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The effect of stair climbing versus treadmill on heart response: A comparison study

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Abstract
Objective – The study aimed to compare the heart rate responses during stair climbing versus treadmill walking and to determine whether the responses were of sufficient magnitude to elicit cardio respiratory training effects.
Background- There is numerous studies done on effective exercise mode and alternatives exercise as a choice for maintaining and improving cardio respiratory fitness but there is less study which compares the effectiveness of stair climbing versus treadmill walking on heart responses to determine whether the responses were of sufficient magnitude to elicit cardio respiratory training effects.
Study Design- An Experimental study.
Methods- 30 participants were randomly selected, aged ranging between 18-30. Then they were randomly assigned into 2 groups. Each group has 15 participants, stair climbing and treadmill walking group. Pre and post of blood pressure and heart rate of stair climbing and treadmill walking activities were taken to make the comparison.
Result- The result of this study showed that both of the group had significant effect on heart rate. However, there was significance different between both groups on blood pressure especially for systolic pressure.

Keywords: stair climbing, treadmill walking, heart rate etc.

Introduction
In many countries, including Malaysia, the rate of physical inactivity is on the rise. A World Health Organization (WHO) study published in the British Scientific Journal Lancet in July found that 61.4% of Malaysians above the age of 15 are physically inactive countries in the region. This can lead to the many problems, for example their cardio respiratory effort. The growing problem of individual that difficult to maintain or improving their cardio respiratory fitness may be part due to lack of opportunity for them to undertake exercise in their daily lives. Reasons include time or money restrictions, or a lack of suitable facilities. Stairs provide a ubiquitous and cost- effective opportunity to incorporate cardio respiratory exercise into the daily routine. Indeed, stair climbing has been shown to enhance muscle recruitment and improve cardiovascular capacity. Nowadays, various exercises are recommended for maintaining and improving cardio respiratory fitness. Walking is often recommended for individuals because of its practical nature and may be more convenient than other activities.

Materials and Methods
Study design: This research was conducted as comparison study where both groups of participants (Group A: Stair climbing group, Group B: Treadmill walking group) attended the activities of stair climbing and treadmill walking to collect their blood pressure and heart rate.

Study settings: The subject was 30 healthy, among Asia Metropolitan University occupant, ranging in age from 18- 30 years old. They were randomly assigned into 2 groups, stair climbing group and treadmill walking group. For participants those attended for treadmill walking were conducted at physiotherapy lab (Asia Metropolitan University), meanwhile participants those attended for stair climbing walking were conducted using stairs near the Casa Suria apartment (opposite to Asia Metropolitan University).

Sample and Sampling Technique: 30 participants who satisfy the inclusion criteria (healthy amateur and sedentary lifestyle) were conveniently selected for the study.

Measurement tools: Stair, Kettler Treadmill and Tensoval Heart Rate Monitor

Inclusion Criteria

- Both genders
- Age: 18- 30 years old
- Healthy amateur
- Normal BMI
- Sedentary lifestyle
- No chronic disease

Exclusion Criteria

- Musculoskeletal problem
- Fracture of limb
- Professional athletes
- Taking medicine/drug within 1 week before
- Active in sport
- Obese

Procedure

The subject was 30 healthy, among Asia Metropolitan University (AMU) occupant, ranging in age from 18- 30 years old. They are randomly assigned into 2 groups, stair climbing group and treadmill walking group. The subject was given the explanation about the activities that they attended, especially about the intensity, duration and frequency of activities. Consent of subject were taken. The subject those fulfilling the inclusion criteria were include in the study. Subjects will be excluded if they fulfil the exclusion. Then, the subject was divided into 2 groups, 15 subjects for each group. Before, starting the activities, the heart rate and blood pressure of the subject were checked using heart rate monitor blood pressure monitor. After that, the subject proceeds to the activities that they will attend according to their group. The activities were stair climbing for 50 steps and treadmill walking with speed 4.0km/hrs in 4 minutes for each group. After the participants finish the activities, their heart rate was measured immediately.

Statistical analysis: This study is analyzed by using paired t test under SPSS software version 16.0 to compare the outcomes between the two groups.

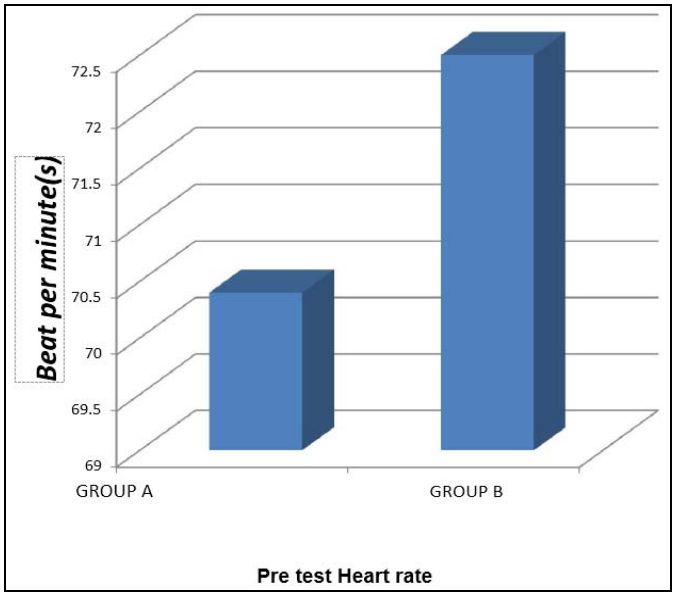
Descriptive Analysis

Parameters		Minimum	Maximum	Mean
Age (Years)		21	28	24.5
Heart Rate		62	81	70.4
Blood Pressure	Systolic	101	124	116.5
	Diastolic	70	92	80

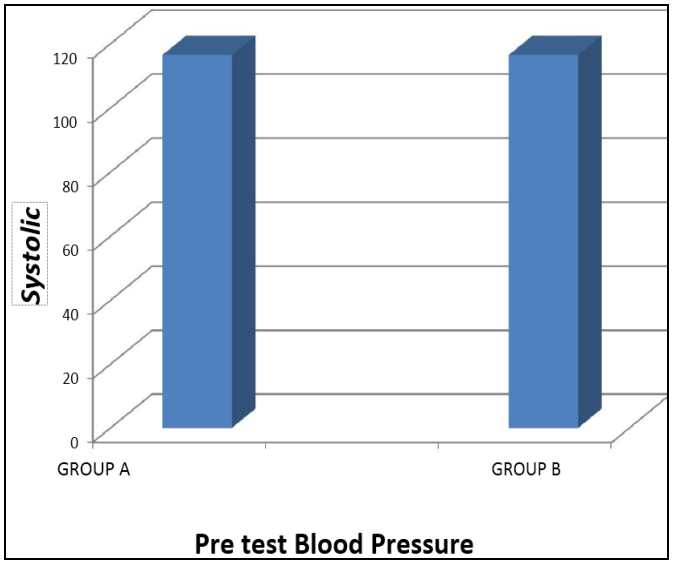
Shows the minimum, maximum and mean value for Group a (pre test) according to the parameters stated above.

parameters		minimum	maximum	mean
Age (Years)		21	29	25.2
Heart Rate		54	88	72.5
Blood Pressure	Systolic	104	124	116.5
	Diastolic	87	70	78

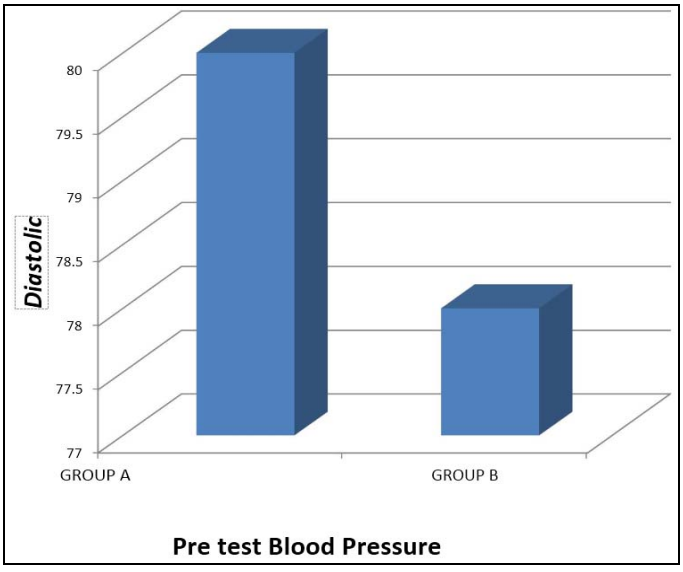
Shows the minimum, maximum and mean value for Group B (pre test) according to the parameters stated above.



The bar chart above shows the mean of pre test heart rate for both Group A and Group B.

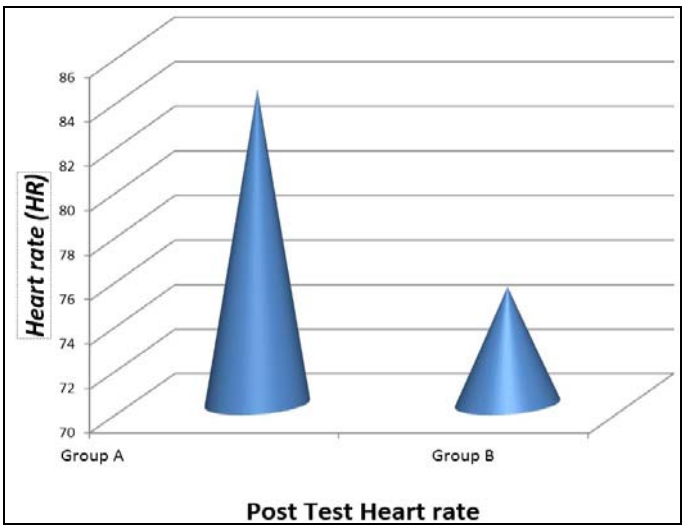


The bar chart above shows the mean of pre test blood pressure (systolic) for both Group A and Group B.

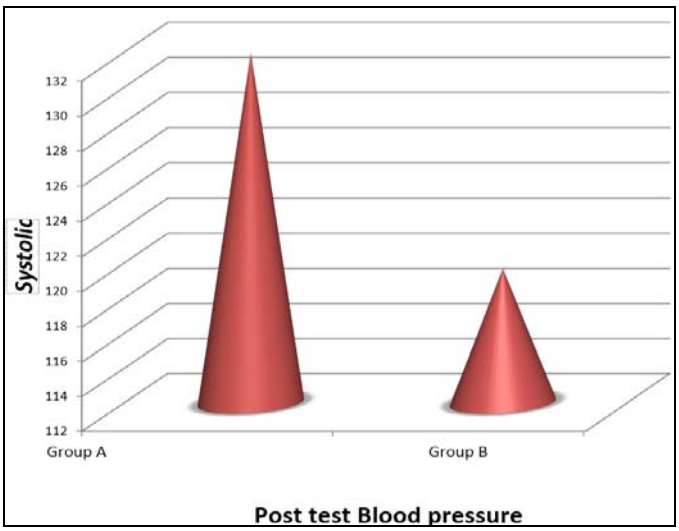


The bar chart above shows the mean of pre test blood pressure (systolic) for both Group A and Group B.

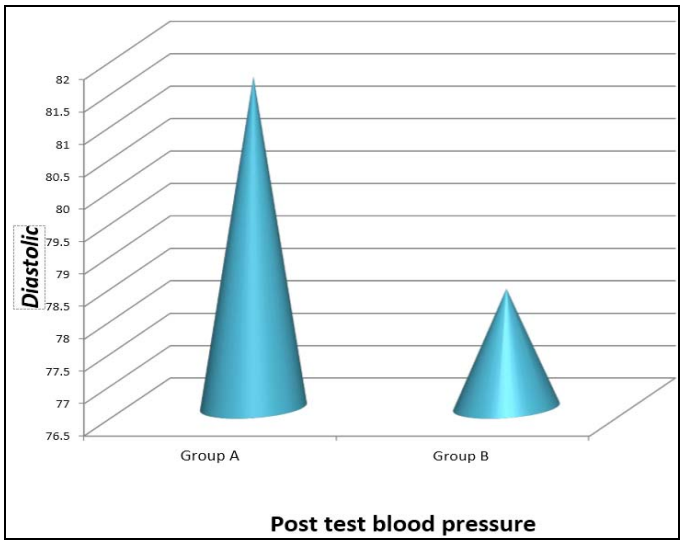
Comparison mean of posttest heart rate value between group A and group B.



The bar chart above shows the comparison mean of Posttest heart rate for both Group A and Group B.



The bar chart above shows the comparison mean of Posttest blood pressure (systolic) for both Group A and Group B.



The bar chart above shows the comparison mean of Post test blood pressure (diastolic) for both Group A and Group B.

Descriptive statics of heart rate and blood pressure (systolic and diastolic) between group a and b.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Pre test HR Group A	15	62	81	70.40	5.962
Post test HR Group A	15	71	96	84.13	8.245
Pre test HR Group B	15	54	88	72.47	9.257
Post test HR Group B	15	58	88	75.27	9.043
Valid N (listwise)	15				

From the descriptive statics of heart rate the mean and standard deviation for pre stair climbing and post stair climbing was found to be (70.40±5.962) and (84.13±8.245) respectively. Pre test and post test for treadmill walking shows that the mean and standard deviation was (72.47±9.257) and (75.27±9.043) respectively. From the table above, it was shown that the minimum and maximum heart rate of pre test for Group A was 62 and 81 beat per minutes respectively. Meanwhile for post test, the heart rate was 71 and 96 beat per minutes respectively. In group B, the minimum and maximum heart rate for pre test was 54 and 88 beat per minutes respectively. In post test, the heart rate was 58 and 88 beat per minutes respectively.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Pretest BP (systolic) Group A	15	101	124	116.53	6.069
Posttest BP (systolic) Group A	15	125	142	131.93	5.161
Pretest BP (systolic Group B	15	104	124	116.47	6.266
Posttest BP (systolic) Group B	15	110	128	119.67	5.150
Valid N (listwise)	15				

From the table above, the mean and standard deviation of the pre and post test of the blood pressure (systolic) for stair climbing was (116.53±6.069) and (131.93±5.161) respectively. Meanwhile, the pre and post test for treadmill walking shown the little different of the mean, (116.47±6.266) and (119.67±5.150) respectively. There was considerable increase in the stair climbing mean compare to treadmill walking.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Pretest BP (diastolic) Group A	15	70	92	80.13	6.653
Posttest BP (diastolic) Group A	15	72	88	81.60	6.057
Pretest BP (diastolic) Group B	15	70	87	78.13	5.194
Posttest BP (diastolic) Group B	15	70	85	78.33	5.010
Valid N (listwise)	15				

There was not much different of the mean value for both groups according to the table shown above. The pre and post test mean for stair climbing was (80.13±6.653) and (81.60±6.057) respectively and for treadmill walking, (78.13±5.194) and (78.33±5.010) respectively.

Paired t Test

Pre test and post test of heart rate between Group A and B.

Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 Pre test HR Group A - Post test HR Group A	-13.733	8.430	2.177	-18.402	-9.065	-6.309	14	.000
Pair 2 Pre test HR Group B - Post test HR Group B	-2.800	2.757	.712	-4.327	-1.273	-3.934	14	.001

From the comparative mean study, applying of the paired sample „t" test for pre and post test heart rate for Group A shown at t(14)= 6.309 at $p \leq 0.05$ is .000 and for Group B shown that t(14)= 3.934 at $p \leq 0.05$ is .001 both of the groups show the equivalent so there was no significant difference between 2 groups on heart rate because both of the *p* value is ≤0.005.

Blood pressure (systolic) pre test and post test between Group A and B.

Paired Samples Test

	Paired Differences					T	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair Pre test BP (systolic) Group A - Post test BP 1 (systolic) Group A	-15.400	7.424	1.917	-19.511	-11.289	-8.034	14	.000
Pair Pre test BP (systolic) Group B - Post test BP 2 (systolic) Group B	-3.200	3.895	1.006	-5.357	-1.043	-3.182	14	.007

From the comparative mean study shown on the table above, applying the sample „t" test for the pre and post test for the blood pressure (systolic) on Group A shown that at t(14)= 8.034 at $p \leq 0.005$ is .000 which is significant and the alternate hypothesis is accepted for the blood pressure result. Meanwhile, for Group B, the pre and post test of the blood pressure(systolic) after applying the paired sample „t" test shown that t(14)=3.182 at $p \leq 0.005$ is .007. Therefore, there was no significant difference for the Group B on blood pressure measure.

Blood pressure (diastolic) pre test and post test between Group A and B.

	Mean	Std. Deviation	Paired Differences			T	df	Sig. (2-tailed)
			Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 Pre test BP (diastolic) Group A - Post test BP (diastolic) Group A	-1.467	8.509	2.197	-6.179	3.246	-.668	14	.515
Pair 2 Pre test BP (diastolic) Group B - Post test BP (diastolic) Group B	-.200	3.364	.868	-2.063	1.663	-.230	14	.821

Paired Samples Test

Comparative mean for the blood pressure (systolic) on pre and post test for both groups shown that there was no significant and the *p* value is 0.515 for Group A and 0.821 for Group B.

Discussion

The primary objective of this study was to compare the effects of stair climbing and treadmill walking on the cardio respiratory parameters (blood pressure, heart rate) on

apparently healthy adults. At the commencement of the study, the groups were not significantly different in any of the variables investigated, so that the 2 groups were equivalent at the study and any subsequent difference between them could largely have been due to the difference between the interventions received by the groups. The finding through this study, stair climbing exercise and treadmill walking had significant effect on heart rate. Stair climbing was significantly better on the cardiovascular parameters and cardiovascular endurance. Usually, stair climbing is met the minimum requirements for cardio respiratory benefits and can be considered a viable exercise for most people and suitable for promotion of physical activity state by Teh *et al*, April 2002. However, in such activities such as walking, running and cycling, that can considered as physical activities, has been shown to increase in a linear fashion with heart rate for average person (Astrand PO *et al* 2002). The findings on the blood pressure for both groups show the stair climbing exercise had a significant effect compare to treadmill walking. This may be due to the speed and the timer that given to the treadmill walking were not enough. However, the significant was clearly for stair climbing although there is so much different steps that had been use from the previous study that only using public staircase of 199 steps utilize by Boreham *et al*, 2000.

Result

The results of this study showed that both of the group had significant effect on heart rate. However, there was significant difference between both groups on systolic blood pressure.

Conclusion

Based on the findings of this study, it can be concluded that stair climbing and treadmill walking had equivalent effect on the heart rate with significant difference $p(\leq 0.05)$. Besides, stair climbing exercise is good for alternative exercise because stair climbing possibly provides an important function in cardio fitness and physical activities together.

Limitation

- Participant awareness about the heart rate taken.
- The subject were classified as sedentary on whole and not mentioned whether they are totally sedentary or partially sedentary.
- Lack number of subject.
- No specific speed for the treadmill walking in this study.

Research Recommendation

- Increase the number of subject and classified into sedentary and partially sedentary.
- Need specific timer and speed for treadmill participants.
- Let the subject did not know the purpose and objective of the study.

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