International Journal of Basic and Applied Medical Sciences ISSN: 2277-2103 (Online)
An Open Access, Online International Journal Available at http://www.cibtech.org/jms.htm
2014 Vol. 4 (3) September-December, pp. 44-48/Gupta et al.
Research Article

A STUDY OF EFFECT OF PHYSICAL ACTIVITY ON AUTONOMIC FUNCTIONS ASSESSED BY FREQUENCY DOMAINS OF HRV IN HEALTHY YOUNG MALES

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ABSTRACT
The amount of HRV represents the physiologic and psychological health. Regular exercise decreases sympathetic activity and reactivity and increase in vagal tone. Goal of present study is to determine whether regular exercise increases heart rate variability and minimum how much amount of exercise is required to improve HRV and health. The study was conducted on 90 young, healthy males of age group 18-25 years. Subjects were divided into three groups according to physical activity assessed by Metabolic equivalent minutes per week. Category 1-low MET score<1500 MET min per week. Category 2-moderate 1500-3000 MET min per week. Category 3-high >3000 MET min per week. After 15 min of rest in supine posture continuous ECG for 5 min recorded and heart rate variability was calculated. These 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. LF ab power (), LFnu () and LF/HF ratio () decrease significantly with increase in physical activity. HF ab power (), HFnu () and Tpower () increase significantly with increase in physical activity. Post hoc Tukey's test shows that there is no significant difference of LFab power, HFab power, LFnu, HFnu, LF/HF ratio and Tpower when comparison was done between category 2 vs 3. Hence regular physical activity is associated with increased HRV, reduced sympathetic activity and increased parasympathetic tone and improved health. Moderate amount of exercise (1500MET minutes per week-3000 MET minutes per week) is sufficient to increase HRV. Vigorous exercise has no added beneficial effect on HRV.

Keywords: *Heart Rate Variability, Physical Activity, Metabolic Equivalent Minutes per Week, Sympathetic Activity, Parasympathetic Activity*

INTRODUCTION
Heart rate variability (HRV) means the oscillations between consecutive instantaneous R-R integrals (Unsitalo *et al.,* 2004). 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 (Hottenrott *et al.,* 2006). Previous studies shown that the regular exercise decrease the sympathetic reactivity and activity after short span of 6 weeks physical training schedule (Deepak *et al.,* 1999). It is found previously that the long term exercise results in autonomic conditioning that favors the physical performance and HRV has been found to be great value to quantify the changes in autonomic control (Simons *et al.,* 2010). A large number of studies on exercise and physical training clearly indicate that the autonomic parameters serve as marker of training effect. Blom *et al.,* (2009) also showed that heart rate variability is related to self reported physical activity (Blom *et al.,* 2009). 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 study cohort consisted of 90 medical students in the age group of 17- 25 years who underwent a short term HRV laboratory from September to November 2013. These medical students were divided into three groups according to level of physical activity calculated by physical activity questionnaire ()[7].

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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

1) 3 or more days of vigorous intensity activity of at least 20 minutes per day OR
2) 5 or more days of moderate –intensity activity and/or walking at least 30 minutes per day. OR
3) 5or more days of any combination of walking, moderate intensity or vigorous intensity activates achieving a minimum total physical activity of at least 1500 MET-minutes/week.

Category 3 High

1) 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.

Subjects with acute illness, any chronic ailments, smokers and alcoholics were excluded. The study was approved by Ethics Committee of S.M.S. Medical College, Jaipur.

Short term 5 Minutes HRV Recording: Use of tobacco or intake of tea, coffee, caffeine containing soft drinks or beta stimulant asthma 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 lead I, II or 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 reflects cadiac parasympathetic influence due to respiratatory sinus arrhythmia. The low frequency component occurs within 0.04-0.15 Hz.

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.

Calculating Physical Activity Score[7]

Type of activity	**Total time/week**	**Intensity level**	**MET values assigned**	**Activity scores**
Work				
College				
Walking				
Light house work				
Heavy house work				
Gardening				
Manual work				
Sports-running/jogging				
Sports –football/rugby				
Sleep				
Leisure (left over)				
Total				

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Met Values Assigned for those Aged 16 and Over (Mendell and Holmes)

Activity	**Met value**	
Walking		
Slow pace	2.5	
Steady ,average pace	3.3	
Fairly brisk pace	3.8	
Fast pace-at least 4mph	5.0	
Work		
Very physically active	6.5	
Fairly physically active	3.5	
Not very physically	2.3	
Not at all physically active	1.5	
College		
Very physically active	3.7	
Fairly physically active	3.1	
Not very physically	2.3	
Not at all physically active	1.5	
Sports	Sweaty /out of breath	Not sweaty/out of breath
Swimming	8.0	5.0
Cycling	8.0	5.0
Work out at gym/exercise bike/weight training	6.9	3.33
Aerobics /keep fit/gymnastics/dance for fitness	5.75	4.38
Any other type of dancing	4.83	3.0
Running /jogging	9.0	5.0
Football /rugby	9.5	5.0
Badminton /tennis	5.75	4.5
Squash	12.0	5.0
Exercise (eg. Press up/sit ups)	8.0	4.25
Housework –light	2.96	
Housework –heavy	3.08	
Gardening	3.89	
Manual work	5.93	
Sleep	0.9	
Leisure	1.0	

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Observations

Table 1: Baseline characteristics 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
LF ab Power	1961±554	1167±670.4	1014±585	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	0.00
HFnu	42.77±11.93	53.45±15.11	56.56±14.72	0.00
LF/HF	1.56±0.83	1.08±0.75	0.89±0.49	0.001
T. Power	2619±1341	4641±3175	4886±2868	0.002

Table 3: Tukey Test

Comparison	LFab power	HF ab power	LFnu	HFnu	LF/HF	T Power
Category 1 vs 2	Yes	No	Yes	Yes	Yes	Yes
Category 1 vs3	Yes	Yes	Yes	Yes	Yes	Yes
Category 2 vs 3	No	No	No	No	No	No

P<0.05→YES

RESULTS AND DISCUSSION

Present study shows 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 comparison 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 comparison is done between category 1 vs2 and category 1 vs3. There is no significant difference observed when comparison done between category 2vs3.

Decrease sympathetic activity shown in present study with increase in physical activity is in accordance of study done by Dixon *et al.,* (1992). Increased parasympathetic activity with increase in physical activity observed in present study is also observed in previous studies (Goldsmith *et al.,* 1992; Puig *et al.,* 1993; Shin *et al.,* 1997; Shin *et al.,* 1995). Low to moderate intensity exercise is associated with favorable changes in HRV is shown in middle aged people by Unsital *et al.,* (2004). This is in line with finding of present study. Present study shows that there are no additional benefits when physical activity increase from moderate level to high intensity level. This is in accordance to study done by Gamelin *et al.,* (2009).

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 (Jurca *et al.,* 2004).

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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Implication of Study

By further studying the amount and type of physical activity and its effect on HRV we can devise an exercise program to improve HRV and thus can be used in rehabilitation of patients. On the basis of this study young people can be encouraged to improve physical activity to improve health.

Limitation of Study

In present study measuring physical activity relies on question are in which moderate activities such as walking and home related tasks are reported less accurately than vigorous activities such as jogging or swimming that are planned and structured. Such measurement errors can change the result.

Thus physical activity improves HRV and health. Physical activity1500 MET minute/week to 3000 MET minutes/week is sufficient to improve HRV and thus health.

REFERENCES

Blom EH, Olsson EMG, Serlachius E and Ericson M (2009). Heart rate variability is related to selfreported physical activity in a healthy adolescent population. *European Journal of Applied Physiology* **106** 877-883.

Deepak KK, Kaushal N, Shaw D, Pandey RM and Paudel BM (1999). Predictive value of autonomic parameters for outcome of physical training. *Clinics Auto Research* **9** 222.

Dixon EM, Kamath MV, Mc Cartney N and Fallen EL (1992). Neural regulation of heart rate variability in endurance athletes and sedentary controls. *Cardiovascular Research* **26**(7) 713-9.

Gamelin FX, Baquet G, Berthoin S, Thevenet D, Nourry C, Nottin S and Bosquet L (2009). Effect of high intensity intermittent training on heart rate variability in prepubescent children. *European Journal of Applied Physiology* **105** 731-738.

Goldsmith RL, Bigger JT Jr, Steinman RC and Fleiss JL (1992). Comparision of 24hour parasympathetic activity in endurance trained and untrained young men. *Journal of the American College of Cardiology* **20**(3) 552-8.

Hottenrott K, Hoos O and Esperer HD (2006). Heart rate variability and physical exercise. *Herz* **31**(6) 544-52.

International physical activity questionnaire Nov 2005

Jurca R, Church TS, Moss GM, Jordan AN and Earnest CP (2004). Eight weeks of moderate – intensity exercise training increases heart rate variability in sedentary postmenopausal women. *American Heart Journal* **147**(5).

Mendell J and Holmes B (No Date). *Physical Activity*, Chapter 15, LINDS **3** 101-129.

Puig J, Freitas J, Carvalho MJ, Puga N, Ramos J and Fernandes P *et al.*, (1993). Spectral analysis of heart rate variability in athletes. *Journal of Sports Medicine and Physical Fitness* **33**(1) 44-8.

Shin K, Minamitani H, Onishi S, Yamazaki H and Lee M (1997). Autonomic differences between athletes and nonathletes : spectral analysis approach. *Medicine and Science in Sports and Exercise* **29** 1482-1490.

Shin K, Minanitani H, Onishi S, Yamazaki H and Lee M (1995). The power spectral analysis of heart rate variability in atheletes during dynamic exercise part 1. *Clinical Cardiology* **18**(10) 583-6.

Simons RP, Mendes RG, Castello V, Machado HG, Almeida LB, Baldissea V, Catai AM *et al.*, (2010). Heart rate variability and blood lactate threshold interaction during progressive resistance exercise in healthy older man. *The Journal of Strength & Conditioning Research* **24** 1313-1320.

Unsital ALT, Tomilaitinen, Vaisanen SB and Lansimies E (2004). Physical training and heart rate and blood pressure variability a 5 year randomized trial. *American Journal of Physiology - Heart and Circulatory Physiology* **286** H1821-H1826.

Unsitalo ALT, Laitinen T, Vaisanen SB, Lansimies E and Rautamaa R (2004). Physical training and heart rate and blood pressure variability: a 5yr randomized trial. *American Journal of Physiology* **286** H1821-H1826.

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