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RESEARCH ARTICLE

Positive effect of Raja yoga meditation on cardiopulmonary parameters in type II diabetes mellitus

Tara G Chawla, Mrunal S Phatak, Rajendra G Bhagchandani

Department of Physiology, Indira Gandhi Government Medical College, Nagpur, Maharashtra, India

Correspondence to: Tara G Chawla, E-mail: drtarachawla@yahoo.com

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ABSTRACT

Background: Stress is an unavoidable part of life and it causes many unwell effects. Diabetes mellitus (DM) is a common metabolic disorder, which can be caused by stress. By reducing anxiety, meditation has numeral useful effects on the functioning of the individual body. **Aims and Objectives:** This study is contemplated to focus on the results of Raja yoga meditation in patients with DM by studying its impact on blood pressure (BP), heart rate (HR), and pulmonary function tests (PFTs). **Materials and Methods:** The present study was carried out on 90 participants. They were divided into three teams, Group I: Thirty non-diabetic, non-meditators, Group II: Thirty non-meditators, diagnosed type 2 DM for over 5 years, and Group III: Thirty diagnosed patients of type 2 DM for over 5 years and practicing Raja yoga meditation for over 5 years PFT, BP, and HR were measured. Results were analyzed statistically. **Results:** It was found that systolic as well as diastolic BP and HR were considerably high in Group II as compared to Group III. Systolic and diastolic BP between Group III and Group I does not show any significant difference. In Group II, forced expiratory volume in 1 s (FEV1), forced vital capacity (FVC), FEV1/FVC, expiratory reserve volume (ERV), forced expiratory flow ($FEF_{25–75\%}$), maximum voluntary ventilation (MVV), and peak expiratory flow rate (PEFR) were significantly reduced as compared to Group I. FVC, FEV1, FEV1/FVC, $FEF_{25–75\%}$, and ERV in Group III were significantly higher when compare with Group II; however, the mean of MVV, IRV, and PEFR was higher in Group III compared to Group II, but it does not show any significant difference. The mean of FVC, MVV, IRV, and ERV of Group I and Group III shows statistical significance, except for FEV1, FEV1/FVC, $FEF_{25–75\%}$, and PEFR. **Conclusions:** Regular practice of Raja yoga meditation results in low risk of developing cardiopulmonary diseases in diabetic patients.

KEY WORDS: Raja Yoga Meditation; Diabetes Mellitus; Pulmonary Function Test; Blood Pressure; Heart Rate

INTRODUCTION

The growing materialism in society is leading to extensive stress in all the age groups. Day-by-day stress is taking a significant toll on human fitness. Stress is responsible for physiological changes within the body, such as high anaerobic cellular activity, raised cortisol levels, and increased blood pressure (BP) and heart rate (HR). Stress will cause various endocrine diseases such as Cushing's disease, hyperthyroidism or hypothyroidism, and diabetes mellitus (DM). Secretion of different endocrine glands is regulated by pituitary hormones. Further, the pituitary hormones, which are under the control of hypothalamus, get adversely affected by psychological stress. This can result in fluctuations in pituitary hormones, which in turn causes derangement in the normal functioning of many endocrine glands.[1] Stress also disturbs the physiological balance of sympathetic and parasympathetic activity.[2]

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It has been well known that mobilization of energy takes place due to the activation of the sympathetic nervous system.[3,4] This event could be due to glycogenolysis and lipolysis which is mediated by the effect of cortisol and epinephrine.[5,6] In addition, the alpha-adrenergic receptors in the pancreas, due to sympathetic stimulation, may slow down the discharge of insulin.[6] Furthermore, it has been shown that exogenous catecholamines alter glucose tolerance in healthy persons[7,8] as well as in diabetic patients.

DM, a chronic disorder of glucose metabolism, affects millions of people around the world. At present, India is the diabetes capital of the world with more than 45 million diabetic patients. The metabolic derangements in diabetes affect the functioning of cardiovascular system, respiratory system, as well as nervous system. Hyperglycemia and dyslipidemia are linked to increased cardiovascular risks. Management of these complications concentrates mainly on maintaining euglycemic status. This can be achieved by dietary modifications, yoga, meditation, and appropriate therapy. Meditation produces a "Relaxation response" by a host of biochemical and physical alterations in the body. Optimum autonomic equilibrium can be attained with regular practice of meditation.

Multiple physiological pathways that are modulated by stress and result in various diseases are impacted by meditation practice. Meditation is a technique of self-generated relaxation. Raja yoga meditation reestablishes psychological harmony by relieving mental and physiological stress. Hence, this study was designed to assess the effect of Brahma Kumaris Raja yoga meditation on cardiorespiratory parameters in the patients with type II DM.

MATERIALS AND METHODS

The study was carried out on 90 participants of both male and female among the age group of 50–60 years in the department of physiology. The sample size required to be calculated to 30 per group considering the mean ± standard deviation of the parameters with α error (%) – 5%, power – 80th, and ½ sided test – 2. The approval from the institutional ethics panel was obtained. Participants were asked to report in the department of physiology at 9:00 am. The participants were divided into three teams (n = 30): Group I: Healthy participants (non-diabetic, non-meditators) were chosen randomly from the non-teaching staff of the institution; Group II: Non-meditators, diagnosed type II DM for more than 5 years visiting diabetic outpatient department of our institute; and Group III: Diagnosed type II DM for more than 5 years and practicing Raja yoga meditation for 1 h daily for more than 5 years, at the local Brahma Kumaris Center (Mahal), Nagpur. Participants with history of previous experience of yoga, sports training, history of any cardiorespiratory disease or infection, type I DM, hypertension, past history of major surgery, alcohol consumption, smoking were excluded from the study. Lactating mother and pregnant females were also excluded.

The study procedure was explained to all the participants and written informed consent was obtained. A detailed cardiovascular examination was done. Height and weight of the participants were measured. After the anthropometric measurements, the lung function of these participants was assessed by SPIRO EXCEL – computerized spirometer (PhysioPac Medicaid System) and analyzed as per the American Thoracic Society of Standardization of Spirometry.[9]

Summary statistics such as mean, standard deviation, and the range were used to summarizing the central tendency and variability of the quantitative variables of the three teams. ANOVA, i.e., one-way analysis of variance was performed to find the significance of the difference in means across three teams. Furthermore, the Bonferroni test was used to categorize pairs, in which means were significantly different.

RESULTS

In Group III, systolic and diastolic BP as well as HR were significantly low when compared to Group II ($P < 0.05$). There was no significant difference in the systolic BP between Group I and Group III ($P > 0.05$). It had been found that forced vital capacity (FVC), forced expiratory volume in 1 s (FEV1), FEV1/FVC, maximum voluntary ventilation (MVV), expiratory reserve volume (ERV), forced expiratory flow ($FEF_{25–75\%}$), and peak expiratory flow rate (PEFR) were considerably reduced in Group II compared to Group I ($P < 0.05$). FVC, FEV1, FEV1/FVC, ERV, and $FEF_{25–75\%}$ in Group III were considerably higher as compared to Group II ($P < 0.05$). The mean of MVV, IRV, and PEFR in Group III was higher than Group II; however, it does not show any difference ($P > 0.05$). The mean of FVC, MVV, IRV, and ERV of Group I and Group III shows statistical significance ($P < 0.05$), except for FEV1, FEV1/FVC, $FEF_{25–75\%}$, and PEFR ($P > 0.05$) [Tables 1 and 2].

DISCUSSION

In the present study, it had been noted that in Group II, the various parameters on lung function such as FVC, FEV1, FEV1/FVC, MVV, ERV, $FEF_{25–75\%}$, and PEFR were considerably less when compared to Group I.

The result of the present study is in accordance with the conclusion of the studies.[10-13] Chronic hyperglycemia induces decreased pulmonary function in diabetic patients. This impaired lung function is because of microangiopathy

Table 1: Group-wise comparison of anthropometric and cardiovascular parameters

Variables	Group I (*n*=30) (mean±SD)	Group II (*n*=30) (mean±SD)	Group III (*n*=30) (mean±SD)	*P*-value I versus II	*P*-value I versus III	*P*-value II versus III
Age (years)	51.43±5.39	50.33±6.21	53.23±5.43	1.000	0.672	0.155
Height (cm)	157.71±6.20	158.58±6.68	157.16±6.20	1.000	1.000	1.000
Weight (kg)	64.16±7.22	66.06±11.00	66.16±9.77	1.000	1.000	1.000
Systolic BP (mmHg)	124±6.18	132.13±7.06	123.8±12.11	0.003	1.000	0.001
Diastolic BP (mmHg)	79.9±5.5	88±5.22	82.73±8.85	0.000	0.337	0.010
HR (b/m)	76.2±4.91	78.5±5.20	73.63±5.22	0.256	0.166	0.001

$P<0.001$ very highly significant, $P<0.01$ highly significant, $P<0.05$ significant, $P>0.05$ non-significant. SBP: Systolic blood pressure, DBP: Diastolic blood pressure, HR: Heart rate, b/m: Beats/min, SD: Standard deviation

Table 2: Group-wise comparison of the pulmonary function parameters

Variables	Group I (*n*=30) (mean±SD)	Group II (*n*=30) (mean±SD)	Group III (*n*=30) (mean±SD)	*P*-value I versus II	*P*-value I versus III	*P*-value II versus III
FVC (L)	2.74±0.65	1.94±0.43	2.3±0.70	0.000	0.029	0.023
FEV1 (L)	2.30±0.53	1.57±0.52	1.96±0.57	0.000	0.057	0.018
FEV1/FVC (%)	87.20±4.15	77.73±15.66	86.25±4.15	0.001	1.000	0.003
MVV (L/min)	77.91±18.11	46.95±19.16	58.44±22.86	0.000	0.009	0.064
IRV (L)	0.43±0.16	0.30±0.26	0.40±0.29	0.06	0.000	1.000
ERV (L)	0.44±0.20	0.20±0.09	0.33±0.14	0.000	0.000	0.001
$FEF_{25-75\%}$ (L/s)	2.92±1.14	2.49±0.82	2.98±1.11	0.003	0.323	0.004
PEFR (L/s)	5.66±1.43	4.26±1.28	5.06±1.94	0.015	0.475	0.443

$P<0.001$ very highly significant, $P<0.01$ highly significant, $P<0.05$ significant, $P>0.05$ non-significant, FVC: Forced vital capacity in liters, FEV1: Forced expiratory volume in 1 s in L/s, FEV1/FVC: FEV1 as a percentage of FVC (%), MVV: Maximum voluntary ventilation (L/min), IRV: Inspiratory reserve volume in liters, ERV: Expiratory reserve volume in liters, $FEF_{25-75\%}$: Forced expiratory flow 25–75% in L/s, PEFR: Peak expiratory flow rate in L/s, SD: Standard deviation

due to the non-enzymatic glycosylation of proteins and biochemical alterations in the connective tissue of the lung chiefly collagen and elastin.[14-17] This biochemical alteration also causes thickening of the basal lamina of alveolar epithelial and a specific type of fibrosis of the lung.[14,18] Clinically, these functional abnormalities due to biochemical alteration can be manifested by way of a decrease in elastic recoil of the lung as well as respiratory lung volumes.[19] One study also suggested that alterations in bronchial reactivity are due to neuropathy of autonomic and phrenic nerves.[20]

Significant improvement in pulmonary function parameters in meditators was also reported by Raichur *et al*., 2010; Sayyed *et al*., 2010[21,22]; Ahmed *et al*., 2010; Bhutkar *et al*., 2008; Yadav and Das, 2001[23-25]; Vyas, 2001[26]; Kasiganeshan *et al*., 2004[27]; and Roopa, 2011.[28] These changes are induced by supraspinal mechanisms mainly due to relaxation of respiratory muscles cause an increase in ERV, which ultimately increase the VC. Meditators shows better diminution in nervousness, reduced worry and more relaxed physiological functioning. This is due to the decrease in limbic arousal and autonomic modulation.

In stress, sympathetic over activity causing broncho-constriction and an increase in resistance of airways via alpha receptors.[29] There is an increase in the level of opioid neuropeptides and decrease in adrenaline and noradrenaline release, which modulate the bronchial smooth muscle tone. Receptors for these neuropeptides are present in some neurons in the respiratory centers.[30] Activation of the parasympathetic system results in decrease in the BP and the HR. Regular practice of meditation is associated with a blunted sympathetic activity which is responsible for decreased load on the heart resulting in the reduction in the heart rate.

Gupta *et al*., 2006;[31] also observed decreased sympathetic arousal in meditators results in decrease in HR, respiratory rate and blood pressure Meditation causes gradual decrease in sympathetic domination resulting in a better balance between sympathetic and parasympathetic activity. This in turn produces hypo metabolic state which causes decrease in HR and BP[32]. Vyas *et al*., 2002;[26] studied in short as well as long-term Raja Yoga meditators and compared to non-meditators and observed that diastolic blood pressure in non meditators were high as compared to Raja yoga meditators. There is a reduction in stress-induced sympathetic overactivity, which results in lowering of the BP and the HR. Meditation relaxes the whole body and thereby decreases blood vessel tone and peripheral resistance.

The limitation of the study was the sample size as there were many dropouts. The number of long-term Raja yoga meditation practitioners who were diagnosed diabetics was very less in the present center. The rest of the subjects enrolled for the study showed maximum compliance. Hence, we recommend similar but multicentric study with increased sample size from various Brahma Kumaris centers across different regions of Maharashtra.

CONCLUSIONS

The significant decrease in HR and systolic and diastolic BP and better pulmonary function tests in meditators indicate that the persons who practice Raja yoga meditation on a regular basis were at a minor risk of developing cardiorespiratory diseases. Raja yoga meditation maintains the normal homeostasis in the body and has optimistic effects on the cardiopulmonary system, and thus, it can be inspired to be used as a non-pharmacological technique to avoid cardiopulmonary complications in type II DM.

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