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Original Article

Physiotherapy Section

Effect of Yogic Breathing Manoeuvre on Pulmonary Function and VO_2 Max in Male Football Players

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ABSTRACT

Introduction: Yoga has proven to improve spiritual as well as psychophysiological behaviour of a human being. This helps them to perform better in their game improving abdominal strength and gives benefits to every player's need. It also helps improve both physical and mental health.

Aim: To analyse the effects of yogic breathing manoeuvre on pulmonary functions and Maximal Aerobic Capacity (VO_2 max) in male football players.

Materials and Methods: This quasi-experimental study was conducted in Department of Physiotherapy, School of Physiotherapy at D.Y. Patil University, Navi Mumbai, Maharashtra, India, from February 2019 to February 2020. The study included 60 male players within the age group from 18-25 years with at least two years of experience. They were divided into two groups- group A was experimental group and group B was control group. Group A performed pranayama along with routine football specific training and group B performed only football specific training for six weeks. Pre and post values for pulmonary functions and VO_2 max were taken by Pulmonary Function Test (PFT) and Queens College step test as outcome measures. The data was analysed using independent t-test.

Results: Mean age of group A and group B was 19.7±1.69 years and 20.6±1.89 years, respectively. After doing yogic breathing maneuvers for six weeks, there was a significant (p-value <0.001) improvement in pulmonary function and VO_2 max values in male football players for experimental group as compared to control group. The mean difference for Forced Expiratory Volume in 1 second (FEV1) was 0.3% and 0.13% and for VO_2 max was 0.71 mL/kg/min and 2.71 mL/kg/min for control and experimental group, respectively.

Conclusion: Implementing regular practice of yogic breathing manoeuvre along with football training improves pulmonary functions of the football players.

Keywords: Forced expiratory volume, Forced vital capacity, Pulmonary function test, Queens college step test

INTRODUCTION

Football has become a sport that interests all population worldwide. The game demands different skills of rapid acceleration or deceleration, short sprints, jumping, turning, kicking and tackling while playing [1]. Yoga, for a fact, helps player to perform better in their game. Yoga is an ancient science and in these recent years it has become popular all over the world. Yoga techniques include combination of pranayamas (voluntary breathing exercises), dhyana (meditations), and asanas (specific posture). Yoga training includes complex forms of breathing pattern, but the soul of its practice is the powerful bridge between body and mind [2,3]. Pranayama is a deep breathing technique, which decreases the work of breathing and reduces the dead space ventilation. Regular practice of pranayama enhances physical and mental health, improves autonomic tone and reduces the result of stress and strain on the body [4].

Kapalbhati, Bhastrika, Bhramari, Nadi and Sadhana are the various types of pranayama amongst practitioners [5]. The Sanskrit word Kapalbhati is made up of two words in which kapal means forehead or skull and bhati means light, illuminating, shining [6]. Bhramari pranayama is one of the ancient yogic breathing techniques which has proven that it reduces cardiovascular reactivity to stress. Bhastrika pranayama is a Sanskrit word which means breathing like bellows. Bellows was a device which was used to fan fire for producing a strong current of air in ancient days [7].

It has been seen that pulmonary functions provides important clinical information to quantify and identify the defects and abnormalities in the functions of respiratory system [8]. It has been seen that the strength and exercise performance can be dependent on respiratory system of a trained athlete. The gold standard for assessing the cardiorespiratory endurance of a person is by measuring maximal oxygen consumption which is interpreted as VO_2 max. There are various direct and indirect methods used to assess VO_2 max in which Queens College step test uses the prediction equation and uses heart rate. It is not time consuming and does not need any trained personnel [9,10].

In view of the above background, there is no literature available on the effects of Kapalbhati, Bhramari and Bhastrika on pulmonary function and VO_2 max in footballers. Thus, the aim of this study was to evaluate the effects of yogic breathing manoeuvres on pulmonary functions in football players.

MATERIALS AND METHODS

This quasi-experimental study was conducted in Department of Physiotherapy, School of Physiotherapy at D.Y. Patil University, Navi Mumbai, Maharashtra, India, from February 2019 to February 2020. The study included 60 male players within the age group from 18-25 years with at least two years of experience. Ethical clearance was obtained from Institutional Ethics Committee of D.Y. Patil University, Navi Mumbai (Ref. No.- DYPUSOP/313(a)/2018 dated 14th December 2018).

Sixty football players were selected from different football clubs of Navi Mumbai, who participated in the study by convenient sampling. They were divided into two groups:

- Group A- Experimental group (n=30)
- Group B- Control group (n=30)

Sample size calculation: The formula used was [11,12]

$$\eta \geq \frac{^{*}Z_{(1-\alpha/2)}+Z_{(1-\beta)}\{2^{*}(\sigma_1)^2+(\sigma_2)^2\}}{(\mu_1-\mu_2)^2}$$

$Z_{1-\alpha/2}$=1.96 (95% CJ or 5% LS)

$Z_{1-\beta}$=0.84 (80% power)

σ_1=Standard deviation of experimental

σ_2=Standard deviation of control

μ_1-μ_2=difference in mean of experimental group and control group.

The final Mean sample of 30 per group was obtained.

Inclusion criteria: Male football players within the age group from 18 to 25 years, with at least two years of experience were included in the study.

Exclusion criteria: Subject with any musculoskeletal disorder, female participants, and those with history of allergy that would affect breathing were excluded from the study.

Study Procedure

Subjects were explained about the procedure of the study, and a written consent was obtained from them. The data collected were age, gender, height, weight, Body Mass Index (BMI). For the experimental group pranayama session lasted for 15-20 minutes, three days a week for a total of six weeks. These sessions were conducted along with their routine football specific training. The control group received only their routine football specific training.

Pretest, and post-test parameters (after six weeks) for all 60 samples were recorded which included Pulmonary Function Tests (PFT) values:

A-Using portable PFT device

- Forced expiratory volume in the first second (FEV1)- in percentage
- Forced Vital Capacity (FVC)- in Litre
- FEV1/FVC
- Peak Expiratory Flow Rate (PEFR)- L/min

B- Queens College step test

- Maximum amount of oxygen uptake (VO_2 max)- in mL/kg/min

Pulmonary function tests: PFT were performed with a portable spirometer, with the subject sitting in a comfortable chair or stool. The test was repeated for at least three times, and the highest value was considered for the analysis.

Queen's College step test: It was assessed to measure VO_2 max in which maximum oxygen uptake of an individual was seen. The height of the step was 16.25 inches (41.3 cm), and a total duration of three minutes, at the rate of 24 cycles per minute, was set by a metronome. The subjects were asked to warm up for 10 minutes before the test, and the command was given for starting the test as "GO" with stopwatch timer on. It was ensured that every subject maintains the required pace for three minutes [13].

After completion of the exercise, within the recovery period the carotid pulse rate was measured for 5-20 seconds in the standing position. This pulse rate was converted into beats per minute and the following equation was used to predict the maximum oxygen uptake capacity:

PVO_2max (mL/kg/min)=111.33-(0.42×pulse rate in beats/min) [13]:

Yogic Breathing Exercise

After initial recordings of the above-mentioned test, yoga breathing exercises were conducted during the evening practice session in small groups of 5-6 people. Every subject was put into daily practice of yoga breathing exercises (pranayama) for five minutes of each technique. Three pranayama techniques used were: Bhastrika, Bhramari and Kapalbhati [Table/Fig-1] [5,7-9].

Pranayama exercises	Repitations/Time	Elapsed time/ Distance
Bhastrika pranayama	1 repitation (20 times): 2-5 minutes slow to rapid breathing.	Total: 15-20 minutes
Bhramari pranayama	3 repitations (3-5 times): 1-2 minutes	
Kapalbhati pranayama	60 times: Slow repetitions progressing to fast repitations 5-10 minutes	

[Table/Fig-1]: Pranayama exercises protocol.

Players were instructed to sit in a comfortable pose sidhasna or sukhasana (ease pose) with erect spine for all the three techniques.

Bhastrika pranayama: In Bhastrika pranayama (Bellow breathe) players were taught to inhale deeply through nostrils, forcing the diaphragm move down and outwards, expanding the lungs as much as possible, feeling the collar bone rising up and exhaling out quickly through nostrils (which will drop the collar bone). The inflated chest and abdomen starting to shrink as the lung collapse. The process of exhalation was faster than inhalation in this technique [7].

Bhramari pranayama: In Bhramari pranayama (Bee Breathe), players were told to close their eyes by placing the index fingers on forehead and remaining fingers along the sides of nose below eye and near nostrils. After deep inhalation, tip of fingers were used for closing the nostrils to keep the lungs filled, and then exhaling through the nose with humming sound was originated from the throat (OM chanting) [8].

Kapalbhati pranayama: For Kapalbhati pranayama (shinning forehead breath), nasal inspiration was taken through the nose and forceful expiration was done by pulling in the stomach muscles as this placed the emphasis of the breathing on exhalation rather than inhalation. Exhalation time was less than inhalation time. While exhaling, the proper contraction of stomach muscles were noted which helped to push the air out [9].

STATISTICAL ANALYSIS

After six weeks the data was analysed using Statistical Package for the Social Science (SPSS) version 16.0 software. The confidence interval was set at 95% and Chi-square test and independent t-Test was done. The p-value <0.05 was considered significant.

RESULTS

Mean age of group A and group B was 19.7±1.69 years and 20.6±1.89 years, respectively. Height (cm) and weight (kg) for group A was 167.9±6.53 cm and 61.23±6.53 kg and for group B was 166.86±5.98 cm and 60.6±4.08 kg, respectively. Body Mass Index (BMI) for group A was 21.83±1.3 kg/m^2 and for group B was 21.76±0.9 kg/m^2 [Table/Fig-2]. Comparison of mean and SD of PFT functions and VO_2 max at pre and post between experimental and control groups is presented in [Table/Fig-3].

Variables	Control group	Experimental group	p-value
Mean age (years)	20.6±1.89	19.7±1.69	0.06
Body mass index (kg/m^2)	21.76±0.9	21.83±1.3	0.80

[Table/Fig-2]: Comparison of mean and SD of demographic details between experimental and control groups.
Chi-square test, p-value <0.05 was considered significant

Variables	Baseline (Mean±SD)	Post 6 weeks (Mean±SD)	Confidence interval Lower to Upper -95%	p-value
Control group				
FEV1 (%)	3.11±0.14	3.15±0.15	(-0.05) to (-0.02)	<0.001
FVC (L)	3.50±0.20	3.53±0.20	(-0.03) to (-0.02)	<0.001
FEV1/FVC	0.89±0.46	0.89±0.45	(-0.006) to (-0.00)	<0.01
PEFR (L/min)	3.30±0.16	3.34±0.16	(-0.03) to (-0.02)	<0.001
VO_2 max (mL/kg/min)	49.7±4.09	50.4±4.00	(-0.90) to (-0.53)	<0.001
Experimental group				
FEV1 (%)	3.15± 0.23	3.28± 0.23	(-0.14) to (-0.12)	<0.001
FVC (L)	3.51±0.26	3.62±0.27	(-0.11) to (-0.09)	<0.001
FEV1/FVC	0.89±0.03	0.90±0.03	(-0.01) to (-0.006)	<0.001

PEFR (L/min)	3.35±0.21	3.43±0.20	(-0.08) to (-0.07)	<0.001
VO_2 max (mL/kg/min)	49.07±4.5	51.79±4.4	(-2.95) to (-2.47)	<0.001

[Table/Fig-3]: Comparison of mean and SD of PFT functions and VO_2 max at pre and post between experimental and control groups.
FEV1: Forced expiratory volume in the first second; FVC: Forced vital capacity; PEFR: Peak expiratory flow rate; VO_2 max: Maximum amount of oxygen uptake
p-value <0.05 was considered significant by independent t-test

When mean difference (pre and post intervention) was compared between control and experimental group, FVC, PEFR and VO_2 max were seen to be significant whereas FEV1 and FEV1/FVC were non significant [Table/Fig-4].

Variables	Control group	Experimental group	Confidence interval lower to upper -95%	p-value
Mean Differance FEV1 (%)	0.03	0.13	(-0.10) to (-0.07)	0.82
Mean Differance FVC (L)	0.02	0.1	(-0.09) to (-0.06)	**0.001**
Mean Differance FEV1/FVC	0.003	0.009	(-0.009) to (-0.001)	0.123
Mean Differance PEFR (L/min)	0.03	0.08	(-0.05) to (-0.04)	**0.016**
Mean Differance VO_2 max (mL/kg/min)	0.71	2.71	(-2.29) to (-1.70)	**0.028**

[Table/Fig-4]: Comparison of mean differences of PFT functions and VO_2 max at pre and post between experimental and control group.
p-value <0.05 was considered significant by independent t-test

DISCUSSION

In the Indian philosophy, the liberation of soul through perfection is the goal of all the orthodox systems. Yoga is an ancient Indian practice which includes varieties of exercises and breathing techniques which causes betterment of proper health and lung functions. Pranayama is a part of yoga which consists of breathing techniques which can be practiced in slow or fast manner and has three periods: purak (inhalation), kumbhak (retention) and recheck (exhalation) [6,8,11].

The result of this study showed a significant difference with an increase in pulmonary function post intervention in male football players of both experimental and control groups. The above findings were supported by the study from Mooventhan A and Khode V, who concluded that that Bhramari pranayama and OM chanting are used to raise energy levels, calm the body, increase respiratory stamina, relaxing the chest and expanding the lung. Slow and deep breathing exercise reduces the dead space ventilation and restores the air throughout the lungs. During pranayama, the pulmonary stretch receptors are stimulated when the lung is inflated to the maximum. This in turn improves the FEV1 as the stretch receptors decreases the tracheobronchial smooth muscle tone, sequentially decreasing air resistance and increasing airway caliber [8].

Bamne SN concluded that in Bhastrika pranayama, the lung fields are filled and emptied completely and efficiently which increases the strength in respiratory muscles particularly diaphragm. When the lungs are filled there is release of surfactant and prostaglandins in alveolar spaces which decrease the bronchioles smooth muscle tone and increases lung compliance respectively [7]. Similarly in this study, the pulmonary functions improved in the experimental group.

Dinesh T et al., had studied the effect of Kapalbhati pranayama on pulmonary function. They concluded that Kapalbhati pranayama demands breathe coordination at higher rate and therefore requiring higher rate of respiratory muscle activity [4]. In Kapalbhati pranayama there is powerful contraction of the abdominal muscles mainly the external and internal obliques, transverse abdominis and rectus abdominis during force exhalation. Oxygen consumption rates are approximately 1.1-1.8 times higher during Kapalbhati techniques compared to sitting quietly. Rapid Kapalbhati pranayama maintains acid-base balance by making dead space of the lungs active and hence increasing oxygenation of tissues and cleaning the whole body [14].

As players have higher values of lung function compared to normal individuals, regular prolonged forceful inspiration and expiration can lead to increase in respiratory muscle strengthening which helps lungs to inflate and deflate to its maximum capacity. There are rhythmic diaphragmatic movements in improvement of blood circulation of heart and lung muscles [15,16]. Increase in VO_2 max indicates increased oxygen consumption by muscle and decreases in the vascular tone which in turn results in stimulation of parasympathetic activity [17,18]. In the present study, the control group showed significant difference in the values of pulmonary function and VO_2 max due to their regular football specific training. But in the experimental group who were given pranayama techniques along with the football specific training, improvement was observed more than the control group.

The pranayama technique used in this study (bhastrika, bhramari, Kapalbhati) can be used in many sports which mainly focus on the aerobic endurance such as basketball, throwball. It can also be used in anaerobic training such as weight lifting, sprinting, high intensity interval training which involves short, intense burst of physical activities. Now-a-days due to excess of pollution, breathing is getting affected due to less amount of fresh air inspired, which leads to many diseases and lung conditions affecting our lung capacity [19,20]. The yogic breathing manoeuvre can also be incorporated in regular training for other sports as well to reduce the risk of injury and to improve the pulmonary function of a player.

Limitation(s)

In this study the age group that was considered was limited. Moreover, only male club football players who were into the regular practice were included. More studies involving both the gender and a wider age group must be performed.

CONCLUSION(S)

It can be concluded that a six weeks of yogic breathing manoeuvre lead to an increase in pulmonary function and VO_2 max in male football players. This suggests that yogic breathing manoeuvre can be added in training programs, along with aerobic and anaerobic exercises for improvement in the pulmonary function capacity of the players.

Author contributions: SJ has been involved in the conceptualization of the study and data collection, SP contributed towards the methodology and the discussion part, JP contributed towards analysis and writing of the manuscript. All the authors collectively contributed their valuable work for the final manuscript.

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