

Comparative Study Of Cardiovascular Changes After Staircase Ascent and Descent

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Abstract: Background and Objectives: Despite its obvious advantages few studies have examined health outcomes of exercise schedule of regular staircase ascent and descent which is included in physically active lifestyle in the maintenance of good health. Here we compared cardiovascular changes and recovery time between staircase ascent and descent, between male and female. **Method:** 64 male and 64 female of age group 18-22 were told to perform staircase ascent and descent exercise with rest pause in between to assess changes in blood pressure and pulse rate immediately after exercise compared to resting condition. **Results:** The statistical analysis was done using SPSS version 17 software and Student's t-test was applied. Mean changes in systolic blood pressure and pulse rate were significantly more after ascent as compared to descent, mean recovery time for blood pressure and pulse rate was significantly more after ascent as compared to descent in both groups ($p < 0.05$). Significant rise in mean systolic blood pressure was found more in males as compared to females. Interpretation and **Conclusion:** As staircase descent is less stressful to the cardiovascular system compared to ascent, the former can be used as an activity that may be beneficial for individuals who were previously sedentary and can be applied at the beginning stages of an exercise training program.

Key words: Blood pressure, Pulse rate, Staircase ascent-descent

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Introduction: A physically active lifestyle is well established as a central component in the maintenance of good health and disease prevention¹. However, the majority of population in our society appear reluctant to undertake even the minimum exercise recommendation to achieve discernible health benefits².

Moreover, the prevalence of sedentary behaviour is more. Stimulating our society to engage in a more active lifestyle and exercise schedule could effectively lower coronary heart disease (CHD) rates³. The increased automation of work procedures means the longest sedentary phase in waking hours⁴. The workplace has therefore been identified as a critical setting for the delivery of interventions designed to reduce chronic disease among adult populations⁵.

Ideally, the program must not interfere with work, take only a minimal amount of time, no financial costs and special equipment and be effective in altering health related fitness^{6,7}. Staircase ascent and descent is a familiar and routine mode of activity in our life that has been shown to independently predict longevity in populations⁸. Despite the apparent practicality of staircase ascent and descent in an urban occupational setting, only a paucity of literature has investigated the potential health benefits. Cardiovascular response to such an exercise

schedule can be used as major criteria in exercise prescription for both the patients and healthy population which will help in reducing the risk of any cardiovascular events.

However, it has been noted that the substantial anatomical, physiological, and morphological differences that exist between men and women may affect their exercise capacity and influence the magnitude of response to exercise. The objective of this study is to determine the cardiovascular responses to staircase ascent and descent, differences between apparently healthy male and female subjects.

To date, the effects of smoking cessation and changes in dietary habits on risk factors for coronary artery disease (CHD) have been the focus of most health promotion interventions, with only a small number of randomized controlled trials targeting physical activity⁹. Therefore, the purpose of the present study is to assess the cardiovascular changes after staircase ascent and descent and also to investigate any gender differences in them so that appropriate preventive measures can be timely implemented.

Studies have suggested that active and healthy lifestyle could effectively lower coronary heart disease (CHD) rates among both males and females in general and one possible way is the inclusion of staircase walking both ascent and

descent into the daily schedule, particularly in an urban working environment. Staircase walking thus can be used as an activity that may be beneficial for individuals in population who are previously sedentary and at the beginning stages of an exercise training program.

This study will help in improving the cardiovascular fitness in population by cultivating a healthy lifestyle and exercise schedule for both males and females. From this study we can justify that preventive measures are better than curative to curtail cardiovascular events related deaths by implementation of overall healthy life style, both in males and females population.

Objectives of this study:

1. To evaluate cardiovascular changes after staircase ascent in males and females.
2. To evaluate cardiovascular changes after staircase descent in males and females.
3. To compare cardiovascular changes after staircase ascent and descent.
4. To compare cardiovascular changes after staircase ascent and descent in males and females
5. To compare recovery time after staircase ascent and descent.

Material and Method: Study design: The study was conducted in a well-known tertiary hospital in Mumbai. The participants of the study were college students of age group 18 - 22 years. The permission to conduct the said study was taken from the local ethics committee. Sample size: 128 college students. Each participant subjected to a test period of not more than 30 minutes on a single visit basis. Duration of the study: 11 days. The subjects fulfilling the inclusion criteria were included in the study.

Selection of the subjects: The volunteers were first explained about the purpose of the study. They were selected according to preset criteria for selection. Written informed documentary consent was taken. Detailed medical history and physical examination of the subjects were done as per the Performa.

Inclusion criteria: Students who gave proper consent were included in the study. Students between 18 - 22 years were included in this study. Both healthy male and female students were included in this study.

Exclusion criteria: Students age below 18yrs and above 22 yrs, students who are chronically ill, students who are taking any medication, students who had undergone any recent abdominal surgery, students having cardio-respiratory illness.

Absence of these criteria confirmed by history and clinical examination of every student participating in the study. Study procedure: Study was carried out on healthy male and female volunteers aged between 18-22 years. 128 volunteer individuals fulfilling inclusion criteria were included in the study. Proper consent of healthy volunteer was obtained before the procedure.

Group A consists of 64 male volunteers and, Group B consists of 64 female volunteers. Each participant from both the groups was explained in detail about the study procedure. The following cardiovascular parameters were determined on 4 occasions namely pre-test, immediately after ascending staircase and before and immediately after descending staircase in each participant from group A and group B pulse rate (P) by palpatory method, systolic blood pressure (SBP), diastolic blood pressure (DBP) by mercury sphygmomanometer and recovery time (time duration in which above parameters returns to normal range).

After taking pre-test readings the subject was asked to climb up the staircase of a standard heritage building of a tertiary care institute. Each step of the staircase is of 7 inches in height and 11 inches in width which we have taken as a References standard in this study, there are 150 steps. Subject was climbing the staircase at an average walking speed without any undue exertion. The subject was instructed to halt at any stage as soon as he/she either feels uncomfortable or is unable to carry out further test due to any reason. Immediately after reaching the desired location after ascent again the readings were taken. After rest period of 15 minutes again readings were taken. Then subjects were asked to walk down the staircase at an average speed without any undue exertion. Immediately again readings were taken as soon as the subject reaches the desired location after descent. After staircase ascent and descent recovery time was measured. The readings were

recorded by the same investigator as per the study procedure. Comparison was made in pre and post exercise test readings after ascent and descent, between males and females. The pre-test and post-study measurements of cardiovascular parameters were done under similar environmental conditions in both the groups.

Result: The statistical analysis was done using SPSS version17 software and Student’s t-test (unpaired t-test) was applied. (*)Difference in mean value was significant ($p < 0.05$). NS-Difference in mean value was not significant.

1) Comparison of mean changes in systolic blood pressures after ascent and descent: Mean change in systolic blood pressure was **28.65** after ascent, which was significantly more as compared to **13.09** after descent among male group. Mean change in systolic blood pressure among female was **25.06** after ascent, which was significantly more than **11.75** after decent.

2) Comparison of mean changes in systolic blood pressures between male and female

Period	Mean SBP (mm Hg) ($\bar{X} \pm SD$)		P value
	Male (N=64)	Female (N=64)	
Resting	115.38 \pm 6.59	105.41 \pm 6.72	*0.0000
After Ascent	144.03 \pm 7.56	130.47 \pm 6.32	-
After descent	128.47 \pm 6.08	117.16 \pm 6.39	-
Mean change (Resting – Ascent) (Resting – Descent)	28.65 \pm 6.37 13.09 \pm 5.01	25.06 \pm 3.77 11.75 \pm 4.06	*0.0002 0.0989

3) Comparison of mean changes in diastolic blood pressures after ascent and descent: Mean change in diastolic blood pressure was **1.06** after ascent, which was more but not significant as compared to **0.09** after descent among male group. Mean change in diastolic blood pressure among female was **0.37** after ascent, which was more as

compared to **0.28** after decent, but the difference was not significant.

4) Comparison of mean changes in diastolic blood pressures between male and female

Period	Mean DBP (mm Hg) ($\bar{X} \pm SD$)		p value
	Male (N=64)	Female (N=64)	
Resting	72.16 \pm 6.32	65.69 \pm 6.97	*0.0000
After Ascent	73.22 \pm 6.76	66.06 \pm 6.77	-
After descent	72.25 \pm 6.58	65.97 \pm 6.92	-
Mean change (Resting – Ascent) (Resting – Descent)	1.06 \pm 1.88 0.09 \pm 1.03	0.37 \pm 1.59 0.28 \pm 0.79	0.0967 0.2438

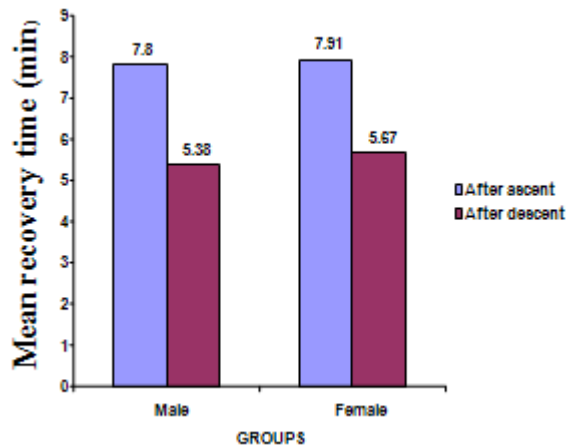
5) Comparison of mean changes in pulse rate between male and female

Period	Mean Pulse rate (beats/min) ($\bar{X} \pm SD$)		P value
	Male (N=64)	Female (N=64)	
Resting	77.59 \pm 6.72	79.19 \pm 8.01	0.2232 (NS)
After Ascent	124.50 \pm 12.25	128.66 \pm 10.92	-
After descent	101.78 \pm 9.40	105.47 \pm 8.37	-
Mean change (Resting – Ascent) (Resting – Descent)	46.91 \pm 12.76 24.19 \pm 10.10	49.47 \pm 11.40 26.28 \pm 8.45	0.2335 (NS) 0.2064 (NS)

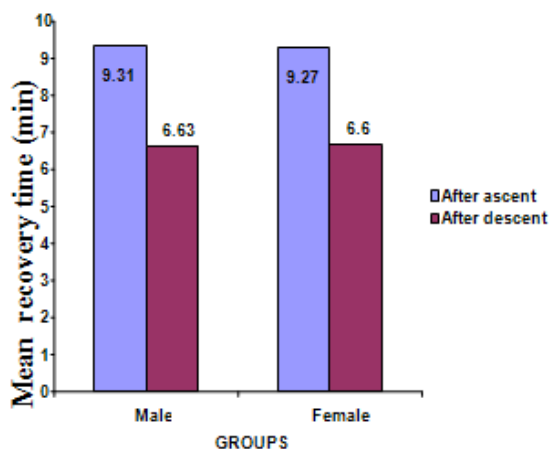
6) Comparison of mean changes in pulse rate after ascent and descent: In the above table, mean change in pulse rate was **46.91** after ascent, which was significantly more as compared to **24.19** after descent among male group.

Mean change in pulse rate among female was **49.47** after ascent, which was significantly more as compared to **26.28** after descent.

7) Comparison of mean recovery time for systolic blood pressure between ascent and descent



8) Comparison of mean recovery time for pulse rate between ascent and descent



Mean changes in systolic blood pressure and pulse rate were significantly more ($p < 0.05$) after ascent as compared to descent in both groups. Mean diastolic blood pressure changes were not significant after ascent and descent. Mean recovery time for blood pressure and pulse rate was significantly more ($p < 0.05$) after ascent as compared to descent in both groups, gender difference not significant. After ascent and descent, significant rise in mean systolic blood pressure was found more in males as compared to females but a non significant rise in mean pulse rate was found in females compared to males.

Discussion: In present study we got results that after staircase ascent and descent exercise there is significant increase in systolic blood pressure, pulse rate and diastolic blood pressure changes are not significant. As exercising muscles required more blood flow to fulfil requirements so there is increase in stroke volume in relation to this there is increase in systolic blood pressure. Diastolic blood pressure remains somewhat constant due to peripheral vasodilatation which facilitates blood flow to the working muscles also increases availability of oxygen and nutrients. Increase in heart rate first due to parasympathetic withdrawal further due to increase in sympathetic activity.

In present study resting blood pressure more in males compare to females and pulse rate more in females also changes after exercise are same i.e. systolic blood pressure more in males and pulse rate more in females. Females have a low stroke volume and higher heart rate than males during submaximal exercise when exercise is performed at the same absolute workload. The higher heart rate more than compensates for the lower stroke volume in females resulting in higher cardiac output seen at the same absolute workload^{10,11,12,13,14}.

In present study changes in systolic blood pressure and pulse rate are significantly more after ascent compared to descent. Gravitational force increasingly assists with the work of performing the activity in descent of staircase, thus reducing physiological work required of the body. Downhill walking or staircase descent is an activity with the ability to enhance physical movement without placing undue cardiovascular stress on an individual. In other words, an individual can walk at an faster speed on a negative slope i. e. staircase descent than on the level or uphill and still have lower cardiovascular response¹⁵.

Conclusion: Staircase ascent and descent both have significant changes on the cardiovascular system. As staircase descent is less stressful to the cardiovascular system compared to ascent, the former can be used as an activity that may be beneficial for individuals in the population who were previously sedentary and can be applied at the beginning stages of an exercise training program. Incorporating staircase descent into

exercise programs might be a safe alternative form of exercise for younger and older individuals.

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