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A Randomized Trial to Compare Better Effect of Tai Chi Chuan or Pranayama in Improving Lung Function in Normal Individuals

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ABSTRACT

Objectives:

1. To study the effect of tai chi on lung function
2. To study effect of pranayama on lung function
3. To compare the effects of tai chi chuan and pranayama on lung function.

Methods: 60 healthy volunteers, males and females, aged 18-22 years were recruited for the study. Individuals were categorized into two groups by random allocation. Subjects who were doing any physical activity, practicing tai chi or pranayama, having preexisting history of musculoskeletal, neurological, cardiorespiratory disorders were excluded from the study.

Pre assessment included-Chest expansion, Lung volumes- Forced Expiratory Volume1 (FEV1), Forced Vital Capacity (FVC), Forced Expiratory Volume1/Forced Vital Capacity (FEV1/FVC), Peak Expiratory Flow Rate (PEFR) and Maximal Voluntary Ventilation (MVV), HR and RR. Groups were trained to perform tai chi and pranayama for 6 weeks each. Post assessment was done after 6 weeks.

Results: On statistical analysis, a significant change was seen in Forced Expiratory Volume1(FEV1), Forced Expiratory Volume1/Forced Vital Capacity (FEV1/FVC), Peak Expiratory Flow Rate (PEFR), and Maximal Voluntary Ventilation (MVV), chest expansion at all 3 levels in both groups after 6 weeks of intervention. No significant change was seen in FVC in both groups. There was no statistical significance seen between the two groups for lung function.

Conclusion: Thus, it can be concluded that tai chi and pranayama can help in improving the lung function. As there is no statistical significance found between the two groups, both tai chi and pranayama seems to increase lung function effectively in young healthy individuals.

Key Words: Tai chi chuan, Pranayama, Lung function

INTRODUCTION

Tai chi chuan is a branch of Chinese martial arts which is focused on mind tranquility and its goal to achieve longevity through meditation and lifestyle modification. ^[1]

Tai chi recognizes the interdependence of mind, body and spirit. It includes gentle exercises which bring balance and

harmony and allows the 'chi' to flow. 'Chi' is understood as 'life force' and it's the free flowing movement of chi throughout the body which is essential for a healthy life. Tai chi comprises of slow and gentle movements which can help in relaxation and helps the individual to function at its optimum level. ^[2]

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Tai chi is an ancient Chinese exercise which consists of slow and relaxed movements which helps in total self-development. [3]

Tai chi is a low speed and low impact exercise. It includes graceful motions which are co-ordinated with diaphragmatic breathing to achieve mind tranquility. It is practiced in a semi-squat position and its exercise intensity can be adjusted by controlling the angle of knee. Tai chi chuan is beneficial to cardiorespiratory function, strength, endurance, flexibility, balance and motor control and psychosocial function and helps in prevention of falls in elderly.[4]

Pranayama is the art of prolongation and control of breath. It helps in reshaping of breathing habits and patterns. [5]The inspiration of prana-vayu is Shwasa and expiration is prashwasa and cessation of both is characteristic of pranayama. The beneficial effects of different Pranayama are well reported and has sound scientific basis. [6-7]Yogic breathing or pranayama is part of all yoga's and is the art of controlling the breath. [8]

Pranayama incorporates a wide variety of practices which helps in improving the mental and physical health and as a deep breathing technique pranayama reduces dead space ventilation and decreases work of breathing. [9] Yoga practice consists of the five-principle including proper relaxation, proper exercise, proper breathing, proper diet, and positive thinking and meditation. Yoga consists of very slow, deep breaths with sustained breath hold after each inspiration and expiration. [10]

Pranayama generally involves controlled breathing techniques affecting the respiratory rhythm, namely through prolongation and shortening of breaths, and sometimes breath-holding, all implying voluntary control of respiratory muscles. These voluntary acts influence the breathing pattern and it is normally determined by the autonomic respiratory control center in the brain. Thus, voluntary control of breathing (practiced for 6–10 weeks) induces persistent alteration of the breathing pattern at rest, shown in a reduced breathing frequency.[11]

Pulmonary function tests [PFTs] are simple screening procedures and are performed using a standardized equipment (spirometer- Helios-401) to measure lung function.

This study was designed to compare the effects of tai chi chuan and pranayama on lung function and to find out which method is more beneficial for the cardiorespiratory system.

Methodology

The study protocol was approved by the institutional ethical committee. The study was explained to the subjects and a written consent was obtained from each individual. The subjects were recruited based on the following criteria;

Inclusion criteria- individuals aged between 18-22 years(mean age of tai chi-20.1±1.63, mean age of pranayama-18.4±0.50), both males and females.

Exclusion criteria- Individuals already performing any kind of physical activity, those who were having any musculo-skeletal, neurological, cardiorespiratory conditions. Subjects were categorized into two groups by random allocation using the paper chits with the words 'group-1' and 'group-2' respectively. Group -1 included the subjects who were performing tai chi chuan and Group-2 included the subjects who were performing pranayama.

Pre assessment of all the volunteers was done. Pre assessment included lung function measurement using spirometer helios-401, chest expansion, pulse rate, respiratory rate.

Chest expansion was measured using a standard tape at three levels. (Axilla, nipple and xiphisternum)

Lung function measurement included forced expiratory volume (FEV₁), forced vital capacity (FVC), FEV₁/FVC, maximal voluntary ventilation (MVV), peak expiratory flow rate (PEFR). Vitals like pulse rate (PR) and respiratory rate (RR) were measured.

Intervention

Subjects were trained to perform tai chi chuan and pranayama for 6 weeks respectively.

Group 1(tai chi chuan group) performed tai chi for 30 minutes, 3 days a week for 6 weeks.[12] It included a warm up, shibashi which comprised of 14 maneuvers and brocades which had 8 maneuvers. Tai chi was performed along with a particular music which was soothing and helped the subjects to concentrate and perform tai chi more efficiently.

Group 2(pranayama) performed 5 forms of pranayama- anulom vilom, omkara, bhramari, bhastrika, kapal bhati for 20 minutes per day, 3 days a week for 6 weeks.[15]

Post assessment of all the parameters was done after 6 weeks of intervention.

RESULTS

Statistical analysis was done using Microsoft Excel and statistical package for social sciences- version 16. Statistical analysis of pre and post assessment of both the groups individually was done using paired-t test. Statistical analysis for between the tai chi and pranayama group was done using an unpaired-t test. P-value of ≤0.05 was considered to be statistically significant.

A significant change was seen in FEV₁, FEV₁/FVC, MVV, PEFR and chest expansion at all the three levels in tai chi chuan and pranayama group respectively. (p value<0.05) [Table 1, 2]

There was a significant improvement seen in heart rate in tai chi chuan group (p value=0.03) whereas a significant change was seen in respiratory rate in pranayama group (p value=0.001) after 6 weeks of intervention. [Table-1, 2]

No significant change was seen in FVC in both the groups post intervention. (p value>0.05) [Table-1, 2]

There was no significant change seen when both the groups were compared. (p value>0.05) [Table-3]

DISCUSSION

In the present study, it is evident that, there is a significant improvement in FEV₁, FEV₁/FVC, MVV, PEFr, chest expansion at all the 3 levels after 6 weeks of tai chi chuan and pranayama.

Exercise training plays a major role in every individual's life. Habitual physical activity may increase functional ability and thus enhance capacity for independence in various activities of daily life. [12]

Tai chi chuan is a martial art which has recently been used for health benefits. When performing tai chi, abdominal and thoracic respiration co-ordinates to improve respiratory movement. Abdominal respiration can increase the intensity of diaphragm relaxation and shrinkage so as to enlarge the amplitude of its elevation and decline and constantly change the abdominal and thoracic pressure. Thus respiratory organs can get adequate blood supply and the pulmonary ventilation function can be improved. [13]

During breathing, when a person breaths in, the lungs expand and there is less space in the body. So on breathe in, the venous blood is gently squeezed out. As the individual breathe out, the lung contract increasing the space and as there is vacuum which gets created the lungs expand and fresh arterial blood enters. [2]

Tai chi demands for proper regular breathing pattern. Deep breathing enhances the expansion of the lungs and thus improves circulation and functioning. Ultimately it results in improving lung function. [2]

Studies done by Qing-Hua Song et. al, Chin Lan MD et. al, Guohua Zheng et. al, suggested that tai chi chuan can be used as form of aerobic exercise which can improve lung function.

In pranayama as there is deep breathing, airway resistance is reduced and there is increase in alveolar ventilation. Due to this compliance of lung thoracic system also increases. Thus, forceful exhalation becomes more efficient as deep and slow inhalation and prolonged exhalation causes efficient use of intercostal muscles and diaphragm to get emptied and filled more completely and efficiently. [14]

Strengthening of respiratory muscles occurs during pranay-

ama, there is inflation and deflation occurring at chest and lungs because of which the muscles are made to work at its maximal extent. [15]

There is release of lung surfactant and prostaglandins into alveolar spaces which increases lung compliance and decreases the bronchiolar smooth muscle tone. Thus it is responsible for change in FEV₁, MVV and PEFr. Due to pranayama, there is increase in maximal shortening of inspiratory muscles which have been shown to improve lung function. [15]

There was a significant change seen in FEV₁ (p value=0.017) and heart rate (p value=0.05) when both the groups were compared. (Table-3)

There was a significant change seen in heart rate after 6 weeks of tai chi chuan, p value=0.03 (Table-1)

Change in heart rate is seen as there is increased workload on heart which stimulates the heart to pump more efficiently. [2]

There was also a significant change seen in respiratory rate after 6 weeks of pranayama, p value=0.001 (Table-2)

Change in respiratory rate is seen as there is a modification seen in functioning of bulbopontine complex. Breathing is usually regulated by the bulbopontine respiratory control mechanism which is further modified by suprapontine mechanisms. These suprapontine messages promote the voluntary inhalation and exhalation. Due to pranayama the bulbopontine complex's activity is modified in such a way that its rhythm is slowed down. It is done by voluntary prolongation of phase of inhalation and exhalation by stretching to their fullest. So the bulbopontine complex is adjusted to a new pattern of breathing which is slower than basal rhythm. [15]

Thus tai chi targets the cardiovascular system in a much efficient way when compared to pranayama whereas pranayama helps in improving the respiratory function more efficiently when compared with tai chi chuan.

CONCLUSION

As mentioned in the results, there was significant change seen in tai chi chuan and pranayama group respectively. So, it can be concluded that, practicing tai chi chuan and pranayama help in improving the lung function. Since there was no statistical significance found when both the groups were compared, both tai chi chuan and pranayama seems to improve lung function effectively in healthy individuals.

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Table 1: Shows pre and post 6 weeks of tai chi chuan

Parameters	Pre Tai chi chuan	Post Tai chi chuan	P value
FEV1	2.08±0.46	2.28±0.35	0.012*
FVC	2.62±0.48	2.70±0.55	0.388
FEV1/FVC	79.36±11.51	85.51±7.82	0.007*
MVV	35.13±13.69	44.83±11.03	0*
PEFR	4.56±1.52	5.37±1.06	0*
Chest expansion			
Upper(T2)	2.41±0.92	3.15±0.84	0*
Middle(T4)	2.41±0.68	2.96±0.94	0*
Lower(T6)	2.51±0.82	2.90±0.78	0.007*
HR	78.33±7.78	74.03±8.66	0.034*
RR	17.60±2.89	17.46±2.11	0.84

*- denotes significant change (p value ≤ 0.05)
Pre and Post values are expressed as mean ± SD.

Table 2: Shows pre and post 6 weeks of pranayama

Parameters	Pre pranayama	Post pranayama	P Value
FEV1	1.76±0.60	2.23±0.52	0.005*
FVC	2.32±0.69	2.52±0.782	0.086
FEV1/FVC	79.82±15.10	89.01±8.199	0.008*
MVV	44±11.77	53.46±11.58	0*
PEFR	3.15±1.76	4.37±1.46	0.001*
Chest expansion			
upper(T2)	3.16±0.99	3.70±0.73	0*
Middle(T4)	2.55±0.64	2.86±0.571	0*
lower(T6)	2.48±0.66	2.75±0.58	0.002*
HR	75.6±5.72	75.26±5.54	0.397
RR	19.73±2.40	18.76±2.31	0.001*

*-denotes significant change (p value ≤ 0.05)
Pre and Post values are expressed as mean ± SD

Table 3: Shows p value after the comparison between tai chi chuan and pranayama

Parameters	P value
FEV1	0.017 *
FVC	0.1
FEV1/FVC	0.3
MVV	0.8
PEFR	0.37
Chest expansion-	
Upper	0.7
Middle	0.08
Lower	0.21
Heart Rate	0.05*
Respiratory Rate	0.54

*-denotes significant change (p value \leq 0.05)