Journal of Advanced Medical and Dental Sciences Research

@Society of Scientific Research and Studies ***NLM ID:*** *101716117*

Journal home page: www.jamdsr.com doi: 10.21276/jamdsr Index Copernicus value = 85.10

(e) ISSN Online: 2321-9599; (p) ISSN Print: 2348-6805

Original Research

Physical exercise & cardiac autonomic activity- A clinical study

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ABSTRACT:
Background: The autonomic nervous system (ANS) plays a central role in regulating human bodily functions. The present study was conducted to evaluate the effect of physical exercise on cardiac autonomic activity in adult population. **Materials & Methods:** The present study consisted of 80 males. Group I subjects were subjected to regular exercise programme (endurance training - treadmill walking, running, cycling etc.) for 3 months daily and group II subjects were non- exercise group. Spectral powers of HF, LF were expressed in absolute (ms^2) and normalized units (nu). HRV analysis was calculated. **Results:** The mean heart rate in group I was 70.2 beats/min and in group II was 74.4 beats/min. Systolic blood pressure was 122.4 mm Hg in group I and 110.6 mm Hg in group II. Diastolic blood pressure was 76.2 mm Hg in group I and 80.0 mm Hg in group II. The mean LF (ms2) was 2830.2 and 3190.6, LF (nu) was 902.0 and 924.2, HF (ms2) was 732.8 and 1114.8, HF (nu) was 40.6 and 41.8 and LF/ HF was 1.72 and 1.40 in group I and II respectively. The difference was non- significant (P< 0.05). **Conclusion:** There was no significant effect on cardiac autonomic activity including heart rate variability with regular exercise.
Key words: autonomic nervous system, Heart rate variability, physical exercise

Received: 1 October, 2021 Accepted: 2 November, 2021

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This article may be cited as: Chaturvedi AK, Kumar D, Garg S, Gandhi S. Physical exercise & cardiac autonomic activity- A clinical study. J Adv Med Dent Scie Res 2021;9(11):66-69.

INTRODUCTION
The autonomic nervous system (ANS) plays a central role in regulating human bodily functions. Heart rate variability (HRV) is a non-invasive tool for assessing beat-to-beat changes in HR dynamics.[1] HRV reflects the output of sympathetic and parasympathetic (vagal) activity of ANS, and the vagal HRV influence dominates under resting conditions in healthy persons. Lower levels of vagal HRV indicate ANS imbalance and have been associated with various cardiovascular and metabolic diseases, including type 2 diabetes, metabolic syndrome, hypertension and coronary heart disease, as well as all-cause mortality.[2]
Quantifying the fluctuations in R-wave to R-wave intervals (RRI), referred to as heart rate variability (HRV), has been considered a useful method by which to monitor autonomic activity, in particular cardiac parasympathetic modulation.[3] Monitoring HRV responses to an "exercise challenge test" may provide useful insight into autonomic stress reactivity.[4] This is consistent with the "reactivity hypothesis", which proposes that cardiovascular responses to a stressor may be predictive of certain diseases as well as useful in monitoring the training status of high performance athletes.[5] For example, HRV kinetics during submaximal or maximal exercise may be predictive of aerobic fitness and exercise performance. Similarly, HRV recovery following exercise occurs more rapidly in individuals with greater aerobic fitness.[6] The present study was conducted to evaluate the effect of physical exercise on cardiac autonomic activity in adult population.

MATERIALS & METHODS
The present study consisted of 80 males. All were informed regarding the study and their written consent was obtained.
Data such as name, age etc. was recorded in case history proforma. We divided men into 2 groups of 40 each. Group I subjects were subjected to regular

exercise programme (endurance training - treadmill walking, running, cycling etc.) for 3 months daily and group II subjects were non- exercise group. Global Physical Activity Questionnaire assessed physical activity level. BMI was calculated as weight/height^2 (kg/m2). Blood pressure was also recorded.

ECG was performed in all. Spectral analysis was performed using the Fast Fourier Transform. Frequency domain parameters like total power (TP), high frequency (HF), (0.15 - 0.4 Hz), low frequency (LF), (0.04 - 0.15 Hz) and LF/HF components were obtained. Spectral powers of HF, LF were expressed in absolute (ms^2) and normalized units (nu). HRV analysis was calculated. Results thus obtained were subjected to statistical analysis. P value less than 0.05 was considered significant.

RESULTS

Table I Distribution of subjects

Groups	Group I	Group II
Status	Exercise group	Non- exercise group
Number	40	40

Table I shows that group I subjects were subjected to regular exercise programme and group II subjects were non- exercise group.

Table II Assessment of parameters

Parameters	Group I	Group II	P value
Heart rate (beats/min)	70.2	74.4	0.15
SBP (mm Hg)	122.4	110.6	0.11
DBP (mm Hg)	76.2	80.0	0.92

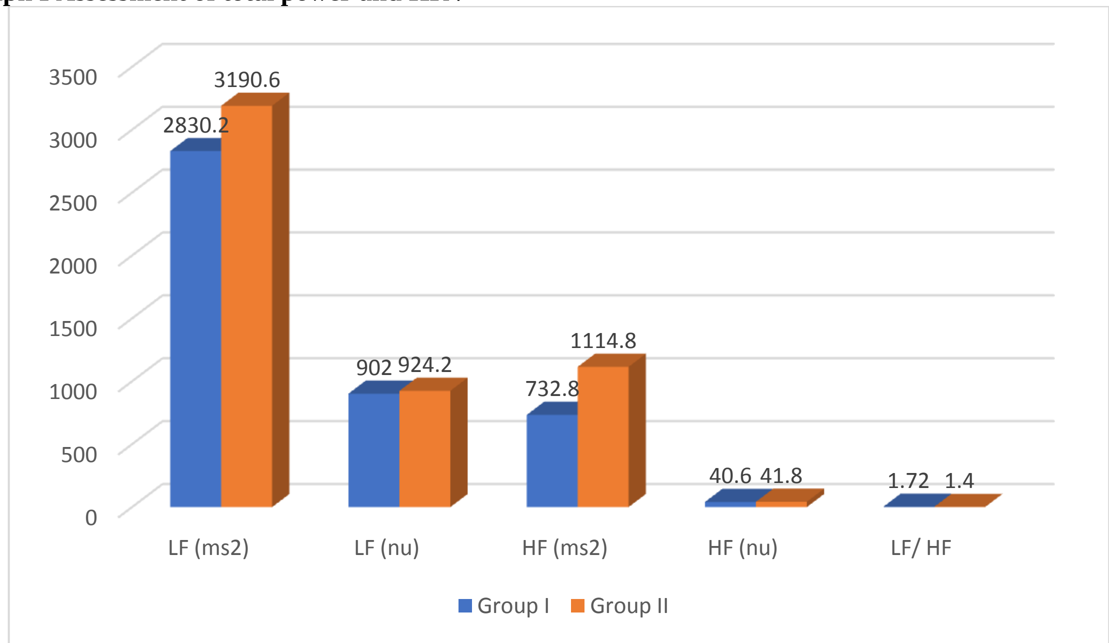
Table II shows that mean heart rate in group I was 70.2 beats/min and in group II was 74.4 beats/min. Systolic blood pressure was 122.4 mm Hg in group I and 110.6 mm Hg in group II. Diastolic blood pressure was 76.2 mm Hg in group I and 80.0 mm Hg in group II. The difference was non- significant (P> 0.05).

Table III Assessment of total power and HRV

Parameters	Group I	Group II	P value
LF (ms2)	2830.2	3190.6	0.21
LF (nu)	902.0	924.2	0.14
HF (ms2)	732.8	1114.8	0.01
HF (nu)	40.6	41.8	0.17
LF/ HF	1.72	1.40	0.15

Table III, graph I shows that mean LF (ms2) was 2830.2 and 3190.6, LF (nu) was 902.0 and 924.2, HF (ms2) was 732.8 and 1114.8, HF (nu) was 40.6 and 41.8 and LF/ HF was 1.72 and 1.40 in group I and II respectively. The difference was non- significant (P< 0.05).

Graph I Assessment of total power and HRV



DISCUSSION

Exercise can be performed in a multitude of different forms, including “aerobic” exercise (dynamic rhythmic exercise involving a large muscle mass, e.g., running and cycling), resistance exercise (e.g., weight/resistance training) as well as other forms (e.g., non-rhythmic/stochastic exercise, mixed-mode exercise, yoga, etc.), which may all elicit different effects on cardiac autonomic activity and HRV measures.[7] Furthermore, these different types are each characterized by multiple sub-divisions that may be considered to constitute the exercise “dosage.” The focus of this review is on dynamic “aerobic” exercise as this form has received the most attention regarding HRV responses and is commonly used for exercise stress tests.[8] The American College of Sports Medicine (ACSM) states that an acute bout of aerobic exercise can be modified by three primary factors constituting the exercise dose: intensity, duration, and modality. If HRV responses to exercise and post-exercise recovery are to be interpreted with any diagnostic/prognostic value, it is important to establish how these factors of exercise prescription influence the response.[9] The present study was conducted to evaluate the effect of physical exercise on cardiac autonomic activity in adult population.

We observed that group I subjects were subjected to regular exercise programme and group II subjects were non- exercise group. Several studies have investigated HRV during exercise. However, in addition to widely varying HRV analysis methodologies amongst the HRV literature, studies employing exercise with HRV measurements also vary markedly in terms of the participants and exercise protocol. Studies have used a range of exercise modalities, with cycling the most common mode employed, although walking/running has also been utilized.[10] Other modes less commonly used are arm-cranking rowing and swimming. Regarding the effect of exercise dose factors (intensity, duration, and modality), intensity has received the most investigative attention, while fewer studies have investigated the effects of duration and modality.[11]

We observed that mean heart rate in group I was 70.2 beats/min and in group II was 74.4 beats/min. Systolic blood pressure was 122.4 mm Hg in group I and 110.6 mm Hg in group II. Diastolic blood pressure was 76.2 mm Hg in group I and 80.0 mm Hg in group II. Tiu et al[12] in their study Group I (Exercising group) comprised of 44 men and group II (Non exercising group) comprised of 44 men found that group I had mean heart rate of 72.38 beats/min and group II had 74.21 beats/ min. The mean systolic blood pressure in group I was 114.26 mmHg and in group II was 110.42 mm Hg. The mean diastolic blood pressure in group I was 74.56 mmHg and in group II was 75.8 mm Hg. Total power of HRV in both groups was compared which was not statistically significant (P> 0.05). There was no significant difference in LF and HF components of frequency domain parameters both in absolute and normalized units. LF/HF component did not show any significance statistically. Physical activity level was 4120±1235.23 in group I and 1206.4±1025.13 in group II.

Tornberg et al[13] investigated how overall self-reported PA associates with HRV in a large population of adolescent men. The study was part of the Finnish MOPO study consisting of 3629 young men enrolled for military call-ups in 2009–2013. Overall PA, including both the intensity and frequency of habitual exercise, was assessed by a questionnaire and the respondents categorized into four groups of PA (low, moderate, high and top). Short-term HRV, physical performance and body composition were measured. HRV, as indicated by mean ln rMSSD, increased according the PA categories as follows: low (3.65 ms (SD 0.7), p<0.001 vs. other groups), moderate (3.78 ms (0.6) p<0.001), high (3.85 ms (0.6) p<0.001) and top activity (3.93 ms (0.6) p<0.001) According to the multivariable linear regression analysis, a significant positive relationship (β = 0.129, p<0.05) was observed between self-reported PA and ln rMSSD independent of body mass index, waist circumference and fat percentage.

CONCLUSION

Authors found that there was no significant effect on cardiac autonomic activity including heart rate variability with regular exercise.

REFERENCES

1. Rennie KL, Hemingway H, Kumari M, Brunner E, Malik M, Marmot M. Effects of moderate and vigorous physical activity on heart rate variability in a British study of civil servants. Am J Epidemiol. 2003 Jul 15; 158(2):135–43.
2. Oliveira RS, Barker AR, Wilkinson KM, Abbott RA, Williams CA. Is cardiac autonomic function associated with cardiorespiratory fitness and physical activity in children and adolescents? A systematic review of cross-sectional studies. Int J Cardiol. 2017 Jun 1; 236:113–22.
3. Sandercock GR, Hardy-Shepherd D, Nunan D, Brodie D. The relationships between self-assessed habitual physical activity and non-invasive measures of cardiac autonomic modulation in young healthy volunteers. J Sports Sci. 2008. September;26(11):1171–7.
4. Melanson EL. Resting heart rate variability in men varying in habitual physical activity. Med Sci Sports Exerc. 2000. November;32(11):1894–901.
5. Hautala AJ, Makikallio TH, Kiviniemi A, Laukkanen RT, Nissila S, Huikuri HV, et al. Cardiovascular autonomic function correlates with the response to aerobic training in healthy sedentary subjects. Am J Physiol Heart Circ Physiol. 2003. October;285(4):1747.
6. Shephard RJ. Exercise for patients with congestive heart failure. Sports Med. 1997;23:75–92. 5. Sloan RP, Shapiro PA, DeMeersman RE et al. The Effectof Aerobic Training and Cardiac Autonomic Regulation in Young Adults. American Journal of Public Health. 2009; 99: 921–928.

7. Pigozzi F, Alabiso A, Parisi A et al. Effect of aerobic exercise training on 24 hr profile of heart rate variability in female athelets. J Sports Med Phys Fitness. 2001; 41: 101–107.
8. Blair SN, Kohl HW 3rd, Paffenbarger RS Jr, Clark DG, Cooper KH, Gibbons LW. Physical fitness and all-cause mortality. A prospective study of healthy men and women. JAMA. 1989 Nov 3; 262(17):2395– 401.
9. Lee IM, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT, et al. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. Lancet. 2012 Jul 21; 380(9838):219–29.
10. Sallis JF, Bull F, Guthold R, Heath GW, Inoue S, Kelly P, et al. Progress in physical activity over the Olympic quadrennium. Lancet. 2016 Sep 24; 388(10051):1325–36.
11. Hallal PC, Andersen LB, Bull FC, Guthold R, Haskell W, Ekelund U, et al. Global physical activity levels: surveillance progress, pitfalls, and prospects. Lancet. 2012 Jul 21; 380(9838):247–57.
12. Tiu DN, Dubey P. Effect of physical exercise on cardiac autonomic activity: A clinical study. J Adv Med Dent Scie Res 2017;5(3):10-13.
13. Tornberg J, Ikaheimo TM, Kiviniemi A, Pyky R, Hautala A, Ma¨ntysaari M, et al. Physical activity is associated with cardiac autonomic function in adolescent men. PLoS ONE 2019;14(9): e0222121.