The Effects of a Two week Yoga Program on Pulmonary Function

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Abstract:

Recent studies on long term yoga training programs have shown improvements in respiratory function (Udupa and Singh 1972). The present study was conducted to ascertain if a short term yoga program had similar results. Seven male and seven participants underwent a one hour daily yoga program for a total of 12 days taught by a certified yoga instructor. Pre yoga and post yoga pulmonary function tests were performed by measuring forced vital capacity (FVC) and breathe holding time (BHT) at total lung capacity (TLC) and at residual volume (RV). The results were analyzed by Two-way repeated measures ANOVA. Significant improvements were observed in forced vital capacity and breathe holding time at (TLC), while at (RV) there were no significant changes. The results indicate that a short term yoga program can improve respiratory function.

Introduction:

Studies on the ancient Hindu practice of Yoga have demonstrated an improvement in respiratory function (Udupa and Singh 1972). Yoga consists of a number of different practices, the most common of which are the pranayama, the coordination of controlled ventilation, and the asanas or stretching exercises. Pranayama requires breath holding which may result in increased parasympathetic control of respiratory control centers (Makwana et al. 1988). In a study of ten males between the ages of 40 and 60 with no previous yoga experience, 80% showed improvement in breath holding time after the completion of an intensive yoga program (Courtney and Cohen 2006). Joshi et al. (1992) demonstrated improved ventilatory functions in the form of lowered respiratory rate (RR), increased forced vital capacity (FVC), and forced expiratory volume at the end of 1st second (FEV₁, %) following six weeks of yoga instruction. Joshi and Joshi (1998) suggested that the improvement in vital capacity could be attributed in part to increased development and strengthening of respiratory musculature incidental to the regular practice of yogic exercise. A study by Yadav and Das (2001) on 60 healthy females demonstrated a significant improvement in FVC, FEV-1 and peak expiratory flow rate over a period of 12 weeks. The results of a study on patients with mild asthma indicated
that practicing pranayama may assist patients with their management of asthma (Singh et al. 1990). Mandanmohan et al. (2003) observed increased respiratory pressures in young adults as gauged by the maximum expiratory pressure test after a six months yoga training program. The purpose of this research was to determine whether yoga practiced over a short duration of 12 days for one hour each day would result in changes in respiratory function by measuring Forced Vital Capacity and Breath Holding Time at Total Lung Capacity (TLC) and at Residual Volume (RV).

**Materials and Methods:**

The research proposal was reviewed and approved by the Brigham Young University - Hawaii Human Subjects Committee. Fourteen individuals between the ages of 19 and 27 participated in the study. The test subjects included seven male and seven female non-smoking individuals, who had similar body mass indexes, height, and normal lung function. Normal lung function was defined as having no current or recent respiratory illnesses or disease. Subjects were asked to describe any respiratory illnesses or deficiencies before the start of the yoga program to ensure all current participants demonstrated normal lung function.

The test group performed yoga for 12 days and were asked not to engage in any other cardiovascular activity for the duration of the study. Individuals who had practiced any type of yoga prior to this experiment were excluded. The group began a daily one-hour yoga regime for a total of 12 days, led by a certified yoga instructor. The instructor led the class by performing each breathing and stretching exercise and directing the class to simultaneously observe and follow her direction for each pose and breathing exercise. During the course of each class the Yoga instructor observed the participants to ensure
that they were performing each stretching and breathing exercise properly. The Subjects were tested at the beginning of the class and 12 days later after the completion of the class. Forced vital capacity (FVC), breath holding time (BHT) at total lung capacity (TLC) and at residual volume (RV) were measured by spirometry. The spirometer was used to test Forced Vital Capacity (FVC), a measure of the amount of air a subject is able to force out after one deep inhalation, measured in cubic centimeters (cc). Subjects were asked to inhale one breath as deeply as possible, and then exhale as hard and as fast as possible into the spirometer. Each participant was also instructed to make sure no air leaked out of the side of their mouths as they blew out into the spirometer. Each subject used a nose clip to plug their nose, preventing any air from escaping through the nasal passage. Subjects were monitored to ensure they were performing this protocol correctly. This procedure was performed twice and recorded.

Breath holding time was tested by asking subjects to perform two tests: one at total lung capacity (TLC) and the other at residual volume (RV). To perform the TLC tests subjects were asked to inhale one breath as deeply as possible and to hold until they physically were unable to continue. To ensure subjects were not breathing they wore a nose clip and also held a glass plate in front of their mouths to know when breathing began once again. The glass plate quickly fogged up once breathing began. Times were measured in seconds using a stopwatch. The breath holding time at RV was done similarly to the TLC test except that subjects were instructed to inhale one deep breath then to exhale until residual volume at which point timing began Residual volume is the volume of air remaining in the lungs after maximum expiration. After exhalation the stopwatch was started and subjects were asked to hold their breath until they physically could not continue. The time was stopped once subjects began breathing again and RV breath holding time was recorded. The identical protocol performed in TLC testing was used to
ensure subjects were not breathing during the RV testing. The data from the pre- and post- pulmonary function tests were compared statistically using repeated measure ANOVA and comparison between genders were tested by independent T test. The coefficient of variation was calculated to ensure the reliably and consistency of the spiropet spirometer.

**Results:**

The coefficient of variation of the spiropet spirometer was determined to be 2.3%. This level of reliability is considered acceptable for respiratory studies. The mean group FVC prior to yoga was 4253.57ml ±(1478.88) and the post yoga group was 4767.86ml (±1575.36). The p value was 0.03 indicating significant improvements among the group (Fig. 1). The mean group BHT at TLC before yoga was 53.78sec (±27.23) and after yoga the BHT at TLC was 76.21sec (±42.2). The p value of <0.001 indicated a highly significant improvement (Fig. 2). The mean group BHT at RV before yoga was 27.57sec (±8.13) and after completion of yoga BHT at RV measured 31.64sec (±9.38) with a p value of .143. These means were not significantly different (Fig. 3)

The pre and post FVC measurement for males averaged 5717.86ml (±1086.91) and FVC for females averaged 3303.57ml (±631.68). The p value of <0.001 indicated a highly significant difference between male and female FVC values (Fig 4). The pre and post BHT at TLC for males averaged 77.07sec (±45.08) and BHT at TLC for females averaged 52.93sec (±21.14). A p value of .193 indicated no significant difference (Tbl.1). In Table 2, pre and post BHT at RV measurements for males averaged 29.14sec (±9.13) and females recorded 30.07sec (±8.89). The p value measured 0.824.
Figure 1: The group FVC means before and after a two week yoga program.

*P value: 0.03

Figure 2: The group BHT at TLC means before and after a two week yoga program.

**p value<0.001
Figure 3: The group BHT at RV means before and after a two week yoga program. P value: 0.143

Figure 4: The FVC means values for males and females. **P value <0.001
Discussion:

After a continuous two week yoga program pulmonary function results showed significant improvement in FVC and Breath Holding Time at TLC. Breath holding time at residual volume did not change. These results suggest that practicing yoga for even a short period of time results in significant improvements in pulmonary function. These data are consistent with other studies (Joshi et al.1992) that have found improvements in ventilatory function following a yoga program of longer duration. These results indicate that the duration of time practicing yoga may not be a critical factor in improving lung function.

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).

Significant improvements in BHT could be attributed to the control of the neural respiratory centers during pranayama. While performing pranayama yoga participants were instructed to consciously be in control of their breathing, which may indicate that the autonomic breathing stimulus was overridden resulting in increased breath holding time (Makwana et al. 1988). It was not clear if the improvement occurred at the level of
neural reception or at higher centers in the brainstem. Improvements in Breath Holding Time at TLC point to a decreased responsiveness of the respiratory centers to CO2 levels along with an increased endurance of respiratory muscles with later signs of fatigue (Joshi and Joshi 1998).

Comparing males and females showed significant differences in FVC. This result suggests that normal males on average have a larger more muscular thoracic cavity enabling them to force more air out of the lungs resulting in higher volumes of FVC. However, males and females showed no significant differences in Breath Holding Time at TLC or at RV indicating that both responded similarly to the yogic breathing and stretching exercises.

In conclusion, this study suggests that a practice of yoga for only a short duration of time showed an overall improvement in respiratory function similar to those found in more long term studies, suggesting that beginners of yoga can also receive health benefits and improved lung function.

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