

# JOY: The Journal of Yoga

## EFFECT OF PRANAYAMA ON SELECTED RESPIRATORY INDICES AND BODY COMPOSITION

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(April-2010)

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### ABSTRACT

The word yoga is derived from a Sanskrit word “yuj” meaning to join. Yoga involves an integration of visceral cleansing techniques (shat-kriyas), physical conditioning by practice of certain body postures (asanas) and breathing exercises (pranayama) and meditation. Pranayama is a form of breathing exercise, very important in yoga. It goes along with the Asanas or exercise. Several studies have shown beneficial effect of yoga as a holistic approach on body composition, anthropometric measurement and respiratory indices. However, few studies have been done to show whether pranayama in isolation or yoga as a holistic approach has an effect on respiratory indices and anthropometric measurement. Therefore the present study was undertaken using 85 subjects (n= 21 in yoga and n=64 in pranayama group) for 3 months. The subjects were assessed for respiratory indices and anthropometric measurement. The intervention study of 3 months showed a significant increase in peak expiratory flow rate in both the groups of yoga and pranayama. Although non-significant, as compared to pranayama group, there was a prominent increase in aerobic capacity and a trend of improvement in anthropometric measurement in yoga group. Due to major error committed during skin fold measurement the body fat percentage calculated was wrong and could not be utilized for the study result. With practice of pranayama, there was improvement in lung function capacity in comparison to yoga as a holistic approach. Therefore further research is required to study the same with large sample size and longer duration intervention.

Key words: yoga, pranayama, body composition, aerobic capacity, lung function test.

## **INTRODUCTION**

The incidence of diseases world over is on increase. It is exacerbated by various factors like sedentary life style, faulty dietary pattern, tremendous mental pressure and environment which lead to an increase prevalence of different types of chronic diseases like cardiovascular diseases, diabetes mellitus, cancer, asthma, chronic obstructive pulmonary disease, metabolic syndrome etc,. Of the 58 million people who died in 2005, 38 million were estimated to have died due to chronic disease alone (WHO, 2005).

Presently, disease management strategy includes pharmacological therapy. Initially this therapy is helpful in management of the disease, but later on there is increase in financial burden, morbidity and mortality (Sabena's and Mandarins; 2009); hence the use of alternative and complementary therapy has been on rise in recent times.

Yoga and pranayama is one such complementary therapy. With increased awareness and interest in health and natural remedies, yogic techniques including pranayama are gaining importance and becoming increasingly acceptable to the scientific community (Subhalakshmi et.al, 2005) It has shown beneficial effects in the various lifestyle related problems such as hypertension (Joseph et al, 2005) ; diabetes mellitus (Sahay, 2007) ; Asthma (Morse, 2007) ; premenstrual syndrome(Frackiewicz and Shiohipz,2001); Stress(Damodar et al, 2002) , anxiety(Gupta et al,2006).

Yoga, originated in India thousands years ago, is a method of learning that aims to attain the unity of mind, body, and spirit through three main Yoga structures: exercise, breathing, and meditation (Halvorson, 2002).

The word 'Yoga' comes from the Sanskrit word 'YUJ' which means to join. Yoga is a science of life to develop the sixth sense to its fullest and to enable and equip man to enjoy a peaceful and blissful life. 'Yoga is skill in action' states the Bhagvad gita. (Krishnan and Sripriya; 2003). It is a philosophy that connects the body, breath and mind to energize and balance the whole person

i.e. physical postures, breathing exercises and meditation to improve overall well being.  
(Wikipedia.com; Ghanavirut et.al, 2006).

The practice of yoga uses eight methods known as “limbs”: Yama (restraint),niyama(observance),asana(postures),pranayama(breathe control), pratyahara (sensory withdrawal), dharana (concentration),dhyana(meditation),& Samadhi(higher consciousness) (Dayaberto et.al)

Pranayama’ is the fourth stage in Patanjali’s eight stage of yoga discipline. Two Sanskrit words are combined in the word ‘Pranayama’- Prana and ayama. ‘Prana’ means life or life force. ‘Ayama’ means development or control. Therefore Pranayama is the development and control of life force.

Pranayama literally means control of Prana. Prana, in Indian philosophy, refers to all forms of energy in the universe. Life force is one part of this energy. Life force in an individual is symbolized by breathing. That is why pranayama is generally considered to mean regulated breathing. (Subbalakshmi et al, 2005)

Fable has it that the fish will be the last to discover that it can survive only in water. This discovery will be made too late, as the fish lies dying, having jumped out of the stream onto the dry earth. At times it would appear that man has made the same mistake about his physical environment, discovering its all embracing properties, only when it is almost too late to act upon that knowledge.

As the person starts aging; there are changes in lung function like;

- Diaphragm and respiratory muscles weaken
- Decreased chest compliance
- Stiffening of the chest wall
- Decreased elastic recoil
- Decreased airway size
- Decreased diffusion

- Decreased exercise tolerance
- Decreased response to hypoxia and hypercapnia
- Decrease in mucociliary transport
- Cumulative toxic exposure
- Decrease immune response

Also, increasing atmospheric pollution is responsible for various respiratory illnesses.

Pranayama, an important aspect of Yoga, helps in strengthening the immune system, so chronic infections are less likely to occur. Regular practice of Pranayama helps in improving the mechanical efficiency of our breathing and makes the most of our lung capacity. Yoga has been proved to have a beneficial effect in treating respiratory illnesses. But very few studies have been reported on effect of pranayama (alone) on respiratory functioning.

Therefore the present study has been undertaken with following objectives:-

1. To assess the effect of practicing only pranayama as compare to pranayama and yogic exercise as a whole on selected respiratory indices in middle aged and elderly people.
2. To study the effect of pranayama as compare to pranayama and yogic exercise on body composition in middle aged and elderly people.

## **METHODOLOGY**

Yoga is a holistic practice for the wellbeing of mind, body and soul. It has different components like Asanas, Pranayam etc. This traditional means of achieving wellness –Yoga with all its components are believed to be interlinked and do not work in isolation. Pranayam is a part of Yoga that mainly focuses on respiratory wellbeing.

The research question in the present study is whether the practice of Pranayam can work in isolation as well.

Adult People from either sex, living sedentary life style, were approached for possible enrolment in the study and an informed consent form was distributed. Those who were willing to participate and were ready to adhere to the experimental protocol signed the form and were enrolled for the three month intervention study, depending on following inclusion –exclusion criteria.

Inclusion criteria	Exclusion criteria
<ul style="list-style-type: none"> <li>• Age group – 30-80 years willing to participate voluntarily and adhere to the study criteria.</li> <li>• Those who have never practiced yoga or pranayama.</li> </ul>	<ul style="list-style-type: none"> <li>• Any form of major illness or chronic ailments, surgery, major cardiac problems except hypertension; affecting their day to day life activity.</li> <li>• Individuals involved in any form of organized physical activity (gym, health clubs...)</li> <li>• Pregnant and lactating women.</li> <li>• Those who have practiced yoga or pranayama before.</li> </ul>

Initially, 125 male and female subjects were recruited. Among them, base line data were collected for 95 subjects. Out of the 95 subjects, only 85 subjects reported after the intervention for data collection.

### **Protocol of the study**

Subjects recruited



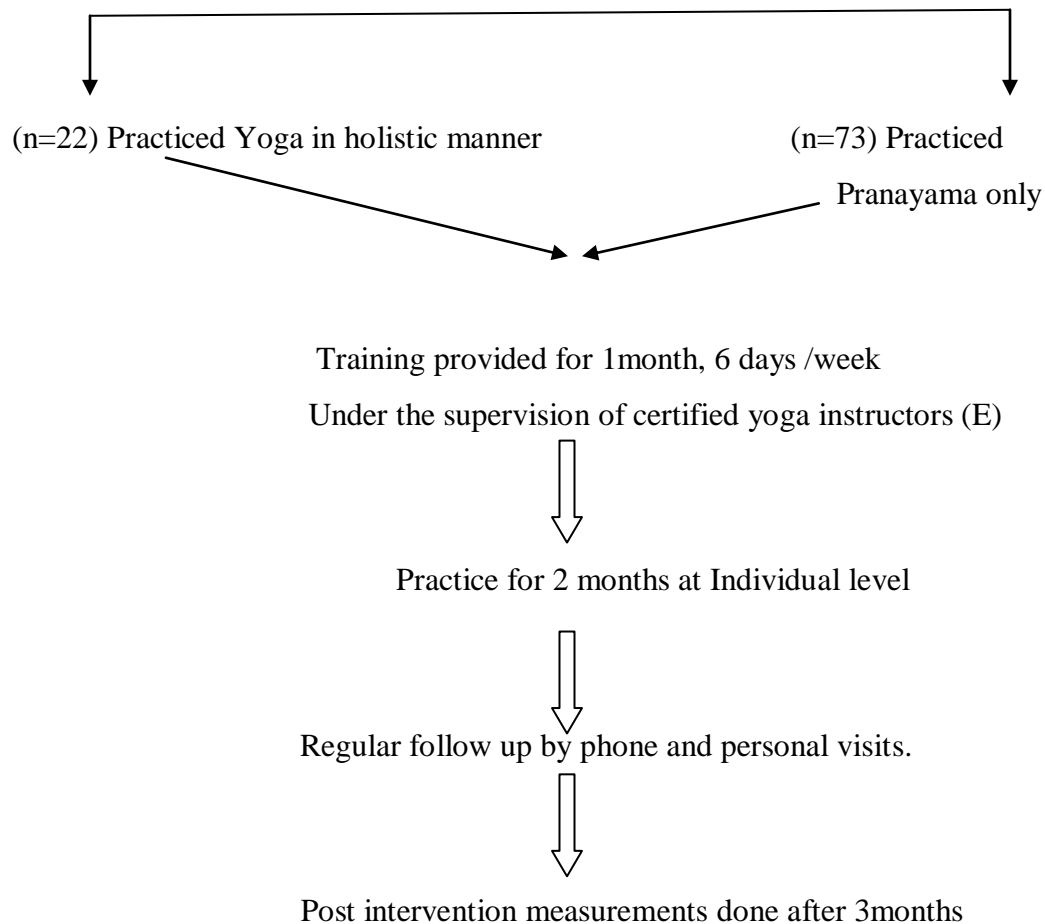
Informed subjects regarding protocol of the study



Measurements for anthropometric measurements, pulmonary functions and skin fold measurements were taken (Baseline data)



Subjects divided into two groups



During the study period, all the subjects were requested to maintain their daily activities as per their routine and no special restrictions were imposed upon them.

Pre and post intervention measurements were taken for the following parameters

- a. Anthropometric measurements: Height, weight, waist circumference, hip circumference.
- b. Skin fold measurements using Herpenden's skin fold caliper to calculate the Body Fat %
- c. Aerobic capacity using 2 minute Knee high spot jog method
- d. Peak expiratory flow rate using peak flow meter
- e. Lung function test using vitalograph spirometer manufactured by vitalograph ltd.
  - Forced vital capacity(FVC)
  - Vital capacity(VC)
  - Forced expiratory volume(FEV)
  - Forced expiratory volume in one second (FEV1%)

- FEV1/FVC

## **RESULTS AND DISCUSSION**

It is generally believed that Yoga works as a holistic approach.

Yoga represents the way of life which endows perfect health- physical, mental, moral and spiritual. Pranayama are yogic breathing techniques that increase the capacity of Lungs; help to strengthen the internal organs, improve mental control and deepen our ability to relax. In the present study, our focus was to assess the effect of pranayama in isolation as compare to Yoga (pranayama + asanas) as a whole, on respiratory indices and body composition.

Out of 85 subjects, 2 subjects in the elderly group (>75 yrs), who had enrolled for the study were taken as case study subjects

### **ANTHROPOMETRIC MEASUREMENT**

Weight, waist circumference, hip circumference were measured and body mass index and waist to hip ratio were calculated from the measured parameter

Paired T test showed a significant improvement in hip circumference by 5.89% in yoga group as compared to pranayama group by 0.57%. Statistically non significant change was seen in WHR in both the study groups. In subjects aged 30-50 years there was an increase by -3.40% in yoga group, whereas in pranayama group in subjects aged 51-75years, 2.22% decrease was seen.

Similarly subjects practiced only pranayam from specific age groups have in fact increased waist line as well as hip circumference. It is definitely indicating that only pranayama; does not have any positive impact on body measurements within 3 months.

Pranayama is a breathing technique which mainly affects respiratory activity hence minor changes are seen in anthropometric measurements with the practice of pranayama in isolation.

BMI of most people among Indian population on an average is 25.89kg/m<sup>2</sup> with SD of 4.60 indicating that they are at a higher risk of developing metabolic diseases like cardiovascular diseases, diabetes mellitus, cancer, metabolic syndrome.

The group who has done the yoga in a holistic manner has shown a positive effect on their body measurements within just three months. It can be seen that the change is more in 'inches' than in 'Kgs', as observed by non-significant loss of body weight but significant loss in Hip circumference. It is also observed that loss in weight is marginally more in elderly group (51-75yrs) than in younger group (30 -50 yrs). Due to small change in weight as well as small reduction in both waist line and hip circumference, BMI and Waist to Hip ratio remain unchanged. But it is encouraging to note that at this matured age with otherwise sedentary life style only yoga could establish a difference within only three months.

Subjects, who were practicing only Pranayama (n=63) for three months has not gain any advantage in body size, either in kgs or in inches (figure 2 and 3). In fact, 2 subjects among age group of >75 years (1 M and 1 F) gained weight although at a non significant level which we have considered as case study subjects.

Thus, a positive effect was seen with the practice of yoga with a holistic approach as compared to pranayama in isolation as far body measurement was concerned, because most of the participants as observed are sedentary workers and housewives and awareness about Yoga as a complementary and alternative treatment is less among these people. Anything that is required to follow regularly needs to be adopted in the lifestyle pattern which is not easy to do. Whenever there is a specific problem, preventive measure Yoga is adopted as therapeutic measure. Hence, complete adherence to the yoga and pranayama practice for experimental requirement is unsure.

Although subjects in pranayama group had a sense of well being and sensed more flexibility in post intervention; long term intervention period is required to bring about changes in weight, BMI, waist and hip circumference.

### **Body composition**

Body composition included the measurement of skin fold thickness (triceps, biceps, subscapular and suprailleiac). Body fat percentage was calculated using body density formula.

Due to a major error committed during the Skinfold measurement, the Body fat % calculation was wrong and could not be utilized for the study result.

In pranayam group, there is non significant increase in body fat % in the males between the ages of 30-39 and 40-49 years. However, it was decreased in the age group of > 50 years.

In males from yoga group, the body fat % was increased in the age group of 30-39; however it was decreased in 40-49 years.



In the female pranayam group it was observed that the body fat % was decrease between the age group of 30-39 year, while it was increased in the age group of 40-49 and also in > 50 years.

However, the females from yoga group showed the increase in body fat % among all the age groups. In yoga group though non-significant; a trend of decrease in body fat % was observed, except in males (n=1) in age group of 30-39 yrs increased from 34 to 36.6 whereas in 40-49 yrs male (n=1) showed a decrease in fat % from 49.4 to 46 as compared to females. It was observed that in pranayama group there is not improvement in body fat % as compared to yoga group. This may be due to the errors in the measurements.

Thus, comparing both the group it was seen that yoga as a holistic approach is more effective as there is involvement of whole body as compared to pranayama which mainly involves the respiratory system.

### **Aerobic capacity**

This was assessed using 2 MINUTE STEP TEST (KNEE HIGH SPOT JOG METHOD), an alternate test for aerobic endurance for elderly.

Yoga, a holistic approach can improve all fronts of health. This is clear when we see that with yoga as well as pranayama; there was an increase in aerobic capacity in all age groups.

T test indicated that, although non significant, there was an increase in aerobic capacity of subjects by 25.52% in yoga group (n=21) as compared to 2.48% in pranayama group (n=62). However, significant change (p value= 0.03) was seen in subjects aged 51-75 years (n=7) by 31.33% post intervention of yoga as compared to pranayama. Although studies have shown that with age aerobic capacity decreases; but with the practice of yoga; improvement is observed in middle age group, which implies that yoga as holistic approach can help in improving aerobic capacity in middle aged people.

Yoga involves all body organs as compared to pranayama which involves only respiratory organs, hence showing better improvement in yoga as compared to pranayama.

Thus, it was observed that, practice of yoga as a holistic approach brings about better improvements in aerobic capacity as compared to practice of pranayama in isolation.

### **Peak expiratory flow rate**

This is measured with the help of a PEAK FLOW METER which measures the person's ability to breathe out air, the airflow through the bronchi and thus the degree of obstruction in the airways and the index of lung functions.

The base line value of peak expiratory volume was lower than the ideal value for all the age groups in both groups (pranayama and yoga) as our subjects were from sedentary senior people. . Though non significant, post intervention value improved and ideal value was reached.

There was an overall significant improvement in all 21 subjects practicing yoga by 17.22%. Significant changes were seen for subjects in both age groups of 30-50 years (n=12) and 51-75 years (n=9), by 19.96% and 14.45% respectively, from pre intervention baseline measurements (n=83).

The Peak Expiratory Flow Rate improved significantly following pranayama practice .T test (figure6) revealed a significant increase of 17.66% in 30-50 years (n=33) ( $361.46 \pm 92.67$  to  $425.30 \pm 102.21$ ) whereas, it was non significant for 51-75yrs aged subjects (n=29). However, greater increase of 37.25% was seen in Peak expiratory flow volume of >75 years (n=2), though non significant which were taken as case study subjects.

With studies conducted it is seen that, as person age's there are changes in lung function especially in the elderly like;

- diaphragm and respiratory muscles weaken
  - decreased chest compliance
  - decreased elastic recoil
  - decreased airway size
  - decreased diffusion
  - decreased exercise tolerance
  - decreased response to hypoxia and hypercapnia
  - decrease in mucociliary transport
  - cumulative toxic exposure
  - decreased immune response

But studies show that with breath control (pranayama) there is;

- improved lung capacity
- increased oxygen delivery to muscles
- decreased resting heart rate and the respiratory rate

It is hypothesized that Pranayama is a breathing exercise hence provides training in the efficient use of abdominal and diaphragmatic muscle in breathing. Pranayama requires breath holding which may result in increased parasympathetic control of respiratory control centre.

The mechanism by which changes in respiratory functions occur is due to greater relaxation of respiratory muscles induced by supra spinal mechanisms which increase expiratory reserve volume contributing to a rise in vital capacity.

Hence, although not significant, there are improvements seen in elderly group in spite of having weak respiratory muscles in the subjects as case study. This indicates that there is some degree of bronchi dilatation, which is leading to better oxygenation of the alveoli.

But in contrast, from the present study it was inferred that, yoga as a holistic approach showed more significant improvements than pranayama in isolation.

Therefore, results indicate that as compared to pranayama in isolation, yoga as a holistic approach is beneficial in improving the respiratory capacity even in a short span of 3months intervention. Hence, it can prove useful also for patients with respiratory diseases, as a preventive and curative therapy.

### **Lung functioning capacity**

This is done with the help of using VOLUME-SPIROMETER which is most commonly used for pulmonary function test, measuring lung function specifically the measurement of the amount (volume) and/or speed (flow) of air that can be inhaled and exhaled.

Pre intervention measurements of lung functioning of 31 subjects were done with Spiro meter.

Among these, 18 subjects reported during post intervention measurements for lung functioning test. Following parameters were tested and measured: VC (vital capacity), FVC (forced vital capacity), FEV (forced expiratory volume) , FEV1 sec (forced expiratory volume in 1 sec), FEV% (forced expiratory ratio) .

The absolute volume of forced vital capacity (FVC) is important because it is an index of the state of elastic properties of the respiratory apparatus, whereas the rate at which FEV1 is expelled from the lungs is predominantly a reflection of the flow resistive properties. FEV1 predominantly reflects resistance to air flow in airways that are greater than 2mm in diameter.

A trend of non significant change was seen overall in all the lung functioning capacity in both the groups; yoga (n=21) and pranayama (n=9). On comparing with the T test it was seen that there were individual variations among the age groups.

In pranayama group, there is a trend of improvement among most of the parameters of lung function in all age groups, except in FVC ( $2.16 \pm 0.67$  to 1.88) in the subjects aged 30-50 yrs. There is a decrease in FEV (1sec) by 0.62%. This may be because; the sample size was very small (n=9) and there is a requirement for more intense practices to show a significant improvement.

On the other hand, subjects of yoga group showed a non significant decrease in FEV: FVC ratio by 7% and FEV by 0.23%, while improvement was seen in FEV1 by 0.04%. In the age group of 30-50 years also, subjects showed non significant improvement in all the parameters as compared to middle aged group.

This may be because the efficacy of lung function is better in subjects of young age group (30-50 years) as compared to middle age group (50-75 yrs.) By consistently performing a variety of asanas muscles of the thoracic cavity are constantly being recruited. This recruitment may lead to greater musculature and thereby result in improved FVC (Joshi, et al 1992).

Though changes are reflected; there is inconsistency in the results obtained, since the sample size was very less to conclude a statistically significant relation between yoga and pranayama with lung functioning capacity.

Pranayama is a breathing technique which involves whole respiratory system where as yoga involves all the organs of the body. Improvement in PFT'S in the study is because of reduction of sympathetic reactivity attained with pranayama training. This may allow broncho dilation by correcting the abnormal breathing patterns and reducing the muscle tone of inspiratory and expiratory muscles. Due to improved breathing patterns, respiratory bronchioles may be widened and perfusion of a large number of alveoli can be carried out efficiently.

Hence, it can be said that "Pranayama" breathing may prevent serious cardio respiratory complications by emphasizing optimal physical and mental conditioning, thereby tranquilizing the mind and as a result providing relaxed and stress free state.

Although parameters like FEV (1sec) of lung function cannot be improved with regular pranayama practice at all times since a person cannot forcefully expirate to his/her maximum in 1sec as lung muscle can contract to only a level depending on the age of person.

It can be inferred that pulmonary functions can be improved by encouraging regular practice of pranayama breathing exercises as compared to yoga which can improve lung function capacity, if practiced intensely for a longer duration.

## SUMMARY AND CONCLUSION

Yoga is emerging as an important practical discipline incorporating a wide variety of practices whose goal is the development of a state of mental and physical health, well-being, inner harmony and ultimately “a union of the human individual with the universal and transcendent Existence”.

Therefore, the present study was designed to investigate the effect of pranayama as against yoga as holistic approach on selected respiratory indices and body composition of middle aged group and elderly people (30-80 years). Among 95 subjects only 85 subjects continued with the intervention, and therefore 85 subjects were included in the intervention. Of these, subjects in elderly group (n=2) who enrolled in the study were taken as case study subjects.

The following parameters were observed in the study:

- Anthropometric measurements (weight, height, waist circumference, hip circumference)
- Body fat percentage (Biceps, Triceps, Subscapulla, Suprailliac)
- Aerobic capacity (2 minute knee high spot jog method)
- Lung function capacity by spirometer
  1. Vital capacity (VC)
  2. Forced vital capacity (FVC)
  3. Forced expiratory volume (FEV)
  4. Forced expiratory volume in 1 second(FEV1)
- Peak flow expiratory rate by peak flow meter.

The subjects were required to fill up a questionnaire to obtain background information on several aspects of fitness, lifestyle (their family history, medical history, dietary patterns, and physical activity) and respiratory health.

Pre measurements were taken: Anthropometric measurements (weight, height, waist circumference, hip circumference), Body fat percentage using skin fold thickness, Aerobic capacity (2 minute knee high spot jog method), Lung function capacity using vitalograph

spirometer(VC,FVC,FEV,FEV1sec,FEV/FVC),peak expiratory flow volume using peak flow meter. After this yoga and pranayama training was carried out for a month. Subjects were asked to practice for 2months at individual level and regular follow up on phone and personal visits were observed. Post intervention measurements were done after 3months and the same tests were carried out for comparison between pre and post intervention.

Yogic procedures have shown a positive impact on weight and BMI. Changes were seen more in 'inches' than in 'Kgs', as observed by non-significant loss of body weight but significant loss in Hip circumference. It is also observed that loss in weight was marginally more in elderly group (51-75yrs) than in younger group (30 -50 yrs). BMI and Waist to Hip ratio remain unchanged.

Pranayama is a breathing technique which mainly affects respiratory activity hence minor changes are seen in anthropometric measurements with the practice of pranayama in isolation. Similarly, subjects practiced only pranayam from specific age groups have increased waist line as well as hip circumference. It is definitely indicating that only pranayam ; does not have any positive impact on body measurements within 3 months.

Thus, a positive effect was seen with the practice of yoga with a holistic approach as compared to pranayama in isolation as far body measurements were concerned. Although subjects in pranayama group had a sense of well being and sensed more flexibility in post intervention; long term intervention period is required to bring about changes in weight, BMI, waist and hip circumference.

Due to major error committed during skin fold measurement the body fat percentage calculated was wrong and could not be utilized for the study result.

Yoga, a holistic approach can improve all fronts of health. This is clear when we see that with yoga, there was an increase in aerobic capacity in all age groups. Significant change was seen in subjects in middle aged group 51-75 years post intervention in yoga group as compared to pranayama group. Although studies have shown that with age aerobic capacity decreases; but with the practice of yoga; improvement is observed in middle age group, which implies that yoga as holistic approach can help in improving aerobic capacity in middle aged people.

Yoga involves all body organs as compared to pranayama which involves only respiratory organs, hence showing better improvement in yoga as compared to pranayama.

The base line value of peak expiratory flow rate was lower than the ideal value for all the age groups in both groups (pranayama and yoga).

The Peak Expiratory Flow Rate improved significantly following yoga practice by 17.22% (n=21) as compared to pranayama (n=62) in isolation. Highly significant changes were seen for subjects in both age groups of 30-50 years (n=14) and 51-75 years (n=7) of yoga group, by 19.96% and 14.45% respectively.

However, statistically non significant ; greater improvement by 37.25% was seen in Peak expiratory flow rate of >75 years (n=2), which were taken as case study subjects. This indicates that there is some degree of bronchi dilatation, which is leading to better oxygenation of the alveoli with pranayama.

Therefore, it is indicated that as compared to pranayama in isolation, yoga as a holistic approach is beneficial in improving the peak expiratory flow rate even in a short span of 3months intervention. Hence, it can prove useful also for patients with respiratory diseases, as a preventive and curative therapy.

A trend of non significant change was seen overall in all the lung functioning capacity in both the groups; yoga (n=21) and pranayama (n=9). It was seen that there were individual variations among the age groups. In pranayama group, there is a trend of improvement among most of the parameters of lung function in all age groups, except in FVC. On the other hand, in subjects of yoga group improvement was seen only in FEV1.

Lung function is better in subjects of young age group (30-50 years) as compared to middle age group (50-75 yrs). Though changes are reflected; there is inconsistency in the results obtained, since the sample size (n=18) was very less and there is a requirement for more intense practices to show a significant improvement.

Pranayama are yogic breathing techniques that increase the capacity of lungs, helps to strengthen the internal organs, improve mental control and deepen the ability to relax. According to yogic belief, expectancy is linked to the frequency of respiration; if we can learn to slow down our breathing, we can add years to our lives. Pranyama is a preventive therapy and not a therapeutic measure.

Long term intervention period is required to bring about the effects on respiratory capacity and body composition .Although the findings in this study indicated that pranayama in isolation may help relieve stress, increase stamina, flexibility, develop a sense of well being, but intra individual variation was observed since the actual number of subjects(n=85) were not present at the time of post intervention and the intervention period was 3 months which brought improvement only on certain parameters like peak expiratory flow rate and pulmonary functioning . Yoga as a holistic approach is thus more beneficial than pranayama in isolation.

Also, regular compliance and adherence to practice measures, discrepeation in diet pattern and most importantly sedentary lifestyle and reduced physical activity due to modern living affects the over all well being of individual.

Thus, results of the study further can be studied and correlated to a larger sample size and for a longer duration to have shown more positive effects.



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