001&P < 0.0001*** highly significant"**

DISCUSSION

Obesity is linked to diabetes, high BP, CVD, and insulin resistance syndrome. The study suggests that integrated approach of yoga effectively reduces BMI, WC, and HC in obese patients, highlighting its positive impact due to key features[13]. A person's body mass index (BMI) may be used to determine how fat (obesity) or skinny they are, which is helpful when talking about issues related to being overweight and underweight[14]. Obesity with a BMI of more than thirty has been shown to shorten life by two to four years, whereas extreme obesity with a BMI of more than forty shortens life by ten years[15,16]. Our research demonstrated the positive impact of yoga practice on participants' BMI who were overweight. Following ten weeks of yoga practice, the mean body weight of the yoga group decreased significantly from 73.6±7.7 to 68.5±7.1 and the BMI from 27.1±1.4 to 25.2±1.3.

Those who did not practice yoga did not exhibit this notable difference. After ten weeks, there was a substantial decrease in body weight ($p<0.05$) and BMI ($p<0.001$) in the yoga group as compared to the control group. It can be because doing yoga has reduced the amount of fat that has accumulated. Our study's considerable reduction in weight and Body mass index is consistent with other studies suggesting that a yoga program may be effective to reduce BMI, WC, and HC. [17,18]. Additionally, Chauhan et al. demonstrated a noteworthy drop in body mass index (BMI) within a month of practicing yoga poses, indicating that the benefits of yoga practice may extend to the prevention of obesity-related diseases[19]. A reduction in the amount of fat that has collected in adipose tissues may be the cause of the weight loss. Following a month of yoga, Sucheta Kumari N's study also exposed a noteworthy diminution in weight ($p=0.020$) and BMI ($p=.000$)[1]. Study by Gadham et. al., also found statistically substantial drop in BMI after three months of yoga practice[20]. Consistent with our research, other study has also reported BMI and body weight reductions following a six days of yoga program, respectively[17]. By lowering fat deposits on adipose tissue, yoga might help maintain long-term health and control bodily processes, which may lessen the difficulties associated with obesity.

It has been shown that doing 12 weeks of Hatha yoga reduces the body's total fat content, which causes significant weight reduction and increases bone density. It therefore contributes to the management of adult obesity. The results of a study show that patients who practice yoga reduce their body weight overall. Bending both forward and backward increases trunk activity, which in turn decreases the superfluous fat deposition in the suprailiac region. Reductions in the suprailiac area lead to a considerable drop in waist and hip circumference[21].

Our study also showed statistically noteworthy lessening in waist circumference, hip circumference and waist hip ratio from baseline values of 94.2±6.8 to 90.7±6.4 ($p=.000$), 103.0±7.3 to 100.6±7.4 ($p=.000$) and .91±.06 to 9±.05 ($p=.044$) after 10 weeks respectively (Table No 1). When the waist circumference and waist hip ratio of the yoga group and control group were compared after 10 weeks, marginal significant decline ($p=0.05$) in mean value of waist circumference and insignificant decline in waist hip ratio were observed in yoga group. Another study also saw substantial reductions in WC, HC, WHR with weight loss. According to this study, yoga can help reduce obesity-related metabolic and cardiovascular issues[22]. Similar to

our current investigation, another study by Shetty et al. showed a substantial decrease in body weight, BMI, WC, and HC following a three-month yoga intervention. In contrast to our findings, this study found no difference in the ratio of fat accumulated peripherally (HC) to fat deposited centrally (WC) inside the belly following yoga training[23]. Hussey et. al showed the inverse relation between body composition and fitness and vigorous activity[24]. Robert ross et. al told that daily physical activity leads to weight loss by reducing abdominal obesity and insulin resistance [25]. According to research by Malhotra et al., yoga poses are beneficial for people with diabetes mellitus. This is demonstrated by the significant decrease in insulin levels and waist-hip ratios, which supports the beneficial effects of yoga poses on glucose utilization and fat reorganization[26]. Yoga forces isometric contraction and stretching of the muscles, which boosts protein synthesis and enhances muscle flexibility and strength. Muscular hypertrophy is the product of both isometric contraction and flexibility. By decreasing vascular tone in the muscles, stimulation of parasympathetic activity improves muscular blood flow and, as a result, strengthens the muscles of the lower limbs. According to study yoga is a physical exercise that strengthens the body, increases stamina, burns calories, and aids in weight loss. Sweating speeds up metabolism and burns fat[27].

In Our study we found significant decrease ($p<.001$) in respiratory rate (from 17.2±2.2 to 15.4±2.1) and significant elevation ($p>.001$) in TV (from 489.1±13.0 to 502.9±21.4), IRV (from 2913.1±245.4 to 3019.6±244.7), ERV (from 826.1±58.6 to 852.9±61.6), FVC (from 4228.4±274.5 to 4375.5±269.2) and BHT (from 33.5±2.8 to 35.9±2.5) after 10 weeks of yoga practice. No significant change was seen in control group. When yoga group was compared with control group significant elevation was seen in tidal volume ($p=.001$), inspiratory reserve volume ($p=.025$), expiratory reserve volume ($p=.050$ marginal significant), Forced Vital Capacity ($p=.009$) and Breath holding time ($p=.000$) (Table 2). As it has been already stated that Yoga is an excellent form of exercise for preserving good health and has a significant impact on a person's ability to breathe. It is claimed that practicing yoga can prevent, regulate, and treat a variety of respiratory conditions. Yoga breathing techniques enhance lung and thoracic compliance, airway resistance, and respiratory muscle strength. Several researchers, conducted studies on the impact of yoga breathing exercise on pulmonary or ventilatory functions[28-32]. Their findings showed that, after practicing yoga breathing, Forced vital capacity (FVC) and forced expiratory volume in one second (FEV1) showed significant improvements, while tidal volume (TV) and the percentage of forced expiratory volume in one second (%FEV1) did not exhibit significant changes.

Study of Banstola D et al found Tidal volume to be drop down after breathing exercises which was statistically insignificant. Expiration occurs passively during silent breathing as a result of lung recoil and inspiratory muscle relaxation. The thoracic cage grows when the inspiratory muscles are contracted, but it returns to its initial size when the inspiratory muscles are relaxed. That is sufficient to create positive lung pressure and evacuate the typical tidal volume. Tidal volume is measured by a respirometer and varies with each breath. As similar with our findings, Banstola study found significant increment in IRV, ERV and FVC[33].

To sustain IRV and inspiratory capability, the accessory breathing muscles must be used. These forced breathing methods need the inspiratory muscles to be strong. To inhale the IRV these muscles must work to the fullest extent of their abilities. The improvement in inspiratory reserve volume and inspiratory capacity after yoga breathing training may be attributed to improved usage of inspiratory muscles. Similarly to release the expiratory reserve volume, the expiratory muscles have to be employed to the fullest extent possible. Abdominal muscles are vital in increasing the expiratory pressure during strong expiration. The increase in expiratory reserve capacity may be indirectly caused by decreased airway resistance. Vital capacity is influenced by the pleura and thoracic structures' integrity, airway resistance, lung and chest wall compliance, and respiratory muscle strength. Vital capacity and forced vital capacity have increased as a result of yoga breathing exercises. This may be attributed to improved respiratory muscle activation, increased mobility and compliance of the structures in the chest wall, or a reduction in airway resistance after a yoga breathing exercise. Hence According to several experts, the benefits of yoga treatment include enhanced pulmonary function, relaxed muscles, and reduced anxiety. The results of this study suggested that yoga breathing exercises increase ventilatory function, suggesting that they may be a more effective treatment approach. Chouragade et al[34] in his study scheduled 90 minutes yoga daily for two months and found significant fall in respiratory rate and heart rate whereas significant rise in IRV, ERV and FVC. Another study of Akhani et al[35] also found significant rise in FVC after 4 weeks of yoga. The bulbopontine complex adjusts to a new breathing pattern that is slower than basal breathing due to pranayamic breathing, which is caused by prolonged inspiration and expiration. The respiratory rate decline is likely due to hypocapnea on the medullary respiratory center and persistent voluntary breathing, which inhibits rhythmic spontaneous breathing[36,37] .

The study's beneficial increase in mean value of forced expiratory volume may be the result of regular pranayamic breathing practice, which strengthens the respiratory muscles by allowing the chest and lungs to expand and contract to their greatest capacity[38]. Lung compliance is increased as a result of the physiological stimulation caused by such extreme inflation and deflation, which secretes prostaglandins and surfactants in the alveoli. Because stretch receptors are stimulated, there is a reflexive decrease in the smooth muscle tone of the airways. This results in an increase in airway width and a decrease in airflow resistance, which improves the dynamic pulmonary function tests[39,40] . Line with our finding one study noticed that, significant increases in IRV and ERV values in subjects of 12-15 age groups by six months yoga intervention[38] . It is believed that the primary breathing practice in yoga that increases breath holding time is pranayama. The explanation for this is a change in autonomic nervous system regulation towards the parasympathetic side. The lengthy effort required for yogic breathing to regulate the respiratory muscles results in an extended breath holding period since the person is deliberately and consistently overcoming the normal respiratory center inputs[36] .

Yoga practice significantly impacts mood, behavior, and mental health. It improves focus, relaxation, and mental clarity, reduces anxiety, tension, and related symptoms, and promotes mental comprehensibility and peace when combined with pranayama, meditation, and yoga.

Regular yoga practice boosts mindfulness, self-awareness, harmony, concentration, and happiness, promoting overall well-being and gratitude.

CONCLUSION:

The higher IRV and ERV following yoga exercises suggest that practicing yoga strengthens both the inspiratory and expiratory muscles. The Kapalbhati incorporates forceful exhale strokes that teach participants to fully utilize their abdomen and diaphragm muscles. These are known as expiratory strokes. The breathing exercises of Pranayama, which involve slow, deep, and complete inspiration and expiration, strengthen and train the respiratory muscles. To sum up, breathing exercises based on yoga are doable and can enhance lung function. It appears to improve the effectiveness of breathing.

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