DOI: https://doi.org/10.53350/pjmhs22163128

ORIGINAL ARTICLE

Effects of Stair Climbing Training on Cardiopulmonary Endurance in Gym Users

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ABSTRACT

Background: Stair climbing is an effective, easy to approach and inexpensive moderate to high intensity exercise with great effects in improving functional status of individuals.High intensity interval training (HIIT) protocol is also a short time exercise with greater long term effects in improving cardiopulmonary endurance.
Aim: To examine the effects of stair climbing on cardiopulmonary endurance in gym users in addition to High intensity interval training (HIIT) protocol and to measure the effects of stair climbing on blood lactate in gym users.
Methods: 32 healthy individuals including males and females have been divided into two groups all the participants were gym users from past three months .Control group followed HITT protocol only and experimental group performed stair climbing in addition to HIIT protocol. Time duration of the training was 8 weeks .Individuals were assessed before and after the training for VO_2max, and blood lactate. Body Mass Index, Rate of Perceived Exertion, and O_2cost, modified Canadian Aerobic Fitness Test (mCAFT) stages Blood Pressure, Heart Rate has also been assessed before and after training.
Results: Results has shown the significant increase in VO_2 max (p value 0.001) and lower levels of blood lactate (≤0.001) within the groups after training. There was no significant improvement in VO2max and blood lactate formation on comparison between the groups.
Conclusion: Current study concluded that there was significant increase in VO2 max and blood lactate with stair climbing in addition to HIIT protocol in gym users within the groups but there is no significance between the groups. It means both the protocols been followed are significant with almost equal affects and both are equally beneficial.
Keywords: Stair Climbing Training, High intensity interval training (HIIT), modified Canadian Aerobic Fitness Test (mCAFT)

INTRODUCTION

Cardiopulmonary endurance is the ability of circulatory and respiratory systems which supply oxygen and sufficient nutrients to all the working muscles of body[1,2]. Individuals with sedentary life style are more prone to cardiac diseases[3]. Among Men & Women cardiorespiratory fitness reduces the risk of cardiovascular disease (CVD) 47% and 70% respectively[4,5] .

According to World Health Organization (WHO) daily exercise recommendations healthy individuals ageing between 5-17 years, should perform moderate activity daily at least for 60 min people in 18-64 years age range should perform for 150 min moderate or at least 75 min of vigorous activity throughout the week are sufficient for health benefits[6,7] in daily routine short time duration activities enhances the cardiopulmonary endurance but many individuals do not find enough time to do even a 30 minute walk on daily basis that could be hazard to their health in future[8].Most of the people fail to reach and to even maintain the recommended guidelines for routine exercises to build a healthy life style i.e. 150 minutes of moderate exercise per week[9]. According to a study In a healthy individual, 30 minutes moderate intensity physical activity for 5 days per week, or 20 minutes of vigorous physical activity for 3 days per week is required to develop and sustain the cardiorespiratory endurance[10].

Stair climbing is moderate to high intensity exercise that depends on the speed of the individual. Stair climbing on daily basis can improve physical fitness and cardiovascular endurance of the person[11,12]. If the intensity is specified, stepping exercise or stair climbing can be equally beneficial as any other High Intensity Interval Training (HIIT) program[13].It is reported in a study that daily stair climbing can beneficially affect maximal oxygen uptake in young females[14]. Stair climbing is a less expensive and easy procedure that can be adapted any daily routine to have cardiac fitness.

Current study has been conducted to measure the effects of stair climbing on cardiorespiratory endurance in combination with high intensity interval training in athletes.

Received on 11-09-2021
Accepted on 23-02-2022

METHODOLOGY

In this randomized control trail 32 non-smoker participants using Gym of University of Lahore, Gujrat Campus during July 2019-December 2019, both genders aged between 20 to 30 years with no known comorbidities, training in gym from past 3 months (doing weight treadmill, gym cycle, weight lifting and other aerobics under the supervision of gym instructor) were included in the study using Non-probability judgmental sampling. While participants with History of any cardiac disease, Congenital physical abnormality, Any known neurological disease or Any previous fracture of upper and lower limb/MSK condition were excluded from the study.

Ethical approval was obtained from Research Ethical Committee of Riphah faculty of Rehabilitation Sciences of Riphah International University, Islamabad.After taking a proper verbal and written consent, Participants were randomly divided into two groups of 16 each.

Group A was dealt with Modified Canadian Aerobic Fitness Test (mCAFT), High Intensity Interval Training while group B was dealt with Modified Canadian Aerobic Fitness Test (mCAFT), and High Intensity Interval Training along with stairs climbing. mCAFT has been performed at day 1 and VO_2 max was calculated. Heart rate (HR), Body Mass Index (BMI), Blood Pressure (BP) and Borg Rating of Perceived Exertion (Borg RPE) were assessed before the start of training .Vitals including HR, Blood pressure and RPE has been monitored during every session. Both Group A and Group B have performed HIIT protocol in gym. After HIIT protocol Group B has performed stair climbing also. Blood lactate was measured within first 24 hours of the training session (1st, and 8th

week.). Training session lasted for 8 weeks, 3 days a week. At the end of 8th week, VO2 max has been calculated again using MCAFT. HR, THR, BMI have also been assessed. For Statistical Analysis, SPSS version 25 was used. First of all Normality of data was checked using Shapiro-Wilk test. For normal data, parametric tests like paired t test for pre and post reading within group and independent sample t test was used to determine difference between groups. While non-normally distributed data was analyzed by non-parametric tests i.e.Mann-Whitney U-test was used taking p-value of ≤0.05 as significant.

RESULTS

A total of 32 subjects were randomly divided into two groups of 16 each. Mean age of High Intensity Interval training (**Group A**) was 25.38 ±2.96 years and Mean age of High Intensity Interval training with Stair climbing training (**Group B**) was 25.13±3.20years. In group A, 11(68.80%) were male and 5(31.30%) were female. In group B, 10(62.50%) were male and 6(37.50%) were female.

As compared to base line, post Borg RPE score was statistically significantly difference in both group (P-value 0.001 for Group A and p-value 0.002 for group B). Post Borg RPE score of both Group A& B was not statistically significant (p-value 0.573). Post-treatment within group analysis showed that all variables i.e. VO_2 Max, Cadence, BMI, Blood Lactate and Target Heart Rate (THR) statistically significantly improved in both groups as shown in Table 1. However, post treatmentbetween group analyses showed that there were no significant differences betweenthe two groups regarding VO_2 Max(p-value 0.102), Cadence(p-value 0.949), Target heart rate (THR) (p-value 0.900) and Blood Lactate(p-value 0.614). Whereas post BMI of group A was 23.86±2.51 and group B was 21.86±2.64the difference was statistically significant (p-value 0.036)

Comparison of pre & post treatment measurements according to groups

Study Variable	High Intensity Interval Training (HIIT)		P-value	High intensity interval training + Stair Climbing Training		P-value
	Pre-Treatment Mean± SD	Post-Treatment Mean± SD		Pre-Treatment Mean± SD	Post-Treatment Mean± SD	
VO_2 Max	47.49±4.28	48.26±4.25	0.044*	47.36±3.80	50.45±3.00	0.001*
BMI	25.17±2.50	23.86±2.51	0.001*	24.08±2.65	21.86±2.64	0.001*
Cadence	123.13±5.71	126.06±5.60	0.001*	121.06±3.21	126.19±5.37	0.002*
THR	169.19±4.56	166.81±5.04	0.001*	170.50±3.03	166.63±3.07	0.001*
Blood Lactate	10.51±0.92	10.25±.0.88	0.001*	11.38±2.48	10.55±2.12	0.004*

BMI; Body mass index, SD: Standard DeviationTHR; Target heart rate

DISCUSSION

Stair climbing is moderate to high intensity exercise that depends on the speed of the individual. Stair climbing exercise including one flight on repetition is more effective to increase the cardiac endurance in smokers then the casual stair climbing[15]. Mary k. et al conducted a study in their study they used intense stair climbing to enhance the cardiopulmonary fitness. They took 31 previously sedentary but healthy females. Study reported the positive effects of stair climbing on cardiopulmonary fitness of the individuals. This study supports results of current study as current study also revealed the same effects of stairs climbing. Results showed similarity in improving the cardiopulmonary endurance .but difference is that in current study HIIT protocol has been used with high sprint bouts and recovery time in between and additional stair climbing is used in experimental group only[16]. Stair climbing is an easy to access exercise with many benefits. Colin et al conducted a study in which they introduced sedentary healthy females to stair climbing. To see the effects they made two groups one comprising 10 females and the other with 12 females.one group did not perform any special exercise plane. While the other followed stair climbing with one percent increase by the end of every week. Time duration of the study was 7 weeks. After the 7 weeks on analysis results has shown the increase in VO2 max (p value <0.01) improved HDL (P <0.05) lower levels of blood lactate (p<0.001). This fore mentioned study also supports results of current study, as current study result shown the similarity in improving VO2max, maintaining HR and lower blood lactate levels with stair climbing[17]. A study was conducted by A.miret al in which he did comparison of stair climbing and one mile walk to improve the cardiopulmonary endurance. He took 34 individuals into groups. Two groups performed stair (half and full) climbing and the followed 1 mile walk. Before the randomization participants performed Harvard stepping test to calculate their pre training VO2 max.HR and HR recovery was also assessed pre and post training of 4 weeks. IPAQ has been used to assess the activity level of individual's results shown that full stair climbing group and 1 mile walk following group improved their cardiorespiratory endurance. But results were more significant for stair climbing because of the difference in time consumption. Current study has shown the significant results for stair climbing in cardiopulmonary endurance and IPAQ has also been used to assess the activity level improvement of individuals in their daily life[10]. A study was conducted by J.gibala et al, to find out the effects of HIIT on cardio metabolic health and fitness. Participants followed high intensity exercise protocol at > 80% of heart rate with active heart rate recovery time periods. They followed the training for 6 to 12 weeks and after training session they have observed the outcome as improved cardio metabolic health[18]. Current study also reveals that HIIT protocol improved the VO2 max after training and overall cardiac fitness has improved after HIIT protocol.

Despite the fact that current study was one of the preliminary study which determine the effects of stairs climbing on cardiopulmonary fitness and blood lactate level in gym users. However it has some limitations. Organization that was targeted to conduct this study was facing downsizing at the time of data collection. Somanyof the employees, whowere part of the study, got terminated.Current research was expensive because of the cost effective test i.e. blood lactate test.Data has been collected from a single organization.

Future studies should be done which can analyze the association of carbohydrate in diet with the blood lactate formation.Outcome would be better if data would be collected from multiple organizations.Results would be better in estimating VO2 max if the data would be collected from same age group.

CONCLUSION

Current study concluded that there was significant increase in VO2 max and blood lactate with stair climbing in addition to HIIT protocol in gym users within the groups. But there were no statistically significant difference between the groups.

Conflict of interest: Nil

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