Original research article

A Comparative Study of Body Composition and Pulmonary Functions in Young Adults having Conventional Exercises, Yoga and Sedentary Lifestyle

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Abstract

Background & Objective: Overweight and obese young individuals with sedentary life style are at a higher risk for deterioration of their respiratory functions. Participation in regular prolonged physical activity is an important factor that yields sufficient improvements in respiratory indices. The aim of the present study was to assess and compare body composition and pulmonary function parameters in young adults having conventional exercises, yoga and sedentary lifestyle.

Material and Methods: A total of 90 subjects of both genders aged between 18 to 30 years comprising athletes who have been practicing conventional (aerobic) exercises and yogis doing pranayama and yoga asanas for a minimum of 30 minutes6 days a week for at least last 6 months and sedentary individuals were studied. Anthropometric measurementswere taken. They were assessed for body composition(BMI,WHR, body fat Percentage (BF%) , total body water (TBW), lean Body Mass (LBM) and pulmonary function (FVC , FEV1 ,FEV1 / FVC Ratio and PEFR) parameters.

Result: In our study, subjects doing yogic exercises had the lowest weight, BMI and WHR and highest TBW among three groups. Body fat% was found to be significantly lower however, LBM was significantly higher in exercise group. The yoga group had significantly higher FVC, FEV1, FEV1/FVC and PEFR values followed by exercise group.

Conclusion: This is concluded that regular practice of yogic or conventional exercises by virtue of increased energy expenditure leads to significant changes in body composition which improvelung functions.

Keywords: body composition, pulmonary functions, young adults, exercises, yoga and sedentary

Introduction

Improvements in living standards and changes in lifestyle, physical inactivity, sedentary behavior and excessive energy intake have resulted in a rapid increase in overweight and obesity rates among adolescents & adults (1-3).

Weight may have effects on pulmonary functions including small airway dysfunction and expiratory flow limitation, alterations in respiratory mechanics, decreased chest wall and lung compliance, decreased respiratory muscle strength and endurance, decreased pulmonary gas exchange, lower control of breathing, and limitations in exercise capacity (4-6).

Few comparative studies have assessed either pulmonary function tests or body composition on yoga practitioners with a control group of athletes or sedentary subjects or both. So the present study was planned to assess if there is any beneficial effects of regular yogic and conventional exercises on body composition and pulmonary function parameters in healthy young adults and to compare these parameters with individuals living a sedentary life style.

Material and methods

This cross-sectional observational study was conducted in the research lab of department of Physiology, Subharti Medical College, Swami Vivekanand Subharti University Meerut. Before initiation of the study, ethical clearance was obtained from the institutional ethical committee. A total of 90 healthy young adults of both genders aged 18 to 30 years were recruited from University campus, Meerut. Informed written consent was taken from all the participants.
Study comprised of 3 groups (30 subjects in each group)

Group 1 (Exercise) - included subjects selected from Sports College of University. All of them were elite athletes & have been living an active sports life in terms of regularly performing exercises for a minimum of 30-45 minutes a day, 6 days a week, for at least last 6 months. Their training included warm up and activities such as jogging, jumping, running, stationary aerobics, strengthening, stretching and cool down.

Group 2 (Yoga)- included subjects from college of Naturopathy & Yogic Sciences, who have been practicing pranayama (i.e. Breathing exercises) like bhastrika, kapalbhati, anulom-vilom for 20 min and yogasanas (yogic postures) in sitting, lying & standing positions for 40 min, under the supervision of trained yoga teacher daily, 6 days a week for at least last 6 months.

Group 3 (Sedentary) subjects who reported no physical exercise or not interested in any sports activity, not practicing yoga, and had no leisure-time physical activity since at least last 6 months., or activities done for less than 20 minutes or fewer than 3 times per week.

Exclusion Criteria

Smokers, history of ingestion of alcohol or any recreational drug affecting metabolism, cardio-pulmonary, hepatic and renal disease, neuro-endocrine disorders , pregnant or lactating females, major psychiatric illness.
Subjects were asked to report to research lab of the department of physiology between 9:00am and 11:00am on two separate occasions. They were explained the experiment protocol at first visit, while the data were recorded during the second visit. They were instructed not to take tea, coffee1 hour, or food 2 hour before the recording. They were asked to refrain themselves from heavy exercise on the day of data recording.

Anthropometric measurements

Height was measured on a parallel plane Stadiometer barefooted with a correction of 0.5 cm. Weight was taken barefooted with minimal clothing on with correction of 0.1 kg using a calibrated electronic weighing machine. Waist circumference was measured by placing the measuring tape in a horizontal plane midway between the lower rib margin and the iliac crest to nearest 0.5 cm at end of normal expiration. Hip circumference was measured by taking at the widest point between the two bony prominences at the level of hips.

Body composition assessment

The participants were instructed to remove any metal objects from their bodies. They were told to lie down in a supine position on a non-conducting couch for 5 minutes, breathing normally in a relaxed position with arms 30 degrees apart from the trunk and ankles at least 20 cm apart. Multi-frequency impedance technique (11) using BIA Bodystat Quadscan 4000 was used to record following body composition parameters
1. Body Mass Index (BMI) 2. Waist-Hip Ratio (WHR) 3. Body Fat Percentage (BF%) 4. Total Body Water (TBW) 5. Lean Body Mass (LBM)

Spirometric assessment
Spirometry was performed according to the American Thoracic Society's recommendation (12) using SpiroTech (Spirometry standard mode, version 1.1.0.25). Each subject was required to complete three trials (with at least two reproducible and acceptable maneuvers) of all parameters. The following parameters were included –
1. FVC. 2. FEV1 3.FEV1 / FVC Ratio 4. PEFR

Statistical analysis
Descriptive Statistics was used to do appropriate statistical analysis for all the parameters, and all values were expressed as mean ± SD. The R software 2.6-2 was used to compare the differences in the parameters among the three groups. One-way ANOVA with Tukey Honest Significant Difference post-hoc test was used for the statistical analysis. Pearson's correlation between several parameters was computed. The P value less than 0.05 was considered significant with confidence interval of 95%.

Result
Table 1 shows comparison of anthropometric and body composition parameters among three groups. Mean± SD values of weight, BMI and WHR were higher in sedentary group and lowest in yoga group. BF% was higher in sedentary group and lowest in exercise group. TBW was higher in yoga group followed by exercise group while LBM was higher in exercise group and lowest in sedentary group. One way ANOVA shows significant difference in BMI and WHR ($P = 0.040$, $P = 0.002$, $P = 0.012$ respectively) and highly significant difference ($P = 0.000$) in weight, BF%, TBW and LBM among all three groups.
Post-hoc by Tukey HSD test showed significant difference in weight & BMI and highly significant difference for BF, TBW, and LBM between exercise vs sedentary groups, in BMI & WHR between yoga vs sedentary groups, and in WHR between yoga vs exercise groups and showed highly significant difference in weight, BF, TBW, LBM between yoga and sedentary groups.
Table 2 shows comparison of PFT parameters among three groups. Mean± SD values were higher in yoga group followed by exercise group. One way ANOVA shows significant difference in FEV1/FVC ($P = 0.015$) and highly significant difference ($P = 0.000$ each) in FVC and FEV1/FVC among all three groups. Post-hoc by Tukey HSD test showed significant difference for FEV1/FVC and highly significant difference for FVC & FEV1 between exercise vs sedentary groups and between yoga vs exercise groups,

In yoga group Pearson's correlation shows highly significant positive relation of WHR & LBM with FVC, FEV1 and PEFR ; significant positive relation of weight with FEV1 & PEFR and of TBW with FEV1 ; and significant negative relation of weight & BMI with FEV1/FVC and of BF with FVC, FEV1 and PEFR. In sedentary subjects Pearson's correlation shows significant positive relation of TBW with FVC & FEV1.

Table 1: Comparison of anthropometric and body composition parameters among three groups (n = 30 in each group)

Parameters	Exercise Mean ± SD	Yoga Mean ± SD	Sedentary Mean ± SD	P value
Wt (kg)	65.00 ± 13.504*****	56.73 ± 9.112$^{€}$	74.83 ± 19.661	0.000
BMI (kg/m^2)	22.423 ± 2.856*	21.560 ± 3.071	30.097 ± 16.940	0.002
WHR	0.895 ± 0.052*	0.849 ± 0.105	0.904 ± 0.053$^{\#}$	0.012
BF (%)	20.467 ± 5.274***	23.350 ± 5.426	29.067 ± 8.491$^{\#\#\#}$	0.000
TBW (%)	54.947 ± 4.883***	55.993 ± 5.207	48.297 ± 7.569$^{\#\#\#}$	0.000
LBM (%)	79.377 ± 5.451***	76.650 ± 5.426	69.077 ± 12.905$^{\#\#\#}$	0.000

* P <0.05, *** P < 0.001 comparison between exercise & sedentary groups
$^{€}$ P <0.05, $^{€€€}$P < 0.001 comparison between exercise & yoga groups
$^{\#}$P <0.05, $^{\#\#\#}$P < 0.001 comparison between yoga & sedentary groups

Table 2: Comparison of PFT parameters among three groups (n = 30 in each group)

Parameters	Exercise Mean ± SD	Yoga Mean ± SD	Sedentary Mean ± SD	P value
FVC (L)	2.490 ± 0.475*******	3.403 ± 0.681$^{€€€}$	2.386 ± 0.446	0.000
FEV_1 (L/sec)	2.390 ± 0.431*******	3.141 ± 0.561$^{€€€}$	2.280 ± 0.370	0.000
FEV_1/FVC	95.966 ± 3.761*****	96.218 ± 4.022$^{€}$	92.952 ± 6.112	0.015
PEFR (L/sec)	6.368 ± 1.190	6.937 ± 1.819	6.145 ± 1.703	0.146

* P <0.05, *** P < 0.001 comparison between exercise & sedentary groups
$^{€}$ P <0.05, $^{€€€}$P < 0.001 comparison between exercise & yoga groups

Discussion

Exercise is regarded as an acceptable and effective way to improve and maintain physical, mental, and emotional health. The purpose of this study was to assess and compare body composition and pulmonary function parameters in young adults having conventional exercises, yoga or sedentary lifestyle.

Our study revealed that weight, BMI, WHR and body fat were significantly higher and total body water and lean body mass were significantly lower in sedentary group as compared to exercising and yoga groups. Subjects doing yogic exercise had the lowest weight, BMI and WHR and highest total body water among three groups. Yoga practice causes an increase in energy expenditure, which leads to significant changes in body composition (13). Body fat % was found significantly lower and LBM was significantly higher in exercise group.

In this study, the yoga group had significantly higher FVC, FEV1, FEV1/FVC and PEFR values than subjects having conventional exercises or sedentary lifestyle ,however Peter et al, found that athletes had higher predicted percentages of mean FVC, FEV1, and PEFR as compared to yogis and sedentary individuals while yogis had higher FEV1/FVC values than the athletic group(14). Panchal & Tawadia compared effects of yoga and aerobic exercise on pulmonary function and physical fitness among young healthy females & found that there were no significant differences in the PFT parameters measured between the yoga group and the aerobics group (15).

Furthermore, in subjects performing yoga we found a significant positive correlation of WHR & LBM with FVC,FEV1 and PEFR; as well as a significant negative correlation of body weight and BMI with FEV1/FVC and a significant negative correlation of body fat with FVC, FEV1 and PEFR. There was also a moderately positive correlation of TBW with FEV1 and LBM with FVC, FEV1, and PEFR. Ishikawa et al. (6) showed a negative relationship between anthropometric and body composition factors and pulmonary functions as measured by FEV1 and FVC, which is consistent with the findings of our study. Bae et al discovered that height, weight, BMI, and body fat % were all significantly correlated with pulmonary functions, where height and weight were similarly correlated (7).

During yoga training, especially during pranayama, there are maximal inflation and deflation of the lungs which cause increased strength, recruitment, and endurance of respiratory musculature(16,17) Other probable mechanisms as suggested by Yadav and Das(18), included increased power of respiratory muscles as a result of work hypertrophy of the muscles during yoga and exercise.

Such maximal inflation and deflation act as a physiological stimulus causing secretion of prostaglandins and surfactants in the alveoli, which thereby increase the lung compliance. There is a reflex decrease in the airway smooth muscle tone due to stimulation of stretch receptors, which thereby increases airway diameter and decreases resistance to air flow, which could explain higher PEFR and FEV1(19,20).

The regular practice of aerobic exercises improves strength of muscles involved in respiration and facilitate the flow of air in and out of lungs. It also improves circulation which facilitates transport of oxygen throughout the body. All these factors together are responsible for improvement in pulmonary functions and physical fitness. Exercise improves ability of muscle to use fats during exercise, preserving intramuscular glycogen which is responsible for weight loss and reduction in BMI (21).

Conclusion

The results of this study can also be explained by higher respiratory muscle strength, improved thoracic mobility, and a balance between lung and chest elasticity that exercising people and yogis may have developed from regular exercise. Thus, regular physical activity leads to positive physiological, psychological, and physical changes in the individual.

Limitations

A small sample size with a limited age range in a confined area was used, limiting the generalizability of our findings to other age groups and regions. Since this was a cross-sectional study rather than an intervention-based, the exercise protocol was pre-determined and not strictly regulated. As a result, inconsistent exercise intensity may account for some of the insignificant results of this study. Other variables such as nutrition and socioeconomic status were not included in the study.

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