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TO STUDY THE EFFECT OF PHYSICAL ACTIVITY ON AUTONOMIC FUNCTIONS ASSESSED BY FREQUENCY DOMAINS OF HRV AND VARIABLES OF LUNG FUNCTION IN APPERANTLY SOUTH INDIAN HEALTHY YOUNG MALES

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ABSTRACT
Physical activity is known to improve physical fitness and to reduce mortality and morbidity from numerous clinical conditions. Regular exercise decreases sympathetic activity, reactivity and increase in vagal tone. The amount of HRV represents the physiologic and psychological health. There is positive relation seen between physical activity and variables of lung function .Goal of present study is to establish the role of regular exercise to improve HRV and lung function . The present study was conducted at Sree Lakshmi Narayana Institute of Medical Sciences, Pondicherry The major purpose of this analytic type of observational study is to explore the role of physical activity on cardiorespiratory fitness in healthy people. 90 subjects of age group 18-25 years divided into three groups. Each group is having 30 subjects. Subjects were divided into three groups according to leisure time physical activity assessed by metabolic equivalent minutes/week. Variables of lung function recorded were FEV1, FEV1/FVC, PEFR, F EF25-75, and MVV. After 15 min of rest in supine posture continuous ECG for 5 min recorded and heart rate variability was calculated. Hence regular physical activity is associated with increased HRV,improved lung function ,reduced sympathetic activity and increased parasympathetic tone.The results of present study were analysed, each group was compared by using ANOVA. p value <0.05 were considered significant .FVC, FEV1, FEV1/FVC increased significantly with increase in physical activity ($p<0.05$) whereas FEF 25-75% and MVV showed highly significantly increase ($p<0.001$). Results of HRV showed that LF abpower,LFnu and LF/HF ratio decrease significantly with increase in physical activity whereas HF ab power, HFnu and Tpower increase significantly with increase in physical activity. Present study strongly suggests that the intensity or severity of the sports determines the extent of strengthening of the respiratory muscles with a resultant increase in the lung volumes. Present study showed that regular physical activity is associated with increased HRV, reduced sympathetic activity and increased parasympathetic tone and improved cardiorespiratory health. Moderate amount of exercise(1500MET minutes per week-3000 METminutes per week) is sufficient to increase HRV.

Key words: Pulmonary function,Cardiorespiratory, Sports, Lung function.

INTRODUCTION

Physical activity known to improve muscle strength, enhances bone accretion, prevent child obesity, and reduce the risk of cardiovascular diseases [1].Lung function is an important predictive tool of both morbidity and mortality in medical practice.The Buffalo Health Study concluded that pulmonary function is a long term predictor of overall survival rates in both genders and can be used as a tool for general health assessment [2].

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There might be an increase in the maximal shortening of the inspiratory muscles as an effect of training, which has been shown to improve lung function parameters [3] Heart rate variability (HRV) means the oscillations between consecutive instantaneous R-R interals[4]. The amount of HRV represents the physiologic and psychological health. HRV is used for the non invasive assessment of autonomic changes associated with short and long term endurance exercise training in both leisure sports activity and high performance training [5]. Previous studies shown that the regular exercise decrease the sympathetic reactivity and activity after short span of 6 weeks physical training schedule [6]. It is found previously that the long term exercise results in autonomic conditioning that favours the physical performance and HRV has been found to be great value to quantify the changes in autonomic control [7]. A large number of studies on exercise and physical training clearly indicate that the autonomic parameters serve as marker of training effect. Blom EH also showed that heart rate variability is related to selfreported physical activity [8]. This study is designed to evaluate how much amount of physical activity can improve HRV. So in present study HRV is measured in three groups which are divided according to amount of physical activity

MATERIALS AND METHODS

The protocol of this study was approved by the institutional review board of SBMCH,Chennai and Sri Lakshmi Narayana Institute of Medical Sciences, Pondicherry. The study cohort consisted of 90 medical students in the age group of 17- 25 years from September to November 2013. These medical students were divided into three groups according to MET value [9] (after calculating 7 days physical activity).

Category 1 - LOW –This is lowest level of physical activity. Those individuals who do not meet criteria for categories 2 and 3.

Category 2- MODERATE

- 3 or more days of vigorous intensity activity of at least 20 minutes per day OR
- 5 or more days of moderate –intensity activity and/or walking at least 30 minutes per day. OR
- 5or more days of any combination of walking, moderate intensity or vigorous intensity activites achieving a minimum total physical activity of atleast 1500 MET-minutes/week.

Category 3- HIGH-

- Vigorous-intensity activity on at least 3 days achieving a minimum total physical activity of at least 1500 MET-minutes/week. OR
- 2)7 or more days of any combination of walking, moderate intensity or vigorous intensity activities achieving a minimum total physical activity of at least 3000 MET-minutes/week.

MET minutes per week =MET level*minutes of activity/day*days per week.

Inclusion criteria: Apparently healthy young adults with age group 18-25 years.

Exclusion criteria-Subject having following features will be excluded.

Cardiorespiratory disease, Thyroid disease Diabetes mellitus, Smokers, Alcoholic, any previous history of COPD.

Short term 5 minutes HRV recording: Use of tobacco or intake of tea,coffee,caffenine containing soft drinks or beta stimulant asthama medication was not allowed 1hr prior to the measurement. After filling physical activity score performa subjects were allowed to rest in supine position for 15minutes in a quiet temperature controlled room at 26±1ºC. ECG was run for 5 minutes for leadI, IIor III for each subject in morning between 9am to 10am. Beat by beat RR interval values were obtained from ECG signals using HRV soft version 1.0. ECG runs for 5minutes was subjected to transformations and analysis using HRV soft version 1.0 developed by AIIMS, New Delhi.

The power spectral density of RR interval was estimated by Fast Fourier Transform, which represented prominent bands of the major oscillatory components of HRV. The High frequency component occurs at frequency of adult respiration, 0.15-0.40 Hz and primarily reflectcadiac parasympathetic influence due to respiratatory sinus arrhythmia. The low frequency component occurs within 0.04-0.15 Hz.

Lung function test

Variables of lung function recorded by RMS Helios spirometer were FVC, FEV_1,FEV_1/FVC, $FEV_{0.5}$, PEFR, $FEF_{25-75\%}$, and MVV for all 3 groups

The results were analyzed for significant differences between groups and within groups by one way ANOVA followed by post hoc Tukey's test. P-values less than 0.05 were considered significant. Primer is used for statistical analysis.

Table 1: Baseline characterstics of subjects in three groups.

	Category 1	Category 2	Category 3
Age(years)	19.09±1.75	18.88±1.57	19.4±1.79
Height (cm)	69.67±4.49	172.20±5.66	172.88±6.5
Weight (kg)	63.07±14.27	63.07±8.12	64.56±13.4
BMI(kg/m^2)	21.87±4.16	21.87±2.75	21.62±3.4

Table 2: Observed power spectral density of RR interval and derived parameters in three groups.

	Category 1	Category 2	Category 3	P values	P-values
LF ab Power	1961±554	1167±670.4	1014±585	<0.05(S)	0.000
HF ab Power	1303±998	1743±1108	2206±1469		0.018
LFnu	57.3±11.85	46.55±15.11	43.26±14.42	<0.05(S)	0.00
HFnu	42.77±11.93	53.45±15.11	56.56±14.72	<0.05(S)	0.00
LF/HF	1.56±0.83	1.08±0.75	0.89±0.49	<0.05(S)	0.001
T.Power	2619±1341	4641±3175	4886±2868	<0.05(S)	0.002

Table 3: Comparison of variables of lung function among 3 groups.

Parameters	Category 1	Category 2	Category 3	pVALUE
FVC(L)	2.81±.61	3±.64	3.5±.62	<0.05(S)
FEV_1(L)	2.61±.46	2.89±.34	3±.38	<0.05(S)
FEV1/FVC	94.85±2.53	96.4±2.4	99.17±2.3	<0.05(S)
PEFR(L)	6.36±2.8	7.3±2.9	3±2.66	>0.05(NS)
FEF_{25-75}(L/S)	4.3±1.29	5.03±1.77	4.9±1.55	<0.001(HS)
FEV0.52	1.99±1.77	2.33±.61	2. 3±.54	>0.05(NS)
MVV(L/M)	105±20.5	125.7±21.5	115.5±17.1	<0.001(HS)

DISCUSSION

The results of heart rate variability of present study showed LF ab power, LFnu, LF/HF ratio significantly decrease with increase in physical activity indicating decrease in sympathetic activity with increase in physical activity. HFab power, HFnu and T Power significantly increase with increasing physical activity indicating increase in parasympathetic activity. When post hoc Tukey Test is done LFab power, LFnu and LF/HF ratio significantly decrease when comparision is done between category1 vs 2 and category 1 vs 3. HFab power, HFnu and T Power is significantly increase with increase in physical activity when comparision is done between category 1 vs2 and category 1 vs3. There is no significant difference observed when comparision done between category 2 vs 3.

Decrease sympathetic activity shown in present study with increase in physical activity is in accordance of study done by Dixon EM [10]. Increased parasympathetic activity with increase in physical activity observed in present study is also observed in previous studies [11-14]. Low to moderate intensity exercise is associated with favorable changes in HRV is shown in middle aged people by Tuomainenetal [15]. This is in line with finding of present study. Present study shows that there is no additional benefits when physical activity increase from moderate level to high intensity level. This is in accordance to study done by Gamelin [16].

The results lung functions of the present study suggested that there was a significant increase in lung function parameters with increase in physical activity. Table 2 showed significant increase ($p<0.05$) in FVC, FEV_1, EV_1/FVC with increase of day to day physical activity as calculated by MET score. EF25-75 and MVV showed highly significant increase ($p<0.001$) with increase in day today physical activity as calculated by MET score. Our finding are in accordance with previous studies that physical inactivity is linked with low cardiovascular fitness and thus recognised as important cause of morbidity and mortality [17]. A study on Chinese school children showed that physical activities positively associated with lung function growth [18]. Bernsten and colleagues found that FVC and FEV1 tended to increase with increasing level of physical activity [19]. Jones et al reported that physical active children had a greater ventilatory capacity than inactive peers [20]. In Norway, Nystad et al. found a trend of decline in lung function with decreasing level of physical activity in all age groups in both men and women [21] An association between physical activity and FEV_1 and FVC has been reported by previous studies in the general population. Men who remained active had higher FEV_1 and FVC than those who led a sedentary lifestyle [22-23]. Our study was done in order to analyse the effects of physical activity on cardiorespiratory functionin healthy adults. Its limitations included the small sample size, inability to measure maximal oxygen uptake (VO2 max), forced expiratory flow and peak expiratory flow

CONCLUSION

Repeated periodic exercise helped in improving lungfunctions especially FEV1 and ratio of FEV1/FVC. Periodicmeasurement of FEV1 can help in generating awarenessregarding lifestyle modifications, and acquiring a healthyhabit of being active Thus according to present study it is concluded that increase in physical activity increases cardiac vagal activity and hence improve health. This increase in cardiac vagal activity is caused by several metabolic, biochemicals, hormonal and neural changes in body. Increase physical activity reduces daily stress, regulate fat metabolism, slow resting HR and improve cardiorespiratory capacity, all of which are associated with increase in cardiac vagal tone. Exercise has beneficial

effect on insulin resistance, lipid profiles and arterial blood pressure which is associated with improvement in autonomic balance [23].

Moreover it is concluded that moderate exercise is sufficient to improve HRV and health. Increasing physical activity more than 3000 MET minutes/week has no added beneficial effect on HRV.

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