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Original Research Article

Effect of Sports on State and Trait Anxiety & Heart Rate Variability

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Abstract: The main objective is to study effect of sports on state & trait anxiety and HRV. The method is Written informed consent was taken from Age matched University students of age group 16-25 year (those answered NO to all physical activity readiness questions) for recording of Spielberger's state and trait anxiety inventory questionnaires reply. For Heart Rate Variability observations; subject's preparation was done as per protocol. Time domain analysis determines parasympathetic activity while frequency domain analysis determines both sympathetic and parasympathetic activity. Poincare analysis provides data on the vagosympathetic balance. Comparison was made between Non exercise control group (n=31), exercise group (n=31) which had an intervention of at least 60 minutes of various sports of moderate to vigorous intensity and all the observation were taken in resting condition after one hour of sports; by applying student t test for equality of means at significance (2-tailed) at p value<0.05. The results In Exercise group ;Resting state anxiety was less ,trait anxiety was high, total anxiety was less(p>.05);.Resting Time Domain HRV showed that No. of RR interval were significantly less(p<.001), means low heart rate and increased parasympathetic activity (P>.05) Resting Frequency Domain HRV showed that higher non harmonic VLF activity(neuroendocrinal, temperature regulation) less sympathovagal balance LF/HF and higher parasympathetic activity (p>.05).Resting Nonlinear HRV showed higher vagosympathetic balance SD1/SD2, higher parasympathetic activity, higher sympathetic activity, higher HRV Triangular index, higher TINN (approximate total power) in comparison to non exercise group(P>.05). in conclusion the One hour of Sports intervention ,decreased State Anxiety ,significantly decreased Resting Heart Rate this indicate an economic functioning of heart and increased Heart Rate Variability this indicates a good interplay or modulation between parasympathetic and sympathetic nervous system. Study also reflected Physiological basis of Anxiety and HRV.
Keywords: Sports, State & Trait Anxiety: Heart Rate Variability

INTRODUCTION

National Mental Health programme and National programme for prevention and control of Non communicable diseases are already launched as India is expressing a rapid health transition with Non communicable diseases surpassing the burden of communicable diseases [1]. Body Fitness Prolongs Life [2]. Lack of sufficient physical activity is the second most important contributor to preventable deaths trailing only to tobacco use. A sedentary life style has been linked to 28% of deaths from leading chronic diseases [3]. Anxiety occurs when an individual believes that the demands of situation are greater than their abilities to cope with it. It is subjective and therefore a variable phenomenon as what is stressful for one person may be stimulating and enjoyable for another. It has been shown that we perform task better when more aroused although as the arousal level continues to increase beyond an optimum level, performance begins to decline [4]. Excessive anxiety is maladaptive .It is often considered to be a major component of unhealthy lifestyle that contributes significantly to the pathogenesis of not only psychiatric but also many other systemic disorders [5],while psychological consequences of exercise deprivation in habitual exercisers is related to significant increase (p<.05) in total mood disturbance ,state anxiety ,tension ,depression, and decrease in vigour within 24-48 hours [6]. Heart Rate Variability(HRV) phenomenon is the oscillation in the interval between consecutive heartbeats as well as the oscillations between consecutive instantaneous heart rates. HRV has the potential to provide additional valuable insight into physiological and pathological conditions and to

enhance risk stratification. Components of HRV provide measurement of the degree of autonomic modulation rather than of the level of autonomic tone, averages of modulation do not represent an averaged level of tone, in other words HRV measures fluctuation in autonomic inputs to heart rather than the mean level of autonomic inputs. Thus, both autonomic withdrawal and saturatingly high level of sympathetic input lead to diminished HRV [7]. Role of HRV in different medical areas that include Cardiology and cardiovascular diseases ,Neurology, Diabetes mellitus, Glomerulonephritis with renal insufficiency, Pharmacological influence ,Toxicology, Work-related stress, Medical ecology, Sports and Fitness, Applied psychology ,Unconventional medical treatments, Transport, army and cosmic medicine ,Health (life) insurance **[**8]. Increased HRV has been associated with lower mortality rate and is affected by both age and sex. During graded exercise, the majority of studies show that HRV decreases progressively up to moderate intensities, after which it stabilizes. There is abundant evidence from cross-sectional studies that trained individuals have higher HRV than untrained individuals. The results from longitudinal studies are equivocal, with some showing increased HRV after training but an equal number of studies showing no differences. The duration of the training program might be one of the factors responsible for the versatility of the results [9].

METHODS

This study was carried out at S.M.S. Medical College Jaipur (Rajasthan University of Health Sciences), Physical Education Department (University of Rajasthan), Written informed consent was taken from Age matched University students of age group 16-25 year(those answered NO to all physical activity readiness questions) [10]. All the observations were taken in resting condition Comparison was made between Non exercise control group (n=31)and ,exercise group (n=31) which had an intervention of at least 60 minutes of various sports of by applying student t test for equality of means at significance(2-tailed)at p value<0.05.Speilberger C D [11]. State and Trait Anxiety Inventory shows individuals respond to each item on a four-point Likert scale, indicating the frequency with which each strategy is used. Example the State-Anxiety scale consists of twenty statements that evaluate how respondents feel "right now, at this moment." The Trait-Anxiety scale consists of twenty statements that assess how respondents feel "generally." Scoring and Norms: Scores on the STAI have a direct interpretation: high scores on their respective scales mean more trait or state anxiety and low scores mean less. Scores on the STAIS-Anxiety scale increase in response to physical danger and psychological stress, and decrease as a result of relaxation training. On the STAIT-Anxiety scale, consistent with the trait anxiety construct, psychoneurotic and depressed patients generally have high scores. KK Deepak, AIIMS [12] gave the procedure of evaluating Heart Rate Variability in which subjects preparation was done as per protocol. For short term analysis of HRV ;ECG was recorded in supine position for 5 minutes after 15 minutes of supine rest, for acquisition ;ECG wave signals were continuously amplified, digitized and stored in computer for analysis of Time domain, Frequency Domain and Nonlinear Domain. For processing the detection of 'R' wave was done by HRV soft version 1.1 developed by AIIMS New Delhi. All recording were visually examined and manually corrected if required abnormal beats and areas of artifact were automatically and manually identified and excluded from the study as and when required. Quantification of HRV was done after generation of tachogram. Task force [7] has given method to measure Heart rate variability for following variables-HRV Time Domain Variables – No. of, RR interval, Maximum vRR (ms.), Minimum RR (ms.), Mean (ms.), NN50- Number of pairs of adjacent NN intervals differing by more than 50 ms in the entire recording; three variants are possible counting all such NN intervals pairs or only pairs in which the first or the second interval is longer. PNN 50%-NN50 count divided by the total number of all NN intervals, RMSSD(ms)- The square root of the mean of the sum of the squares of differences between adjacent NN intervals. SDANN-Standard deviation of average NN interval in all 5 minutes segments of the entire recording (ms= mili seconds).Frequency Domain Variables – VLF ms^2-very low frequency power range in $\leq$0.04 Hz (Non harmonic activity), LFms^2low frequency power range 0.04-0.15Hz(sympathetic and parasympathetic activity) ,HFms^2-high frequency power range 0.15-0.4Hz (parasympathetic activity), Total 5 minutes power ms^2 range $\approx\leq$0.4 Hz,LF Normalized (nu)-LF power in normalized units LF/(total power-VLF)x100 (sympathetic activity),HF Normalized(nu)-HF power in normalized units HF/(total power - VLF) x100(parasympathetic activity) ,LF/HF ratio LF [ms^2]/HF[ms^2] (sympathovagalbalance),VLF/LF,VLF Absolute ms^2,LF Absolute ms^2 ,HF Absolute ms^2,Total power Absolute ms^2 (variance of NN intervals).The physiological explanation of the VLF component is much less defined, and the existence of a specific physiological process attributable to these heart period changes might even be questioned. The nonharmonic component, which does not have coherent properties and is affected by algorithms of baseline or trend removal, is commonly accepted as a major constituent of VLF. Thus, VLF assessed from short-term recordings ($\leq$5 minutes) is a dubious measure and should be avoided when the PSD of short-term ECGs is interpreted. Task force reviewed that nonlinear phenomena are certainly involved in the genesis of HRV. They are determined by complex interactions of hemodynamic, electrophysiological, and humoral

variables as well as by the autonomic and central nervous regulations. HRV Nonlinear Variables- SD1(ms) standard deviation short term variability (parasympathetic activity), SD2(ms) standard deviation long term variability (sympathetic activity),SD1/SD2 (vago-sympathetic balance), HRV Triangular index(approximate total power)- Total number of all NN intervals divided by the height of the histogram of all NN intervals measured on a discrete scale with bins of 7.8125 ms (1/128 seconds), TINN (ms.)(approximate total power)- Baseline width of the minimum square difference triangular interpolation of the highest peak of the histogram of all NN intervals. Tewari *et al.;* [13] reviewed that Time domain analysis determines parasympathetic activity while frequency domain analysis determines both sympathetic and parasympathetic activity . Poincare analysis provides data on the vagosympathetic balance. HRV Manual [14] cited that origin of VLF/UVLFP is still unclear. Current discussions include thermo regulative processes as well humoral influences of the renin-angiotensin-aldosterone system and the illustration of circadian rhythm city. HRV Manual also demonstrated Poincare map in which at the same time the RR time series are displayed within an xy-coordinate system, so each RR interval is allocated as a functional value of the subsequent RR interval. This creates a kind of correlation depiction of two successive RR interval .The evaluation of graphical representation can be both visual-qualitative and also quantitative.

Table 1: Resting State and Trait Anxiety Score

S. No.	**Age (Yrs)**	**State Anxiety**	**Trait Anxiety**	**Total Anxiety**
Control Group n = 31 Resting Anxiety				
Mean	**20.58**	**37.06**	**37.13**	**74.19**
SD	1.822	8.82	7.924	15.1
Exercise Group n=31 Resting Anxiety				
Mean	21.39	36.03	37.42	73.45
SD	1.706	11.7	10.01	
Comparison t test for equality of means				
t- test	-1.799	.392	-.127	.160
p value df=60	.077	.696	.900	.873

Table 2: Resting Time Domain HRV

S. No.	**Age (Yrs)**	**No. of RR interval**	**Maximum RR(ms)**	**Minimum RR (ms)**	**Mean (ms)**	**NN50 Count**	**PNN50 Count%**	**RMSSD (ms)**	**SDANN (ms)**
Control Group n= 31 Resting Time Domain HRV.									
Mean	20.58	388.7	991.5	621.2	782.7	88.35	24.39	52.75	16.86
SD	1.822	55.59	229.3	80.06	115.1	71.72	20.58	31.99	7.855
Exercise Group n=31 Resting Time Domain HRV.									
Mean	21.39	339.3	1115	693.5	904.3	107.8	34.2	71.6	21.79
SD	1.706	56.36	188.8	160.4	150.6	64.29	21.99	47.55	14.04
Comparison t test for equality of means									
t- test	-1.799	3.478	-2.314	-2.246	-3.572	-1.124	-1.814	-1.831	-1.708
p value df=60	.077	.001*	.024*	.028*	.001*	.265	.075	.072	.093

Table 3: Resting Frequency Domain HRV.

S. No.	**Age (Yrs)**	**LF (Normalized Power)nu**	**HF (Normalized Power)nu**	**LF/HF Ratio**	**VLF/LF Ratio**	**VLF (Absolute Power)**	**LF (Absolute Power) ms^2**	**HF (Absolute Power) ms^2**	**Total Power (Absolute Power) ms^2**
Control Group n=31 Resting Frequency Domain HRV.									
Mean	20.58	47.99	52.01	1.539	0.921	1038	1878	2541	5457
SD	1.822	21.15	21.15	1.944	0.6853	745.8	2554	3608	5656
Exercise Group n=31 Resting Frequency Domain HRV									
Mean	21.39	44.49	55.51	1.215	0.9323	1161	1754	2386	5302
SD	1.706	21.17	21.17	1.23	0.5409	1151	1890	2939	5297
Comparison between t test for equality of means									
t- test	-1.799	.652	-.652	.786	-.072	-.502	.217	.184	.111
p value df =60	.077	.517	.517	.435	.943	.618	.829	.854	.912

Table 4: Resting Non Linear Domain HRV.

S. No.	Age (Yrs)	SD1 (ms)	SD2 (ms)	SD1/SD2	HRV Triangular Index	TINN (ms)
up n= 31 Resting Non Linear Domain HRV.						
Mean	20.58	37.36	78.4	0.4479	0.2025	283.9
SD	1.822	22.67	33.45	0.1254	0.04593	175.6
oup n=31 Resting Non Linear Domain HRV.						
Mean	21.39	50.71	97.21	0.5068	0.2071	297.9
SD	1.706	33.71	53.64	0.133	0.05335	155.9
t test for equality of means						
t- test	-1.799	-1.829	-1.656	-1.793	-.369	-.333
p value df=60	.077	.072	.103	.078	.713	.740

Significance at p value <0.05

RESULT:

In our study; Comparison between two different Non exercise Control Group(n=31) and Exercise Group acclimatized for one year with at least one hour of moderate to heavy intensity sports in morning & evening session most of the days except holidays (n=31) showed that there was no significant difference between age groups (p>.05) in Exercise group ;Resting state anxiety was less ,trait anxiety was high, total anxiety was less(p>.05) Resting Time Domain HRV(reflects parasympathetic activity) showed that No. of RR interval (heart rate) were significantly less (p<.001) ,Maximum R-R (p<.05) ,Minimum R-R(p<.05)RR-interval. Mean(p<.001) ,Median (p<.001),Mode p<.001) were significantly increased means low heart rate and increased parasympathetic activity (P>.05)Resting Frequency Domain HRV(reflects sympathetic & parasympathetic activity) showed that higher non harmonic VLF activity (neuroendocrine, temperature regulation) less sympathovagal balance LF/HF and higher parasympathetic activity (p>.05).Resting Nonlinear HRV showed higher vagosympathetic balance SD1/SD2, higher parasympathetic activity, higher sympathetic activity, higher HRV Triangular index, higher TINN (approximate total power) in comparison to non exercise group(P>.05).

DISCUSSION

Metabolism of the body during sports increases to above normal [2]. Physical activity decreases Resting State and Trait Anxiety as it increases serotonin, decreases HPA axis response to stress, increases β endorphin surge, that increases release of dopamine therefore activate pleasure and satisfaction areas in brain [15],α2 GABA(A) receptor mediates anxiety[16]. Acetyl cholinesterase / Paraoxonase genotype and expression predict anxiety scores in Health, Risk Factors, Exercise Training, and Genetics study showed inverse, reciprocal associations with anxiety measures [17]. State anxiety was largely environmentally influenced with contributions from both non-shared or individual specific environmental factors (59%) and shared or family-general environmental (30%) factors. In comparison trait anxiety showed roughly equal genetic (45%) and non-shared environmental (55%) contributions [18]. Similar to our study another research showed that physical exercise activities played a very notable role to eliminate anxiety of the university youth [19]. Those patients whose heart rate was above 70 beats per minute had significantly higher incidence of heart attacks, hospital admissions and the need for surgery [20]. Heart rate recovery after maximal exercise is associated with acetylcholine receptor M2 (CHRM2) gene polymorphism [21]. HRV is the fluctuations of the activity in brain cardiovascular vasoconstrictor and vasodilatatory centers due to Blood pressure oscillation (baro-reflex modulated),Respiration (para-sympathically mediated via thoracic stretch receptors) Thermoregulation (sympathetically mediated via thermoregulatory peripheral blood flow adjustments),Circadian biorhythm [8]. Heart vitality training and heart rate monitor as aids to athletic performances reported that HRV data can indicate the impact of fatigue due to prior exercise sessions, hydration levels, stress and even the degree of performance anxiety, nervousness or other external stressful influences. Studies have shown that it varies within individuals according to size of left ventricle (inherited trait), fitness level, exercise mode (endurance or static training) and skill (economy of exercise). Body position, temperature, humidity, altitude, state of mood, hormonal status, drugs and stimulants all have an effect on heart rate and HRV, as do gender and age [22] Anxiety disorders increase risk of future cardiovascular disease (CVD) and mortality, even after controlling for confounds including smoking, lifestyle, and socioeconomic status, and irrespective of a history of medical disorders. While impaired vagal function, indicated by reductions in heart rate variability (HRV), may be one mechanism linking anxiety disorders to CVD, prior studies have reported inconsistent findings highlighting the need for meta-analysis [23]. Another similar study to our research showed that; a brief walk in an urban park can induce parasympathetic nerve

activity, suppress sympathetic nerve activity, decrease the heart rate, enhance the mood state, and reduce anxiety; walking in urban parks confers physiological and psychological relaxation effects [24].

CONCLUSION

One hour of Sports intervention ,decreased State Anxiety ,significantly decreased Resting Heart Rate this indicate an economic functioning of heart and increased Heart Rate Variability this indicates a good interplay or modulation between parasympathetic and sympathetic nervous system. Study also reflected Physiological basis of Anxiety and HRV

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