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Effect of 1 Week Coherent Breathing Exercise Training on Cardiorespiratory Fitness in Healthy Young Adults: An Experimental Study

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Abstract

Background: CRF indicates the ability of the circulatory, respiratory and muscular systems to supply oxygen to body during sustained physical activity. Changes in physical activity levels results in changes in CRF. CRF includes the oxygen uptake, PR, RR, BP and exercise capacity. To improve CRF coherent breathing training can be performed because it has an effect on cardiovascular health. Coherent breathing exercise produce different types of physiological responses in healthy individuals. But to the best of my knowledge there is scarcity of literature which determines the material.

Aim & Objective: Aim of the study is to assess the effect of 1week coherent breathing training on pulse rate, respiratory rate, vo2 max, FVC and Borg scale of perceived rate of exertion in healthy individual.

Material and Methods: An experimental study was conducted among 45 healthy young adults. Participants were included in study who were able to complete queen's college step test. All the subjects have performed coherent breathing training for a 1 week. Pre and post data were collected. The total duration of training was 30 minutes per day.

Results: Results of the study showed that mean value of the PR 82.84 ± 14.41, RR 19.73 ± 3.94, oxygen uptake capacity 47.69 ± 9.26, and FVC 1.95 ± 0.54 and perceive rate of expectation 2.99 ± 1.52. The study also showed that coherent breathing training had positive effect on CRF**.**

Conclusion: The study demonstrate that coherent breathing training is effective in improving CRF.

Key Words: *Cardio respiratory fitness, physical activity, queen's college step test, forced vital capacity and coherent breathing exercise*

Introduction

Physical activity (PA) is a bodily movement that is produced by skeletal muscles and requires energy exposure (1, 2). PA is connected with positive health outcomes, such as lower risks of ischemic heart disease, stroke, diabetes, and depression (3).

Cardiorespiratory fitness (CRF) is an alternative dimension of physical health connected to beneficial health outcomes. CRF defined as the ability of the

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circulatory, respiratory, and muscular systems to supply oxygen while performing moderate to vigorous dynamic exercise (2, 3).

Among risk factors for cardiovascular disease (CVD), deficient CRF has been the powerful indicator of morbidity (4). A growing body of work associates CRF to factors such as age (5), gender (6), life style (7,8) body mass index (BMI) (9) and environment (10).

CRF was positively correlated to vital capacity (VC), forced expiratory volume (FEV) and negatively with BMI, weight, waist circumference, body fat, resting heart rate (RHR), blood pressure (BP) and C-reaction protein (CRP) (11).

The gold standard technique to measure CRF is maximal oxygen consumption (VO2max) (12). Vo2max relies on the body composition, age, gender ethnicity of individuals (13). Vo2max is calculated by direct as well as indirect methods using exercise protocol (14).

The direct calculation of Vo2max is gold standard technique where participants under goes maximal exercises test on cycle ergometer or treadmill and oxygen consumption measured directly (15,16,17) but it requires expensive, impractical in non-laboratory (18),

Pulmonary functional test (PFT) provides estimation of the mechanical function of the lungs (19). Spirometric tests are major measurements for assessing cardiovascular and respiratory functions. Spirometer is a device with mouthpiece hooked up to small electronic machine. An assessment of subjects involves number of tests that measure lung volumes and capacities, gas flow rates, gas diffusion and gas distribution (20).

Any physical activity will promote CRF in some of amount (21). Studies also showed that PA and exercise training resulted in significant CRF improvement (22, 23, 24). CRF works on the circulatory system, respiratory system and muscular system to supply oxygen to skeletal muscles during PA (25). There are some of techniques to improve CRF. Such as aerobic exercise, resistance exercise, walking, tai chi training, breathing exercise and yoga (26, 27, 28).

Coherent breathing also referred as “resonant breathing”. This technique involves slowing the breath-rate to relaxed breathing. The diaphragm functions as a pump, moving down on the inhale to pump food and blood through the digestive tract and moving up on the exhale, pumping blood through the heart and lungs. The autonomic nervous system controls the activity of the circulatory system, and the enteric nervous system conquers the digestive system. Both are innervated by the action of the diaphragm.

Coherent breathing is breathing slowly and deeply at the rate of five breaths a minute with conscious relaxation on the exhale. This self-regulatory technique may provide a state of mind/body balance, resulting in enhanced health and perceived wellness (29).

Gamma aminobutyric acid (GABA), an amino acid neurotransmitter, has connected as a contributing factor in mood disorders (30). The GABA deficit hypothesis of major depressive disorder (MDD) points to the correlation between depressive symptoms and deficits in the GABA system and GABA receptor (31, 32).

Methodology

STUDY DESIGN –Experimental design (Before-and- after without control group)

SAMPLE SIZE- 45 samples were included in the

study

SAMPLING METHOD- Convenient Sampling Method.

PLACE OF STUDY -S. S Agrawal Institute of Physiotherapy and Medical Care Education, Navsari

STUDY DURATION-6 Month

Inclusion Criteria

- Age (17-25) years.
- Both males and females.
- Subject should be able to complete queen's test.
- Subject should be able to perform spirometry test.
- Subject's willingness to participate.

Exclusion Criteria

- Cardiorespiratory diseases
- Any neurological diseases
- Any musculoskeletal disorders including chest and trunk muscles
- Acute injury
- Family history of asthma or other chronic lung diseases
- Recent surgery

TOOLS

- Step box –41.3cm height for male and female
- Metronome
- Spirometer-spiro tech (version1.1.0.27software)
- Mouthpiece
- Electronic weighing scale
- Wall mounted height scale
- Pulse oximeter

Material

- Stop watch
- chair
- Cotton
- Isopropyl
- Consent form

Outcomes Measures

- Pulse rate
- Respiratory rate
- Queen's College step test
- Forced Vital Capacity (FVC)
- Borg Rating of Perceived Exertion Scale

Procedure

Evaluation of undergraduate physiotherapy students was done. I have purposely Selected Physiotherapy students. For adequate representation to sample, the sample size was 45 student's male and female between the age of 18-23 years were taken.

Purpose and objective of study was explained to them and written consent form was obtained prior to conducting the study. Each and every student of Physiotherapy was participated in the study voluntarily.

Demographic data of all 45 students was collected, that includes; name, age, gender, height, weight, BMI,

systolic BP, Diastolic BP, SPO2. Ideally, subjects instructed to avoided exercise for the previous 24h, fasted for at least 2h and avoided the use of foods and drugs that alter heart rate.

The procedure of measuring oxygen consumption capacity (vo_{2max}) is described below:

STEP 1: The subject was lie down on the plinth and rest was given for 3 min, after which the radial pulse was palpated for 15s and resting HR was calculated. During this time the RR was also been calculated.

STEP 2: To get proper timing in step up and down the metronome was set at 88 beats/min during which the subjects were allowed to make contact with a foot on each beep in an up-up-down-down manner. This cadence results in the necessary 22 steps/min necessary for the test on women. For men, set the metronome at 96 beats/min and thus 24 steps/min.

STEP 3: when the subject is ready, begin the 3 min test and start the stopwatch.

STEP 4: during this to avoid muscle fatigue, the subject was switching the leading leg at least once during the rest.

STEP 5: after exactly 3 min of stepping, the subject was given instruction to stop. And the radial pulse was palpated and RR was taken.

STEP 6: After the performance of queen's college step test subjects were asked for their feeling about exertion on Borg rating scale.

STEP 7: calculate the predicted vo_2max by using the recovery HR in the equations below, where HR is beats/min.

Men: VO_2max (ml/kg/min) = 111.33 – (0.42 x HR)

Women: VO_2max (ml/kg/min) = 65.81 – (0.1847 x HR)

STEP 8: record data on individual record sheet.

The procedure of measuring forced vital capacity is described below:

· The whole procedure was explained to the subject about how to put the spirometer mouthpiece in mouth, inhale through nose, take a deep breath and slow breath in, place lips around the mouthpiece, exhale fully and with as much as force as possible.

· The subject in sitting position.

· The subject performed procedure for 3 trails and average value was noted.

The procedure of measuring perceived rate of exertion is described below:

STEP-1 After the performance of queen's step test subjects were asked for their feeling about exertion on Borg rating scale.

The same procedure was repeated in all 45 subjects.

DETAILS OF INTERVENTION

The main components of coherent breathing are: Relax the mind and body, regulate breathing rate to about 5 breaths per minute, i.e., inhale for about 6 seconds then exhale for about 6 seconds so that a single breath takes about 12 seconds and about 5 breaths per minute.

After the conducting assessment, subjects were given the intervention in form of coherent breathing training.

In which subjects were given relaxed upright position not reclining more than 45 degree and following instruction were given:

Ø Take three or four deep breathing using your diaphragm and primarily breathing into belly.

Ø Stopwatch was used to check intervals.

Ø Place your hand on belly and another on diaphragm to evaluate yourselves about performing shallow breathing.

Ø Inhale fairly deeply and then exhale about 6seconds long.

v Continue session for 10minutes and 2 intervals is given so total duration of total duration of session was30 minutes. Total intervention was 6days/ week.

Results

Table no.1: Demographic characteristics of study participants

Characteristic	Mean ± SD / N (%)
Age	19.58±1.51
BMI	18.15±3.06
Systolic BP	118.98±12.68
Diastolic BP	71.49±8.79

Table no.2: Summary of values on Pules rate, respiratory rate, Vo2 max, FVC and perceived rate of exertion(Borg scale)

Variables	Pre- test Mean ± SD	Post- test Mean ± SD	Z-value	p-Value
Pulse rate	86.04 ± 13.20	82.84 ± 14.41	-5.857	0.000
Respiratory rate	21.11 ± 3.94	19.73 ± 3.94	-5.866	0.000
Vo2 max	43.09 ± 9.69	47.69 ± 9.26	-4.124	0.000
FVC	1.76 ± 0.53	1.95 ± 0.54	-3.584	0.000
Perceived rate of exertion	3.77 ± 1.95	2.99 ± 1.52	-3.584	0.000

Table no3: Correlations between PR,RR,BORG SCALE,VO_2MAX and FVC

	Post_RR-Pre_RR	Post_PR-Pre_PR	Post_Vo2-Pre_ Vo2	Post_Borg-Pre_ Borg	Post_FVC-Pre_ FVC
Z	-5.857	-5.866	-4.124	-3.584	-3.590
P	.000	.000	.000	.000	.000

Disscussion

The primary aim of this study was to assess the effect of one-week coherent breathing exercise training on cardiorespiratory fitness in healthy young adults of 17-25 years of age using vo2 max and FVC. Total n=45 subjects were given coherent breathing training. Before and after a week of training pulse rate, respiratory rate, vo2 max, FVC and Borg scale of perceived rate of exertion were taken. The results of the present study indicates that after a week of training score of healthy young individuals had improved in all parameter and results were highly significant (p=0.001)

A normal resting heart rate for adults ranges from 60 to 100 beats per minute. Generally, a lower heart rate at rest implies more efficient heart function and better cardiovascular fitness. [33] There are various therapeutic interventions used to lower heart rate. One of the therapeutic interventions is coherent breathing which involves taking long slow breaths at a rate of about five per minute that helps to calm the body through its effect on the autonomic nervous system. which activate vagus nerve to put the neural brake on a racing heart is to slow down your breath. [34]

The reduction in pulse rate and blood pressure in breathing group may be due to tonic and phasic changes in cardiovascular system [35] and parasympathetic activity also increases with regular practice of breathing exercise. [35,36] Previously it has been shown in various studies that breathing exercise can results in reduction in blood pressure and heart rate**. DP Deepak 2013** found reduction in blood pressure and heart rate with four weeks of anulom-vilom pranayama. [37] **AV Turnakar et al. 2013** also found reduction in pulse rate after breathing exercise, 20 minute per day for 7 days. [36]

Normal Breathing is considered to be systematic with even chest expansion and deflation; Normal Breathing is moreover an unconscious process. The Primary Respiratory Center is situated in medulla oblongata and pons, which are responsible for controlling the rate and depth of breathing. Respiratory Rate or the number of breaths per minute is defined as one breath to each movement of an air in and out of the Lung. Universally the respiratory rate for an adult is between 12 and 20 breathes per minutes, but there will be some variation depending on age and medical condition. [38]

Vidigal et al. conducted one study to find the effects of slow respiration (6 breaths/min) on autonomic response to postural maneuver. In which they concluded slow breathing improved cardiac sympathetic and parasympathetic responsiveness

to physical perturbations, possible reason may be a result of augmented baroreflex sensitivity due to increased parasympathetic tone, and synchronization of sympathetic and parasympathetic systems at 6 breaths per min [39].

Cardiorespiratory fitness is an important indicator of cardiovascular health and thus an important factor in the prevention of non-communicable diseases. CRF, defined as the capacity of circulatory, respiratory and muscular systems to supply oxygen during prolonged physical exercise [40], has a strong inverse relation to the incidence cardiovascular diseases [41], cancer [42], diabetes mellitus, depression [43] and all-cause mortality [41].

VO2 max is the best physiological indicator of a person's capacity to continue severe work. It has been used to indicate cardio respiratory fitness. VO2 max can be measured using variety of exercises that activate the body's large muscle groups. Most of the exercise modes include treadmill running, bench stepping and stationary cycling [44].

One study done by **Johannes Zeiher's** find the well-established relationships in the literature between anthropometric measures (BMI and WC), total PA and physical exercise, and estimated VO2max using data from a nation-wide, population-based cross-sectional health examination survey among adults in Germany [45].

The Forced Vital Capacity is a good predictor of mortality and morbidity. It is correlated to causes of mortality in general population. [46,47] Some studies shows that the developed world has also shown significant association of FVC with cardiovascular diseases [48,49], Cardio vascular events [50], sudden cardiac death [51], metabolic syndrome [52], Diabetes [53,54] and the progression of chronic kidney disease [55]. Low FVC associate with vascular disease. Age, Gende, Height, Height - Squared are strong predictors of lung function. [56] BMI and waist circumference associated with low FVC. [57]

Yoga breathing exercise increases compliance of lungs and thorax, airway resistance and strength of respiratory muscle. There was significant improvement in FVC. Some of the study shows breathing exercises are feasible and can improve lung function. It seems to be beneficial on respiratory efficiency. [58-62]

Slow, deep breathing also resets the autonomic nervous system through stretch-induced inhibitory signals and hyperpolarization currents propagated through both neural and non-neural tissue which synchronizes neural elements in the heart, lungs, limbic system, and cortex4. It is thought that voluntary deep breathing dynamically modulates the autonomic nervous system by generation of physiologic signals. [63] Most of the study results are based on the practice of slow deep breathing for a few weeks to months but the immediate effect of it is less studied. [64]

The Borg Rating of Perceived Exertion (RPE) scale is a tool for measuring an individual's effort and exertion, breathlessness and fatigue during physical work and so is highly relevant for occupational health and safety practice. [65]

Coherent breathing and meditation are each associated with psychological benefits such as enhanced coping, self-efficacy, and positive mood. In addition, they provide spiritual benefits of compassionate understanding and mindful awareness (Evans, 2009). The combination of awareness in the mind/body and awareness of breath associated with coherent breathing and meditation practices is believed to have a positive impact on psychophysiological function (Evans, 2009). The autonomic nervous system benefits are associated with short- and long-term parasympathetic nervous system dominance [29].

Conclusion

The results of the study prove that coherent breathing training is effective in improving cardiorespiratory fitness in healthy adults. Coherent breathing training is effective in maintenance of normal range of PR, RR and BORGE SCORE and increasing VO2MAX and FVC

Conflict of Interest-Nil

Source of Funding- Self

Ethical Clearance –Taken from institutional advisory board.

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