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Association of post exercise Heart Rate Recovery with BMI in healthy young adults.

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ABSTRACT:
INTRODUCTION: Obesity,defined as the excessive accumulation of body fat resulting from the positive energy balance,acts as risk for type II diabetes and potential predictor for cardiovascular diseases.Obesity leads to impairment in the autonomic nervous system (ANS), present in all age groups,characterized by a decrease in parasympathetic activity,with autonomic imbalanceresulting in attenuated Heart rate recovery (HRR) and predisposition to cardiovascular diseases.HRR is simple and noninvasive assessment of autonomic nervous system function.
AIM: To determine association of post exercise Heart Rate Recovery with BMI in healthy young adults.
METHODOLOGY: A comparative cross-sectional study of postexercise HRR between normal and overweight individuals among 70 students of age group 18 to 25 years divided into:Group-1 individuals with BMI 18.5–24.9 kg/m^2, Group-2individuals with BMI ≥25 kg/m^2 was done in Upgraded Department of Physiology, Osmania Medical College and statistically analyzed using unpaired t- test.
RESULTS:Mean HRR at 1min is attenuatedamong individuals in group 2 as compared to group -1 and is statistically significant ($p<0.0089$) indicating decrease in parasympathetic activation among individuals in group-2.
CONCLUSION: Findings suggest that there is inverse correlation between HRR and BMI.This indicates post exercise attenuated parasympathetic reactivation in individual with BMI≥25kg/m^2,indicating vagus nerve dysfunction.
KEYWORDS:HRR,BMI, submaximal exercise testing, autonomic nervous system.

I. INTRODUCTION:

Obesity leads to impairment in the autonomic nervous system (ANS), present in all age groups, characterized by a decrease in parasympathetic activity, resulting in attenuated Heart rate recovery (HRR) and predisposition to cardiovascular diseases[1]. The increase of heart rate during exercise is due to the decrease in vagal tone followed by an increase in sympathetic outflow.

HRR is simple and noninvasive assessment of autonomic nervous system function that is capable of indicating one's ability to get adaptation to exercise stimuli and assess cardiovascular health.

HRR is defined as the rate at which heart rate decreases within minutes after the cessation of physical exercise (submaximal to maximal intensity exercise), reflects balance between parasympathetic reactivation and sympathetic withdrawal.Recovery of heart rate equal to or more than 12–22 beats after first minute of termination of exercise is considered normal. Thus, the present study aims to determine association of post exercise Heart Rate Recovery with BMI in healthy young adults.

II. METHODOLOGY:

Study design: A comparative cross-sectional study.
Study population: 70 students of age 18-25 years, divided into two groups,
Group 1 – individuals with BMI 18.5–24.9 kg/m²
Group 2- individuals with BMI ≥25 kg/m²
Study done after obtaining informed consent in Upgraded Department of Physiology, Osmania Medical College.

III. METHOD:

BMI was calculated by using Quetelet formula: weight (kg)/height (m2)

Determination of the target heart rate:

Maximum heart rate (MHR) was calculated by the formula 208– (0.7 x age) in years [2].
Heart Rate Reserve (HRR) was calculated by difference between MHR ─ basal heart rate (BHR).
Target HR (THR) was estimated by the equation: (0.70–0.85) x HRR + BHR.
This THR keeps the exercise intensity in the Submaximal range [3].

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Exercise testing and heart rate recovery:
Submaximal exercise testing by bicycle ergometer [3]:
The subject was informed that the test will be six minutes in length.

Subject was asked to pedal for a two- to three-minute warm-up period at a low intensity a minimal load (25 W) before any progressive increase in resistance toallow the subject to practice and cycle ergometer testing familiarize him- or herself with the cadence.

Each progressive stage was between 1 and 3 minutes in length, and the step increments ranged between 25W and 60 W.The workload was determined by the subject gender and physical condition. Once the steady HR of 120 bpm was attained exercise intensity/cycle resistance was increased to reach target HR with pedal stroke 50 rpm. Exercise intensity/cycle resistance was decreased if the HR is near 170 bpm.The testing was stopped if the subject exceeds 85% of age-predicted MHR or cannot maintain the cadence or if he or she experiences chest pain, shortness of breath, dizziness, or nausea.HR was assessed and monitored continuously before, during and after exercise test by 'Omron pulse oximeter.HRR was calculated as the difference in the HR immediately after exercise to HR after a minute of rest postexercise.Recovery of heart rate ≥12–22 beats after first minute of termination of exercise is considered normal[4] .

INCLUSION CRITERIA:
- Subjects in the age group of 18-25years without any known medical illness.

EXCLUSION CRITERIA:
- Subjects with history of any known medical illness like Asthma, Hypertension, Diabetes.
- History of syncope.

IV. RESULT:

The data was entered in Microsoft excel 2019 and was analyzed by SPSS for Windows, Version 16.0. Chicago, SPSS Inc (Statistical Package of Social Sciences). The results are presented as mean ± standard deviation (SD). The unpaired Student'st-test was used to compare the study parameters between two groups.The $P < 0.05$ was considered statistically significant. The present study was conducted on 70 subjects, with mean age was found to be 19.8±1.03years in Group I and 19.7±0.9 years in Group II. The mean BMI was 21.47+ 1.55 kg/m^2 in Group I and 28.42+2.11kg/m^2 in Group II.
The results shows that HRR @1min was significantly reduced in group-2 in comparision with group -1.

Table 1: Comparison of BMI values between two groups.

PARAMETER	GROUP-1 (MEAN±SD)	GROUP-2 (MEAN±SD)	P Value
Age	**19.8±1.03**	**19.7±0.9**	**0.89**
Subjects	**n=35**	**n=35**	
BMI	**21.47+ 1.55**	**28.42+2.11**	**0.001***

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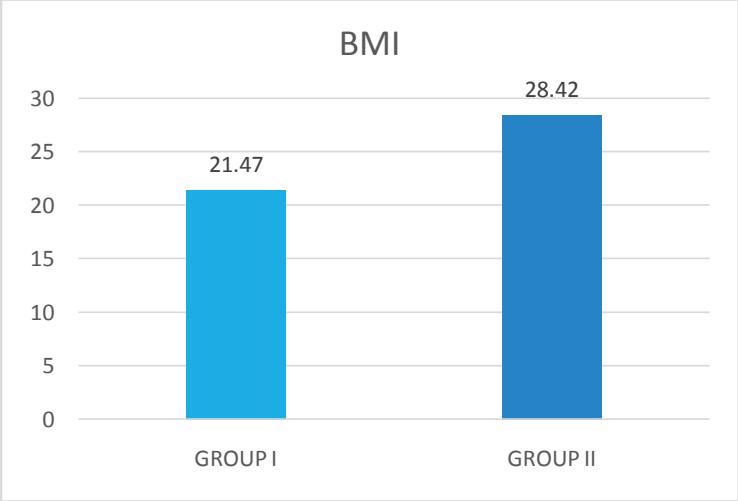

Fig:1 Bar graph representing BMI in Group-1 and Group-2.

Table:2 Comparison of Heart Rate Recovery between the two groups.

PARAMETER	GROUP-1 (MEAN±SD)	GROUP-2 (MEAN±SD)	P Value
Basal HR	**78.86+3.23**	**85.23+12.07**	**0.0215***
Peak HR	**153.72+3.77**	**153.18+12.9**	**0.8031**
HRR @ 1MIN	**25.19 ± 5.86**	**19.86±6.89**	**0.0089***

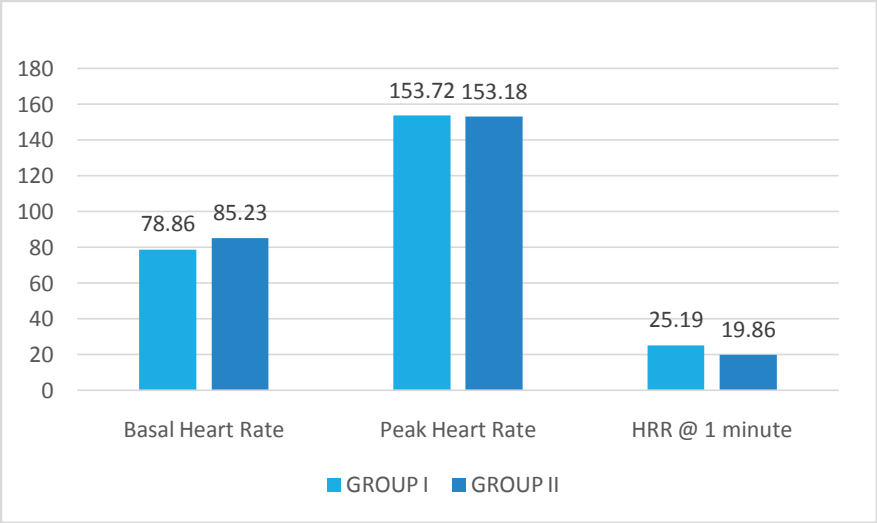

Fig 2: Bar graph representing Basal HR, Peak HR, HRR @1min in Group-1 and Group-2

V. DISCUSSION:

The present study result showed reduced HRR@1min (25.19 ± 5.86) in group-2in comparison to HRR @ 1min (19.86±6.89) in group-1.This is in accordance with study done by Rossi RC[1], Raymond J[4],Tereza Cristina [7].

Cardiac autonomic function can be assessed by HRR following exercise testing, a slow decline indicating reduced parasympathetic reactivation. Individuals who present with impaired HRR after exercise are at risk for cardiovascular disease.

Obesity is an important risk factor for cardiovascular disease and that vagal autonomic dysfunction may be an early cardiovascular risk marker[7].

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Autonomic behavior in obese adults is characterized by a decrease in parasympathetic activity, with autonomic imbalance[1].

Autonomic control of heart rate (HR) during dynamic exercise[6] indicates that the initial increase is due to the withdrawal of parasympathetic nervous system (PSNS) activity and subsequent increases in HR is due to increase in cardiac sympathetic activity.

Increase in HR from rest to mild exercise workloads are a result of decreased parasympathetic nervous activity (PSNA), termed 'parasympathetic (vagal) withdrawal.

Subsequent workload-related increase in HR above 100 beats/ min up to the individual's HR maximum result from increase in sympathetic nervous activity.

During early recovery period, reactivation of parasympathetic effects on heart rate occurs rapidly in first minute. Sympathetic withdrawal also contributes to initial HRR.

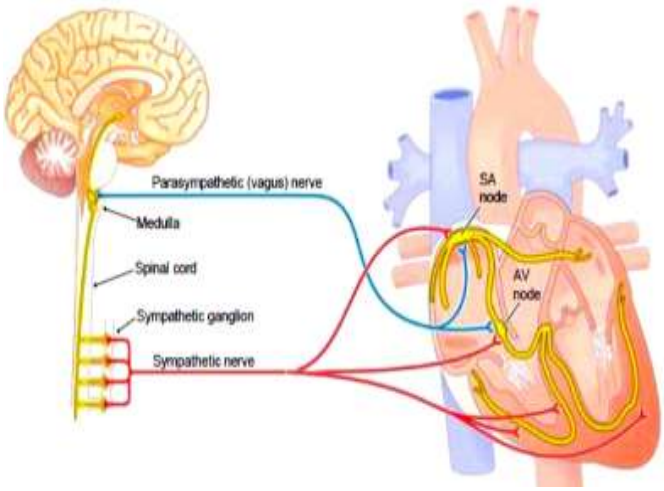
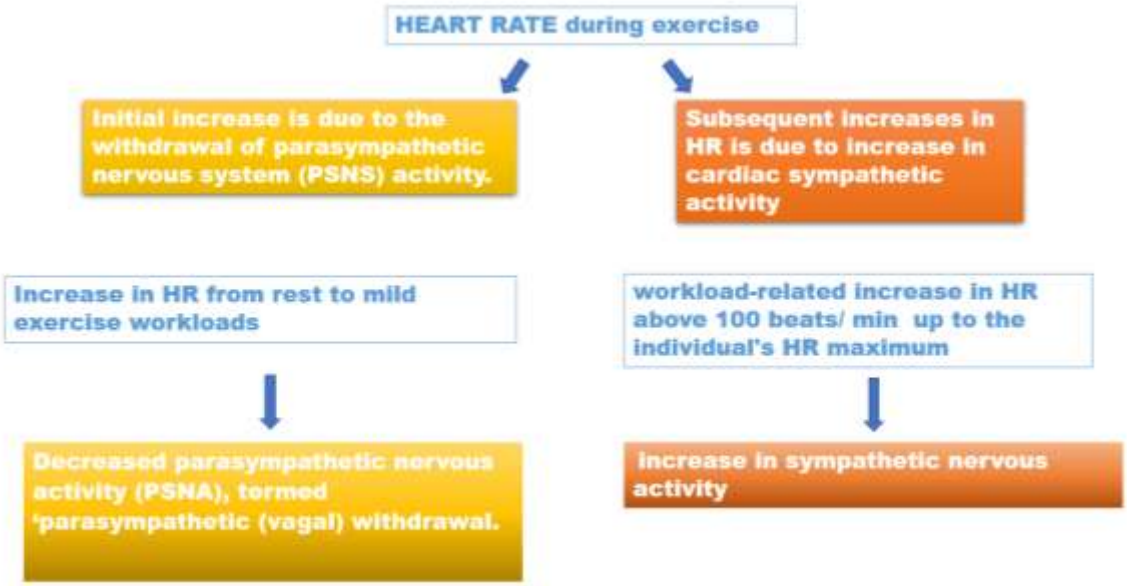


Fig 3: ANS innervation of heart

Autonomic control of heart rate (HR) during dynamic exercise:[6]



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Obesity is associated with chronic inflammation of adipose tissue.

Inflammatory adipokines secreted by white fat, such as tumor necrosis factor-α, interleukin-6, affect the cardiac autonomic balance via the central nervous system, promoting sympathetic hyperactivity, counteracting increased parasympathetic activity and acetylcholine levels, which inhibit release of these inflammatory cytokines.

It is through inflammatory states and autonomic nervous system dysfunction that obese patients have a higher risk of morbidity [7].

Autonomic nervous system is essential in the maintenance of glycemic homeostasis.

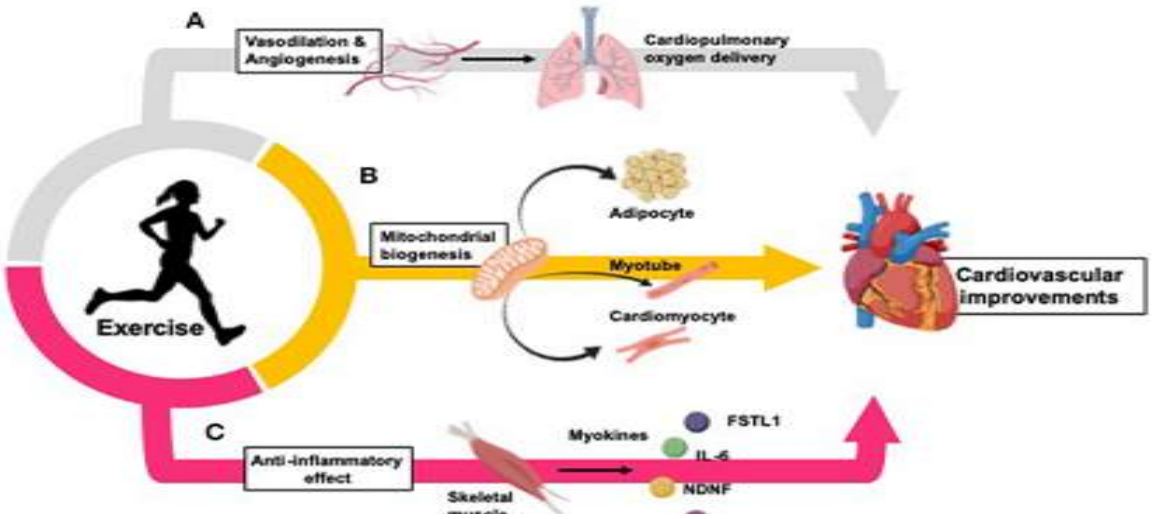
Dysfunction of the autonomic nervous system that is signified by attenuated HRR would result in declined insulin secretion but raised glucose levels, leading to the development of diabetes mellitus and disorders such as CVD through multiple mechanisms including glucose toxicity, inflammation, and endothelial dysfunction[5] .

VI. CONCLUSION:

The present study showed that HRR after exercise was inversely associated with BMI.

Preventive strategies need to be identified which can help in early detection of disease risk, and heart rate recovery used as tool for early risk detection.

Exercise restores sympathovagal balance8)and by prescribing an appropriate exercise protocol to these high-risk individuals would decrease the future risk of CVD and enhance quality of life.



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