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INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/14511
DOI URL: http://dx.doi.org/10.21474/IJAR01/14511

RESEARCH ARTICLE

BLOOD PRESSURE RESPONSES BETWEEN TREADMILL AND ERGOMETER CYCLE

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Manuscript Info

Manuscript History
Received: 05 February 2022
Final Accepted: 11 March 2022
Published: April 2022

Key words:-
Blood Pressure, Maximal Heart Rate

Abstract

This study was done to determine the maximal heart rate and blood pressure difference between Treadmill Running and Ergometer cycling. This study was undertaken in research laboratory of physiology department at Thanjavur medical college . 40 persons with the age group of 18-40 Years were taken as subjects. The subjects were recruited from Thanjavur medical college. The subjects were performed 3 discontinuous graded tests until exhaustion. In Bicycle, cycling was done for 2 mins at 60rpm. In Treadmill, initial Warm-up slowly by walking at a speed of 1.5-2 mph for 1min to 2 min. For first 2 weeks subject was asked to run at 4-8 mph for 20 minutes, 3rdweek to 12thweekfor 30 mins at 4-8 mph. Physiological variables blood pressure and maximal heart rate were measured and compared in between Ergometer Cycling and Treadmill Running.

Introduction:-

Physical fitness is generally achieved through correct nutrition,exercise, hygiene and rest. The benefits of exercise are well established. It is wellknown that regular exercise reduces the incidence of stroke, hypertension, type 2Diabetes mellitus, colon and breast cancer and Obesity. Exercise is inevitable to keep our health in good status. Therecommendations from the ACSM and AHA regarding guidelines for physicalactivity suggest that all healthy adults between age group of 18-65 need moderateintensity aerobic exercise for a minimum of 30 minutes 5 days per week(1) . Aerobic exercises include walking, jogging, running, cycling, swimmingand skating. Indoor aerobic exercise include treadmill, bicycle ergometer,elliptical trainer, stair climbing, etc(2).

In the modern busy life, the bicycle ergometer and treadmill exercises arethe commonest indoor aerobic exercises. These tools are used notonly for maintain physical fitness and also for exercise testing (3). Because exerciseis the most common physiologic stress and it causes major demands on thecardiovascular system(4) .

Exercise testing is a noninvasive test to evaluate cardiovascular responsesto exercise. Despite the many advances in technology for the diagnosis and treatment of cardiovascular diseases, the exercise test remains a very importantdiagnostic modality.

Three types exercises can be used to exercise stress test; isometric,dynamic, and a combination of two. So many modalities have been used toprovide dynamic exercise for exercise testing like escalators, steps and laddermills(3).However the bicycle ergometer and treadmill are the most commonly useddynamic exercise devises(5).

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Thus the increased use of both exercise modalities has escalated the need to compare their relationships between them.

The purpose of the study was to compare , maximal heart rate blood pressure in treadmill and ergometer cycling exercise.

J.Faff et al found the highest HRmax during treadmill exercise in both males and females .Greater energy expenditure during treadmill running resulted in high HRmax values[6] .

Abarentes et al also observed significant differences in maximum heartrate response and showed treadmill is the one which gives maximal heart rateattainable for a individual [7].

Milles et al observed in 18 females in age group of 18-40 years ,theirstudy revealed that HR max were significantly higher by 5 beats per min duringtreadmill running than ergometer cycling [8].

Young Joo Kim et alprovided graded exercise tests on cycle ergometerand Treadmill and noticed the blood pressure response in each mode[9].

Kurl et alconducted study about blood pressure response to exercisestress test in 1026 healthy male subjects .They have noticed that excessiveelevation of SBP during exercise and persistent rise after 2 mins exercise werestrongly associated future stroke, so they recommended exercise systolic bloodpressure testing as a important tool for identification of future stroke[10].

Materials And Methods:-

Study is a randomized control trial for 12 weeks, comparing the physiological responses in treadmill and ergometer cycle.

Subjects were recruited from Thanjavur Medical College Hospital,in the age group of 18-40 years age group. This study was conducted in the research laboratory, Department of physiology, Thanjavur Medical College. 40 female subjects with age group of 18-40 years participated in this study.

Subjects were randomized in to two groups, Group A- Treadmill group;Group B- Ergometer cycle group. Group A consists of 20 subjects who underwent treadmill training and Group B consists of 20 subjects who underwent cycling.

Before starting our study, we obtained ethical committee approval and clearance from our college. Informed consent was obtained from all subjects who were participating in the study. Healthy females with 18-40 yrs were included for this study.

Subjects with history of diabetes, hypertension, coronary artery disease, pulmonary disease, epileptics ,on chronic medications, pregnant / lactating individuals were excluded from the study. Study participants were divided into two groups, Group

A –Treadmil group (n=20), Group B-Ergometer cycle Group(n=20). Heart rate and blood pressure (systolic &diastolic) were measured at rest.

In Treadmill each exercise session was preceded by 10 mins warm up and stretching with 1.7 mph in treadmill, then increasing the speed to 4-8 mph for 20 mins duration during the initial 2 weeks. From 3rd week onwards duration increased to 30 mins. Duration & speed was increased slowly up to exhaustion level of the subject. In cycle each exercise session was preceded by warm up and pedaling speed of 30-40 revolutions per min(RPM),with resistance level in one kilopond.

Pedaling speed was gradually increased to 60-70 RPM for 15 minutes with resistance being increased from 1to 4 in the tension adjuster gradually. Each session is followed by 10 minutes cool down with light stretching exercises.

Exercise session continued for 5 days in a week for 12 weeks.

Blood pressure was recorded at rest and also immediately after exercise.

Heart rate was measured continuously throughout the testing session. Resting heart rate (RHR) was identified as the lowest HR among the eight 15 sec intervals between minutes 7 and 9 of the rest. The highest heart rate during exercise session was considered as HR max [5]

Results And Analysis:-

This study was conducted between treadmill runners and ergometercyclists, results were recorded for the following parameters and comparedbetween both groups.Students paired t test was used to compare betweentreadmill and ergometer cycle group.

We used a level of significance of 95%(p value <0.05 as significance)

The parameters include;
I. Maximum heart rate
II. Systolic blood pressure response
III.Diastolic blood pressure response

The mean difference between pre and post tests of treadmill and cycle groups were compared .Results showed significant increase of mean MHR in treadmill exercise group and marked elevation of**POST-SYSTOLIC BLOODPRESSURE** in ergometer cycle group.

Maximum Heart Rate (HR max)

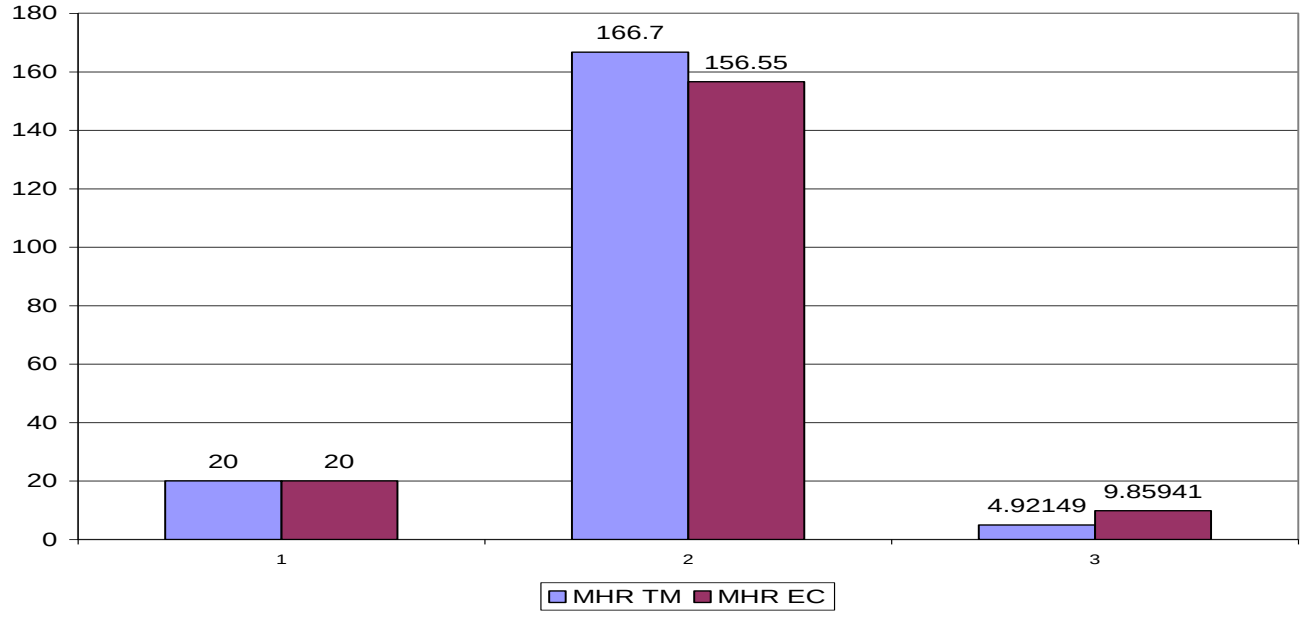
The mean value of maximal heart rate in treadmill group was 166.7±4.92 and the mean value of maximal heart rate in ergometer cycle group was 156±9.85. Paired t-test result showed a statistically significant difference in MHR[P value of .000 (p>0.05)] .

Mean HR max highest in treadmill group.

Table 1:- Comparison of MHR between treadmill group & ergometer cycle group:

Group	Mean	SD	't' value	'p' value
TM group	166.7	4.92	4.119	0.000
EC group	156.5	9.85		

Graph 1: Comparison Of Mhr Between Treadmill Group & Ergometer Cycle Group.



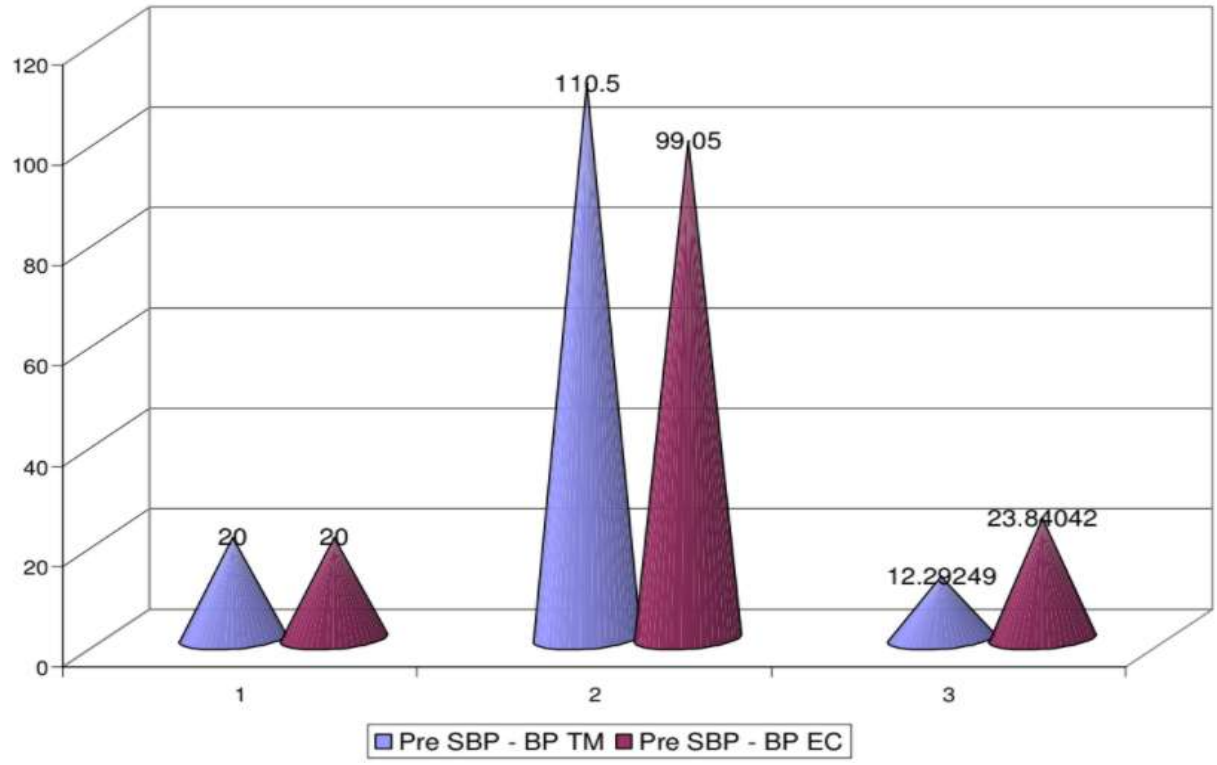
Systolic Blood Pressure Response (SBP)
PRE SBP:
The mean value of pre systolic blood pressure in treadmill group was 110.5±12.29mmHg and in ergometer group was 99.05±12.29 mmHg.

The results of paired‘t’ test showed statistically insignificant changes between treadmill group and ergometer group.

Table 2:- Comparison of PRE-SBP between treadmill group and ergometer group.

Group	Mean	SD	‘t’ value	‘p’ value
TM group	110.5	12.29	1.909	.064
EC group	99.05	23.84		

GRAPH 2:- Comparison Of Pre-Sbp Between Treadmill Group & Ergometer Group.

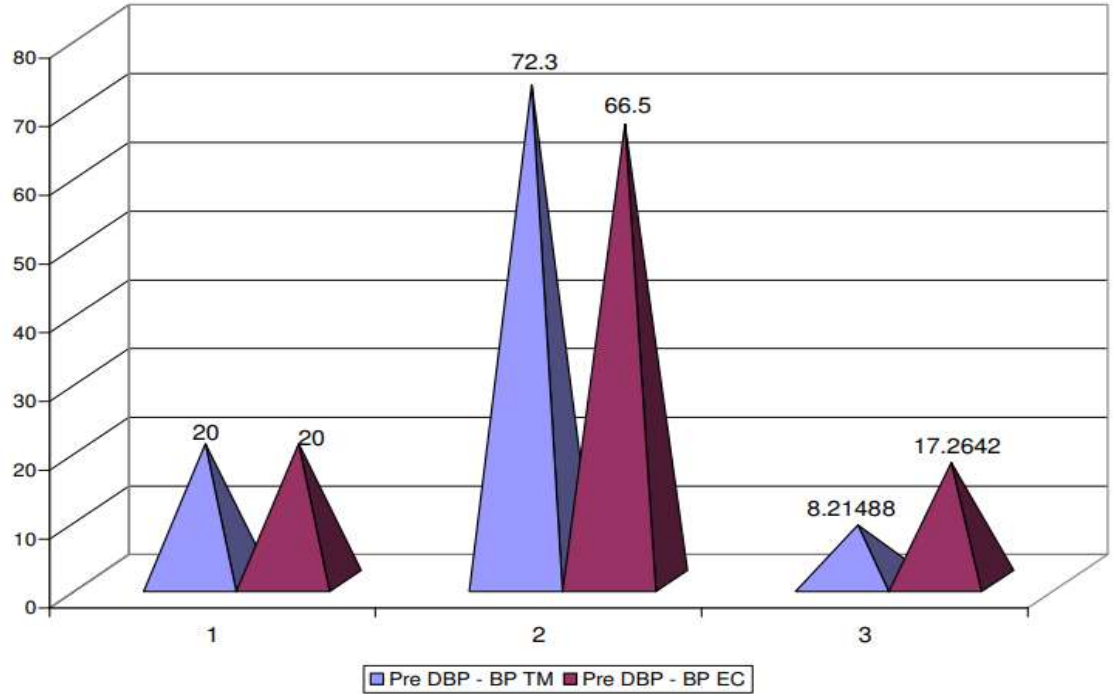


Diastolic Blood Pressure Response
Pre- DBP:
The mean value of pre diastolic blood pressure in treadmill group was 72.30±8.21 mmHg and the mean value of pre diastolic blood pressure in ergometer cycle group was 66.50±17.26 mmHg. The results of paired ‘t’ test showed statistically insignificant changes [p=.183 (p>0.05)] in between treadmill group and ergometer cycle group.

Table 3:- Comparison of PRE –DBP between treadmill and ergometer group .

Group	Mean	SD	't' value	'p' value
TM group	72.30	8.21	1.35	.183
EC group	66.50	17.26		

Graph 3:- Comparison Of Pre –Dbp Between Treadmill & Ergometer Group.



Post SBP Comparision:

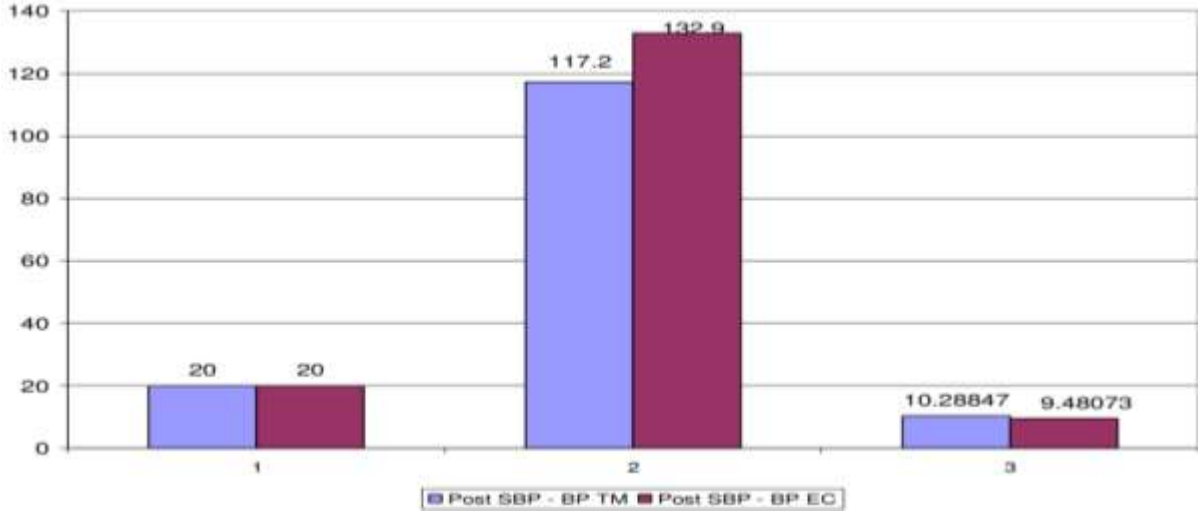
The mean value of post systolic blood pressure in treadmill group was 117.2±10.28mmHg and the mean value of post systolic blood pressure in ergometer cycle group was 132.9±9.48mmHg.

The results of paired 't'test showed statistically significant changes[p=.000, p< 0.05] in post systolic blood pressure and marked elevation of post-systolic blood pressure in ergometer cycle group.

Table 4:- Comparison of POST-SBP between treadmill group and ergometer group.

Group	Mean	SD	't' value	'p' value
TM group	117.2	10.28	-5.09	.000
EC group	132.9	9.48		

Graph 4:- Comparison Of Post-Sbp Between Treadmill Group And Ergometer Group.



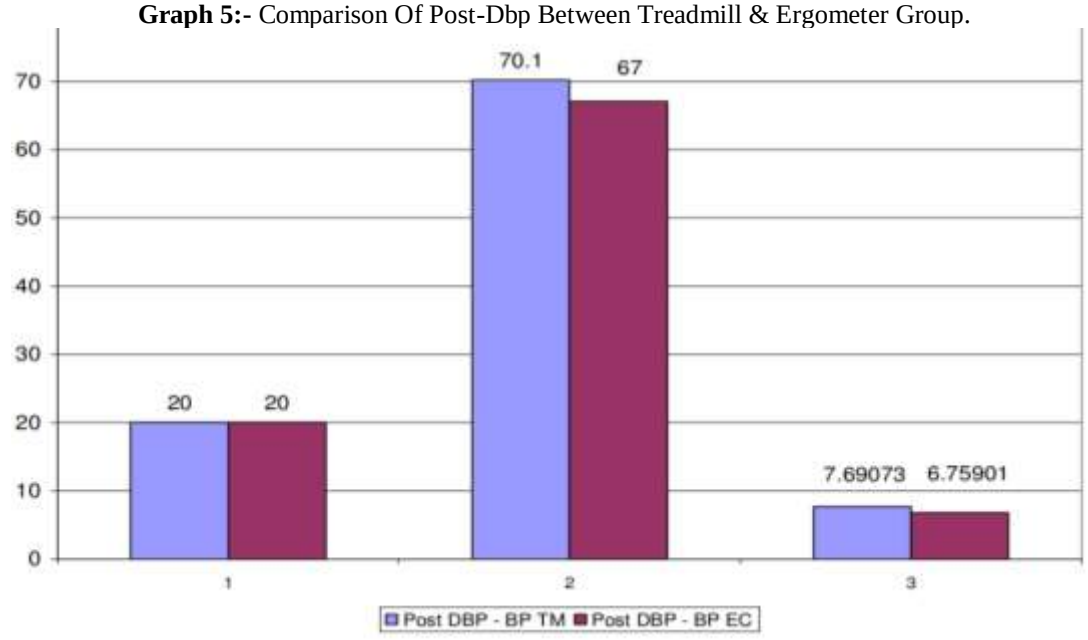
Post- DBP*:*

The mean value of post diastolic blood pressure was 70.10±7.69mmHg in treadmill group and 67.00±6.75 mmHg in ergometer cycle group. The results of paired 't'test showed insignificant differences in post diastolic blood pressure in between treadmill and ergometer cycle groups.

Table 5:- Comparison of Post-DBP between treadmill and ergometer group.

Group	Mean	SD	't' value	'p' value
TM group	70.10	7.69	1.35	.184
EC group	67.00	6.75		

Graph 5:- Comparison Of Post-Dbp Between Treadmill & Ergometer Group.



Discussion:-

Exercise is a period of enhanced energy expenditure[4] .Obesity is one of the major contributor for thedevelopment of cardiovascular diseases, and exercise is the logical adjunct tocaloric restriction in the prevention or correction of obesity.

It is also claimed that regular exercise may prevent or delay the onset ofcoronary vascular disease by lowering plasma lipid and cholesterol values.The exercise test have an integral places in cardiovascular medicinebecause of high yield of functional,diagnostic,prognostic information.

The commonest exercise test modalities are bicycle ergometer and treadmill and these tools have become far most common indoor aerobic exercisemodalities.

Hence in this study, blood pressure and maximal heart rate response between these modes were compared.From hemodynamic studies performed over years, maximal heart rate hasemerged as clearly the most important determinant of cardiac output during exercise.

HR max is commonly used as the indicator of maximal exercise.In the present study, there was a significant increase in maximal heart ratein treadmill running than ergometer cycling.

Study done by Fabien et al, postulated significant differences in HRmaxbetween treadmill and ergometer cycling ,with higher values attained by treadmill . Our result confirms studies by Fabian et al[11].

Fernhall and Kohrt also showed significant differences were observed inHR max between treadmill and ergometer cycle with higher values on thetreadmill running, they showed while in cycling smaller muscle mass involvementhad an effect on central circulation and blood flow to leg compared with treadmillrunning[12,13] .

Studies done by Mc Ardle et al and Roecker K et al also noted samefinding like ours ,such as incremental treadmill test produces higher maximalheart rate values as compared with incremental test on ergometer cycle [14,15].

Normal BP response to exercise is characterized by a progressive increasein systolic pressure, decrease or no change in diastolic pressure.

Our study result showed significant increase of systolic blood pressure incyclists compared to runners.

Young Joo Kim et al reported treadmill test as the most accurate measureof HR max andVO2max.Treadmill has the higher sensitivity in detection ofmyocardial ischemia. Blood pressure response at a maximal exercise is stronger inergo meter cycle, than in treadmill, leads to increase in rate pressure product.Hence, it is possible that cycling may be a burden to cardiovascular system[8].

Fagard analyzed 947 athletes and reported cycling increases the thicknessof myocardial wall and inside diameter of the left ventricle[16].

REED reported Systolic blood pressures at 40% and 60% reserve ashigher in cycle ergometry than treadmill and SBP at the maximum workload washigher in cycle ergometry than treadmill. This report is similar to my studyresult[17].

Franklin et al &Blomqvist et al reported that, there are many factors thataccount for this systolic blood pressure higher during cycling. Cycling as opposedto treadmill running associated with reduced mechanical efficiency. Smallermuscle mass involved in cycling offers greater resistance to blood flow[18,19].

Bunker et al explained higher vasoconstrictive responses produced bynon exercising muscle contributes to greater SBP in cycling[20].

Unlike treadmill running, in cycling on increasing intensity causes greater upper body isometric muscle contraction and higher intramuscular tension on lower body[21].

Blood pressure response in treadmill and cycling may be due tomechanical factors interacting with increased blood volume and left ventricularoverload associated with cycling, since it offers greater resistance to blood flowRaised systolic blood pressure in cycle ergometry can increase themyocardial burden of patients with ischemic heart disease[17].

Conclusion:-

This study was designed to compare blood pressure and maximal heart rate responses between treadmill running and ergometer cycling.

The results of the present study indicated that treadmill running elicited higher maximal heart rate response than bicycle ergometer.

HRmax can accurately measured by treadmill, therefore the sensitivity in detecting myocardial ischemia is higher in treadmill than ergometer cycling.

Blood pressure response is stronger in cycling than running.

The clinical importance of these findings is that bicycle constitutes agreater stress on the cardiovascular system thantreadmill exercise. On the other hand, treadmill exercise produces lesshemodynamic stress on cardiovascular system.Thus treadmill can be recommended for development of cardiovascular/respiratory fitness.

Acknowledgements:-

No sources of funding were used to assist in the preparation of this article.Theauthourshae no conflicts of interest that are directly relevant to the content of this article.

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