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ORIGINAL ARTICLE

Yoga versus aerobic activity: effects on spirometry results and maximal inspiratory pressure*

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ABSTRACT

OBJECTIVE: To clarify whether, in healthy individuals, practicing yoga can modify maximal inspiratory pressure and spirometric indices when compared with the practice of aerobic exercise.
METHODS: A controlled clinical trial. A total of 31 healthy volunteers were allocated to practice aerobic exercise (n = 15) or to practice yoga (n = 16). Those in the first group served as controls and engaged in aerobic exercise for 45-60 minutes, twice a week for three months. Those in the second group practiced selected yogic techniques, also in sessions of 45-60 minutes, twice a week for three months. Forced vital capacity, forced expiratory volume in one second and maximal inspiratory pressure were measured before and after the three months of training.
RESULTS: No significant alterations were seen in the spirometric indices. A slight, although not significant, improvement in maximal inspiratory pressure was seen in both groups. However, there was a significant difference, seen in both genders, between the absolute delta (final value minus baseline value) of maximal inspiratory pressure for the group practicing yoga and that obtained for the group engaging in aerobic exercise (males: 19.5 cm H_2O versus 2.8 cm H_2O, p = 0.05; females: 20 cm H_2O versus 3.9 cm H_2O, p = 0.01).
CONCLUSION: Neither yoga nor aerobic exercise provided a statistically significant improvement in maximal inspiratory pressure after three months. However, the absolute variation in maximal inspiratory pressure was greater among those practicing yoga.

Keywords: Yoga; Exercise; Respiratory muscles; Respiratory function tests; Maximal voluntary ventilation; Spirometry; Inspiratory capacity/physiology

INTRODUCTION

Yoga is a system of philosophy established in India thousands of years ago. It seeks to develop the spiritual harmony of the individual through the control of mind and body. The practice of yoga uses eight methods, known as 'limbs': yama (restraint), niyama (observance), asana (posture), pranayama (breath control), prathyaha (sensory deprivation), dhyana (fixing the attention), dharana (contemplation) and samadhi (absolute concentration). During yoga sessions, the postural maneuvers are executed without repetition and are connected to each other by passages that establish links between the exercises in a sequence that has come to be called choreography. Evidence shows that the regular execution of these choreographies provides the practitioner with more physical flexibility, muscle strengthening, increased vitality, decreased psychological stress and reduced cardiovascular diseases.(1)

Breath control is crucial to the practice of yoga and is emphasized in all of the aforementioned eight methods. In view of this, the effect of yoga on respiratory diseases has been studied, particularly in the treatment of bronchial asthma.(2-4) The impact of yogic training on pulmonary function and diaphragmatic strength is seldom reported in the western literature. It is therefore important to determine whether the practice of yoga, in comparison with the practice of aerobic exercise, can modify maximal inspiratory pressure (MIP) and spirometric indices in healthy individuals.

METHODS

The present study was carried out at the Institute of Sports Medicine and Applied Movement Sciences of the University of Caxias do Sul between January and June of 2004.

The study was an open controlled clinical trial. The healthy individuals of both genders (n = 31) who volunteered to engage in the practice of yoga or aerobic exercises were consecutively divided into two groups: the YOGA group (n = 16), allocated to practice yoga; and the AERO group (n = 15), allocated to practice aerobic exercises. Individuals who were under 18 or over 40 years of age were excluded, as were those who had practiced other physical activities three months prior to allocation, had practiced other physical activities concomitantly with yoga or had practiced aerobic exercises other than those offered by the gym where the study was carried out. Those having been clinically diagnosed with asthma, chronic obstructive pulmonary disease or other chronic pulmonary diseases were also excluded.

The individuals in the YOGA group were recruited from the University of Yoga (Bento Gonçalves and Caxias do Sul branches, both located in the state of Rio Grande do Sul), whereas those in the AERO group were recruited from the Vila Olímpica (gymnasium) of the University of Caxias do Sul.

All study participants gave written informed consent. The research protocol was approved by the Office of the Coordinator of the Institute of Sports Medicine and Applied Movement Sciences of the University of Caxias do Sul.

The clinical evaluation consisted of collecting histories and conducting physical exams, as well as the administration of a structured questionnaire that included questions regarding eating habits and smoking, as well as questions regarding the frequency and duration of the physical activity sessions. Weight and height were measured using anthropometric scales (Filizola, São Paulo, Brazil) to calculate the body mass index: ratio between weight (kg) and height^2 (m).

Simple spirometry was performed using a portable spirometer (Spirodoc; Medical International Research, Rome Italy). The maneuver to measure the forced vital capacity curve was taught to each participant individually and later executed in triplicate. To comply with the acceptability criteria for spirometry results, the best two maneuvers with less than 10% variation between them were recorded, and the one with the higher value was selected for analysis. The pause after maximum inspiration up to total lung capacity, preceding maximum expiration, did not exceed three seconds.(5) Before the performance of the maneuvers, and to confirm the healthiness of the individuals, the following question was systematically asked: "Have you used a bronchodilator within the last six hours?"

Inspiratory muscle strength was expressed in terms of MIP, measured under static conditions, using an aneroid vacuum manometer. In order to determine the MIP, the individual was asked to exhale down to residual volume and then inhale as deeply as possible through a mouthpiece connected to the vacuum manometer, with nasal occlusion by means of a nose clip. The maneuver to measure the MIP was taught to each participant individually and later executed in triplicate. The maneuver was evaluated by two researchers and on a single day to avoid learning bias. To comply with acceptability criteria, the best two maneuvers with less than 10% variation between them were recorded, and the one with the higher value was selected for analysis. Our study used the prediction equations for normal MIP values established by Neder et al. in 1999(6):

Men: MIP = weight (kg) × 0.48 - age (years) × 0.80 + 120

Lower limit of normality = predicted - 27

Women: MIP = 110.5 - age (years) × 0.49

Lower limit of normality = predicted - 15

The fact that the MIP measure had to be performed in the gyms for yoga or aerobic exercises prevented the blinding of the researchers.

The participants practiced physical activities twice or three times a week for three months. The researchers did not interfere with the routine of the exercises used by the physical educators and yoga instructors during the training sessions.

Aerobic exercises consisted of 45- to 60-minute sessions divided into five stages: warm-up (5 to 10 minutes); principal aerobic activity (10 to 40 minutes); cool-down (3 to 10 minutes); localized work (10 to 25 minutes); and stretching (5 to 15 minutes). During the principal aerobic activity, the intensity of the exercise was controlled by the heart rate, with the target rate being between 140 and 150 beats/min. In each session, the following movements were used: run, stationary run (jog in place), short kick, knee-ups, syncopated leap, alternate leap, jumping jacks, lateral pendulum, marching, the grapevine maneuver and heel touch.

Yoga practice consisted of 45- to 60-minute sessions divided into five stages: warm-up (5 minutes); breathing exercises; execution of the postural maneuvers (the choreography generally consisted of fifteen to twenty different positions); relaxation; and meditation.

After twelve weeks of physical activities, spirometry and MIP measurements were again performed, following the procedures described in the first phase, on all of the individuals in each group.

Quantitative data are expressed as mean and standard deviation. Data related to categorical variables are expressed as percentages. When comparing the YOGA and AERO groups, Mann-Whitney nonparametric tests were used for numerical variables, and the chi-square test was used for categorical variables. In the comparisor of pre- and post-training values within groups, the Wilcoxon test was used. The limit of significance chosen was 0.05. The analyses were performed using the software Epi Info 2002 (Centers for Disease Control and Prevention, Atlanta, GA, USA) and Assistat 7.2 (Federal University of Campina Grande, Campina Grande, Paraiba, Brazil).

RESULTS

There were no significant differences between the YOGA and AERO groups regarding the following variables: age, ethnicity, vegetarianism, weekly frequency of physical activity sessions and number of hours per week dedicated to physical activity (Table 1). There was a predominance of White individuals in their thirties. The individuals were omnivorous and exercised two to three times per week. The physical activity sessions lasted from 45 to 60 minutes.

TABLE 1

Comparison of demographic data between individuals performing aerobic exercises and those practicing yoga (initial evaluation)

	AERO (n = 15)	YOGA (n = 16)	p
Gender (%)			0.04
Male	9 (60)	4 (25)	
Female	6 (40)	12 (75)	
Age (years)*	25.1 ± 3.5	27.8 ± 9.0	0.3
BMI	24.3 ± 2.8	22.1 ± 2.8	0.03
Ethnicity (%)			0.9
White	13 (86.7)	16 (100)	
Non-white	2 (13.3)	0	
Smoking (%)	4 (26.7)	1 (6,3)	0.2
Vegetarian	3 (20)	1 (6,3)	0.5
Weekly frequency of activities*	2.5 ± 0.5	2.1 ± 0.6	0.1
Total hours of activity per week*	2.2 ± 0.5	2.1 ± 0.6	0.5

AERO: aerobic exercise group; YOGA: yoga practice group; BMI: body mass index; *mean ± standard deviation

At the beginning of the study, the individuals in the AERO group differed from those of the YOGA group in the following aspects: male gender (60% versus 25%, respectively; p = 0.04) and body mass index (24.3 versus 22.1 kg/m^2, respectively; p = 0.03) (Table 1).

Table 2 shows the comparison between the pre- and post-training mean spirometric and MIP data for the AERO group. Forced expiratory volume in one second (percentage of predicted), forced vital capacity (percentage of predicted), MIP and MIP% were all within the limits of normality, and there were no significant alterations at the end of three months of aerobic exercises. We observed increases of 2.8% for males and 4.1% for females ir mean MIP% between the beginning and the end of the training (Figure 1).

TABLE 2

Comparison between pre- and post-training forced expiratory volume in one second, forced vital capacity and maximal inspiratory pressure in individuals performing aerobic exercises

	Pre-training	Post-training	p
FEV_1*	95.7 ± 2.5	95.5 ± 3.4	0.8
FVC*	102.2 ± 4.8	101.1 ± 4.1	0.5
Manometry M	124.2 ± 30.3	127.1 ± 24.5	0.6
Manometry M* (cmH_2O)	118.4 ± 27.8	121.2 ± 22.0	0.6
Manometry F	85.5 ± 16.6	89.4 ± 14.3	0.7
Manometry F* (cmH_2O)	87.5 ± 16.5	91.6 ± 14.7	0.6

FEV_1: forced expiratory volume in one second; FVC: forced vital capacity; M: Male; F: Female; *% of predicted; Data presented as mean ± standard deviation

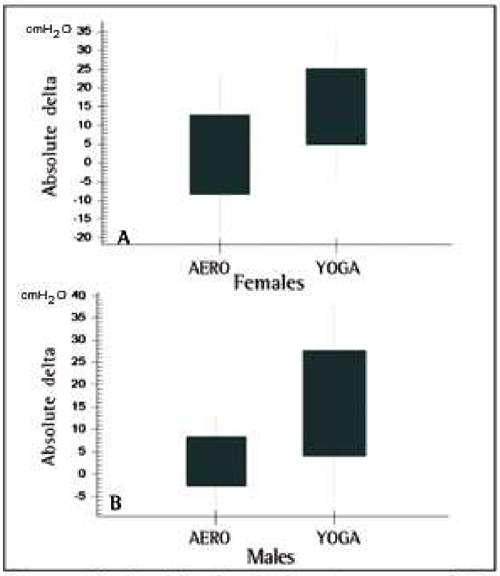

Figure 1 - Absolute delta of maximal inspiratory pressure (final - initial) between the beginning and the end of the twelve weeks of physical activity for males (A) and females (B)

Table 3 shows the comparison between the pre- and post-training spirometric and MIP data for the YOGA group Forced expiratory volume in one second (percentage of predicted), forced vital capacity (percentage of predicted) and MIP% were within the predicted ranges, and there were no statistically significant alterations at the end of three months of practice of yoga. However, we observed increases of 18.6% among males and 20.8% among females in mean MIP% between the initial and final tests (Figure 1).

TABLE 3

Comparison between pre- and post-training forced expiratory volume in one second, forced vital capacity and maximal inspiratory pressure in individuals practicing yoga

	Pre-training	Post-training	p
FEV_1*	101.2 ± 11.0	101.2 ± 15.2	0.8
FVC*	100.1 ± 14.2	100.3 ± 13.1	0.9
Manometry M	112.1 ± 22.0	131.62 ± 45.1	0.09
Manometry M* (cmH_2O)	105.2 ± 52.5	123.8 ± 40.6	0.1
Manometry F	77.4 ± 27.5	97.5 ± 31.8	0.1
Manometry F± (cmH_2O)	80.5 ± 27.9	101.3 ± 31.9	0.1

FEV_1: forced expiratory volume in one second; FVC: forced vital capacity; M: Male; F: Female; * % of predicted; Data presented as mean ± standard deviation

Since the percentage of gain in mean MIP% observed at the end of the observation period was greater in the

YOGA group, the MIP absolute deltas (final MIP - initial MIP) were calculated and compared for both genders between the two groups. The absolute delta for the YOGA group showed a significant functional gain for both genders in relation to the absolute delta for the AERO group: males 19.5 cmH_2O versus 2.8 cmH_2O, and females 20 cmH_2O versus 3.9 cmH_2O, respectively. These data are shown in Table 4.

TABLE 4

Comparison between the two groups studied in terms of the maximal inspiratory pressure absolute delta

	AERO	YOGA	p
DMIP Males	2.8 ± 13.8	19.5 ± 13.0	0.05
DMIP Females	3.9 ± 6.5	20.0 ± 13.9	0.01

AERO: aerobic exercise group; YOGA: yoga practice group; DMIP: (absolute) delta of maximal inspiratory pressure (calculated by subtracting the initial MIP from the final MIP); Data presented as mean ± standard deviation

DISCUSSION

The present study demonstrated that practicing yoga or aerobic exercises for three months did not increase MIP in a statistically significant manner in healthy individuals. The MIP absolute delta calculation demonstrated that the individuals who practiced yoga presented a more pronounced functional gain for both genders in relation to those who practiced aerobic exercises.

To date, few studies have adequately demonstrated improved respiratory function in individuals who practice yoga, and most of those studies involved Eastern populations. In a study involving 27 individuals practicing yoga for twelve weeks, a significant increase in MIP (from 93.8 to 118.1 cmH_2O) was found.[7] The authors of that study conducted a subsequent study of 20 individuals between the ages of twelve and fifteen who practiced yoga for six months, comparing them to twenty age- and gender-matched controls.[8] At the end of the six months, those who practiced yoga presented, in relation to the control group, significant increases in strength, endurance of grasp, MIP, maximal expiratory pressure and forced expiratory volume in one second.

Practices recommended for the rehabilitation of patients with chronic obstructive pulmonary disease (daily sessions and the use of airflow-regulating devices)[9-11] were not followed in the present study. Therefore, our data did not allow us to define whether the gain in respiratory function observed in the individuals who practiced yoga, demonstrated by the MIP absolute delta calculation, was exclusively secondary to the improvement in diaphragmatic function. Two recent studies[9-10] demonstrated that respiratory training protocols, using a device with a pressure threshold regulated with a 30% MIP load and daily 30-minute sessions, improved muscle strength and reduced dyspnea in patients with chronic obstructive pulmonary disease. These findings were corroborated by a meta-analysis compiling the results of fifteen randomized controlled studies on the effect of respiratory muscle training in patients with chronic obstructive pulmonary disease (200 subjects in the experimental groups and 183 in the control groups).[11] That analysis demonstrated that respiratory muscle training significantly increases the strength and endurance of those muscles, as well as significantly decreasing dyspnea (at rest and upon exertion), mainly in the group of patients presenting poor respiratory muscle strength prior to the training.

In our study, no significant alterations were observed in the spirometric indices. However, some trials have demonstrated that the practice of yoga, mainly by young individuals, can increase forced expiratory volume in one second and forced vital capacity, thereby altering respiratory patterns.[12-14] When compared to those who do not, individuals who practice meditation present greater vital capacity and tidal volume, as well as lower systemic diastolic pressure and serum cholesterol levels.[15]

Although our observation period was only three months, we consider it adequate to sustain our results. Improvements in respiratory performance have been observed after programs of yoga practice lasting only ten weeks.[16] Some authors[17] demonstrated decreases in both fasting and postprandial blood glucose levels, as well as in levels of glycosylated hemoglobin, in 20 patients with non-insulin-dependent diabetes, aged from 30 to 60 years old, after the daily practice of yoga for 40 days. These outcomes were followed by slight improvements in forced expiratory volume in one second (0.27 L) and in forced vital capacity (0.17 L).

The fact that our sample was obtained through consecutive nonrandomized inclusion of individuals constitutes a limitation of our study. There was a predominance of females in the YOGA group and of males in the AERO group. We consider this finding a cultural artifact of our region, where there is predominance of females in yoga classes. The higher mean body mass index in the AERO group might have been influenced by the predominance of males in that group. In order to overcome these limitations, we analyzed MIP by gender and found no differences between men and women in the response to training.

The present study demonstrated that the spirometric function of individuals who practice yoga or aerobic exercises did not change after three months of training.

We observed that the MIP of the individuals who practice yoga or aerobic exercises did not present a statistically significant increase after the three-month training. However, greater MIP modification was observed in the YOGA group. Further studies, including longer observation periods, more intense training or both, should be carried out in order to achieve a better evaluation of the potential of the practice of yoga to modify respiratory function.

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