Original Research Article

Effectiveness of Stair Climbing Test in Assessing Cardiorespiratory Fitness

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ABSTRACT

Background: Physical fitness is defined as "a set of attributes that people have or achieve that relates to ability to perform physical activity". Being physically unfit leads to problems like overweight, obesity and other cardiovascular problems. The need of this study is to find the effectiveness of stair climbing test in assessing cardiorespiratory fitness in normal healthy individuals.
Aim: To find out the Effectiveness of stair climbing test in assessing cardiorespiratory fitness.
Objectives:
To find out BMI in normal healthy individuals
To find out cardiorespiratory fitness using stair climb test
Methodology: The subjects were screened for inclusion and exclusion criteria and 50 subjects were selected using convenience sampling. The basic demographic data was collected and the BMI was calculated. The vital parameters were measured before and after the stair climb test. The test was carried in the hospital premises, where the subjects were asked to climb the stairs for 3 minutes.
Results: The results were obtained using stair climb test on the basis of pre and post test data collected. Statistical analysis showed minimum change in vitals and significant change in outcome measures in SBP ($p = 0.0001$), DBP ($p = 00001$), PR ($p = 0.0001$) while using the stair climbing test in assessing Cardio respiratory fitness.
Conclusion: The stair climbing test can be effectively used as a Cardio Respiratory fitness tool, with minimum change in the vitals.
Key Words: Body Mass Index, Cardio Respiratory Fitness, Stair Climb Test

INTRODUCTION

Physical fitness is defined as a set of attributes or characteristics individuals have or achieve that relates to their ability to perform physical activity. These characteristics are usually separated into the health-related and skill-related components of physical fitness. Health-related physical fitness components include Cardio respiratory endurance, Body composition, Muscular strength, Muscular endurance, Flexibility whereas, Skill-related physical fitness components include Agility, Coordination, Balance, Power, Reaction time, Speed. [1]

According to American College of Sports Medicine and American Heart Association, the Primary Physical Activity Recommendations are such that, all healthy adults aged 18–65 year should participate in moderate intensity aerobic physical activity for a minimum of 30 minutes on 5 days/week or vigorous intensity aerobic activity for a minimum of 20 minutes on 3 days/ week. [2]

Evidence to support the inverse relationship between physical activity and premature mortality, Cardio Vascular Disease / Coronary Artery Disease, hypertension, stroke, osteoporosis, Type 2

diabetes mellitus, metabolic syndrome, obesity, colon cancer, breast cancer, depression, functional health, falls, and cognitive function continues to accumulate. [3] Most studies show a negative co relation of BMI with vitals CRF that is more is the BMI less is the cardiorespiratory fitness.

Uthman O et al (2007) in a study titled, "Comparison of physical activity level between overweight/obese and normal weight individuals: A systematic review" identified and reviewed 58 studies were identified and reviewed. Results were mixed, with most studies showing an inverse association of physical activity with fatness. The study concluded that there is a significant weak to moderate inverse cross sectional relationship between physical activity and body fatness. Moreover, this review provides evidence that the association is strongest among male and younger subjects. [4]

M Brunet et al (2007) in their study entitled, "The association between low physical fitness and high body mass index or waist circumference is increasing with age in children: the 'Que´bec en Forme' Project" measured the Body mass index and waist circumference on 1140 children and the physical fitness tests like standing long jump, 1-min speed sit-ups and speed shuttle run were performed on the subjects. The study concluded that the Body mass index and waist circumference are negatively correlated with physical fitness and are more pronounced in older children. [5]

According to a study, "Mortality trends in the general population: the importance of cardiorespiratory fitness" by Duck-chul Lee et al (2010) Cardio Respiratory Fitness appears to attenuate the higher risk of death associated with obesity although it is not yet clear whether CRF completely eliminates mortality risk in obese individuals. [6]

Stairs prove to be easily available and an effective exercising tool. Its use should thus be promoted in order to increase level of physical activity. A stair climb test is one such way. By such a test people can evaluate their fitness levels at regular intervals at their own convenience. Stairs are easily accessible in home as well as working environment; this test may serve as a simple, self-administered procedure that encourages sedentary individuals to engage in moderate aerobic exercise. It should not be used to yield a precise indication of cardiorespiratory fitness, but rather to create an interest in exercise by providing a broad categorization of fitness, thereby motivating individuals to greater physical activity. [7]

NEED OF THE STUDY
Several studies have been conducted that have shown as standard tests to assess the level of cardiorespiratory fitness. However there are very few studies where in the use of stair climbing test is done to measure cardiorespiratory fitness level.

So the need of this study is to provide basis to use a stair climbing test that is simpler, cheaper and easily accessible by any individual not only to test but also to improve their level of cardiorespiratory fitness.

It is also to see whether what kind of effectiveness exists between BMI and other cardiorespiratory vitals HR using a stair climbing test in normal healthy individuals.

AIM
To find out the Effectiveness of stair climbing test in assessing cardiorespiratory fitness.

OBJECTIVES
To find out BMI in normal healthy individuals
To find out cardiorespiratory fitness using stair climb test

METHODOLOGY
Study Design: Cross Sectional Study
Place of Study: DR. B.R. Ambedkar Medical College
Sampling Technique: Convenient sampling
Study Sample: 50 normal healthy individuals

Study Duration: Total Study duration – one month

Inclusion criteria:

- Age 18 to 25 years
- Both male and female
- Normal healthy individuals willing to participate

Exclusion criteria:

- Individuals with any pre existing Metabolic condition

Outcome Measures:

- Systolic Blood Pressure
- Diastolic Blood Pressure
- Pulse Rate
- Respiratory Rate

MATERIALS USED IN THE STUDY

- Pen
- Paper
- Measuring tape
- Weighing machine
- Stethoscope
- Sphygmomanometer
- Bed
- Hand Watch
- Stairs

PROCEDURE

50 subjects were selected according to the inclusion and exclusion criteria. The basic demographic data was collected and the BMI was calculated. The vital parameters like respiratory rate, pulse rate and blood pressure were measured before and after the stair climb test. The test was carried in the hospital premises, where the subjects were asked to climb the stairs for 3 minutes. The data was analysed.

RESULT

The Data Analysis was segregated into demographic and outcome analysis. The stair climbing test was performed with 50 normal healthy individuals from DR. BR. Ambedkar Medical College, of this 21 were male, 29 were female. The age group selected was 18 to 25 years with their mean age of 24 years.

Table 01: Gender Distribution

GENDER	MALE	FEMALE
NO OF SUBJECTS	21	29
% OF SUBJECTS	42%	58%

Table 01: Shows the Gender distribution in the study there were 29 female and 21 male out of 50 subjects.
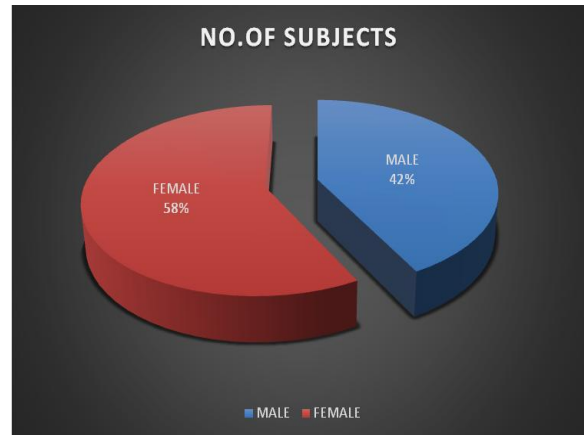
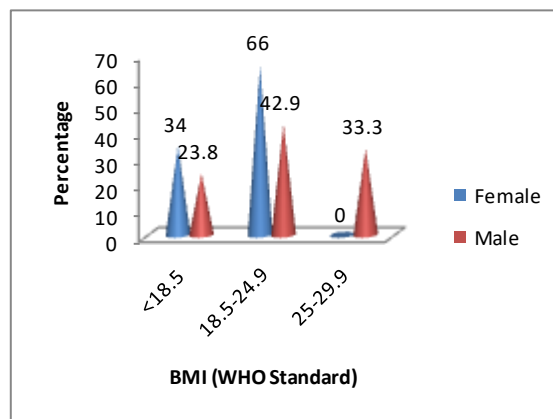**Graph 01: Gender Distribution**

Table02:- BMI (WHO standard) distribution in the sample according to the gender.

BMI (WHO Standard)	Gender			
	Female		Male	
	Number	%	Number	%
<18.5	10	34	5	23.8
18.5-24.9	19	66	9	42.9
25-29.9	0	0	7	33.3
Sub-total	29	100	21	100
Total	50			

Table 02:- Shows the BMI (WHO standard) distribution in males and females and there were 10 females and 5 males in the group of BMI <18.5 .There were 19 females and 9 males in the group of 18.5-24.9 there were no females and 7 males in the group 25-29.9.
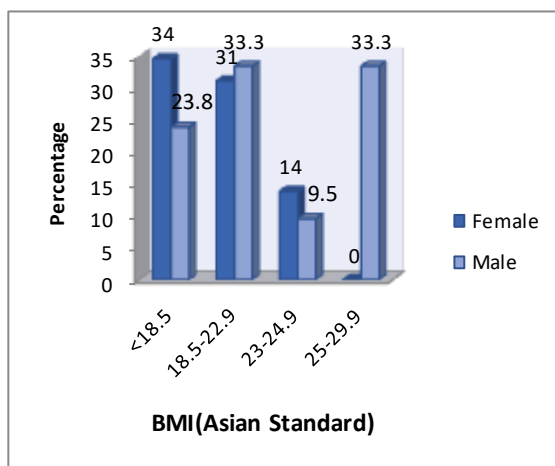

Graph 02:- BMI (WHO standard) distribution in the sample according to the gender.

Table 03:- BMI (Asian standard) distribution in the sample according to the gender

BMI(Asian standard)	Gender			
	Female		Male	
	Number	%	Number	%
<18.5	10	34	5	23.8
18.5-22.9	9	31	7	33.3
23-24.9	4	14	2	9.5
25-29.9	0	0	7	33.3
Sub-total	29	100	21	100
Total	50			

Table 03:-Shows the BMI (Asian standard) distribution in males and females and there were 10 females and 5 males in the group of BMI <18.5. There were 9 females and 7males in the group 0f BMI 18.5-22.9.There were 4 female and 2 male in the group of BMI 23-24.9 and there were no females and 7 males in the group of 25-29.9.


Graph 03:- BMI (Asian standard) distribution in the sample according to the gender.

Table 04:- Distance covered by the subjects according to the gender.

Distance climbed (Avg.=446cm)	Gender			
	Female		Male	
	Number	%	Number	%
<=446cm	9	31	11	52.4
>446cm	20	69	11	52.4
Sub-total	29	100	21	100
Total	50			

Table 04:-shows the Distance covered in the males and females and there were 9 females and 11 males in the group <=446cm.There were 20 females and 11 males in the group >446cm.
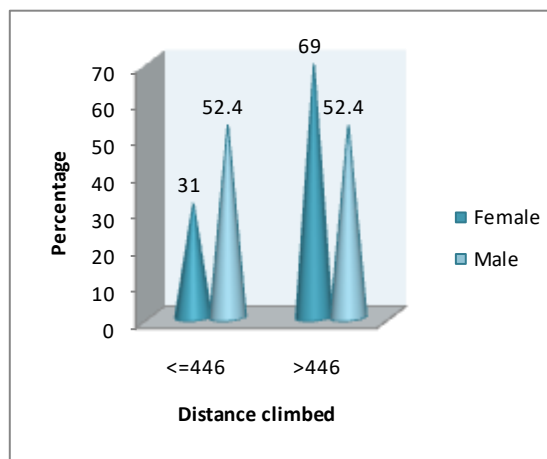

Graph 04:- Distance covered by the sample according to the gender.

Table 05(a):- Systolic Blood Pressure (SBP) measured before and after stair climbing test in female subjects.

SBP (in mmHg)	Pre-test		Post-test	
	Number	%	Number	%
100-120	18	62	1	3
>120	11	38	28	97
Sub-total	29	100	29	100
Total	29		29	

Table 05(a):- Shows the SBP measured in female there were 18 females in pre-test and 1 female subject in post-test in the group of SBP 100-120. There were 11 females in pre test and 28 females in post test in the group of SBP >120.
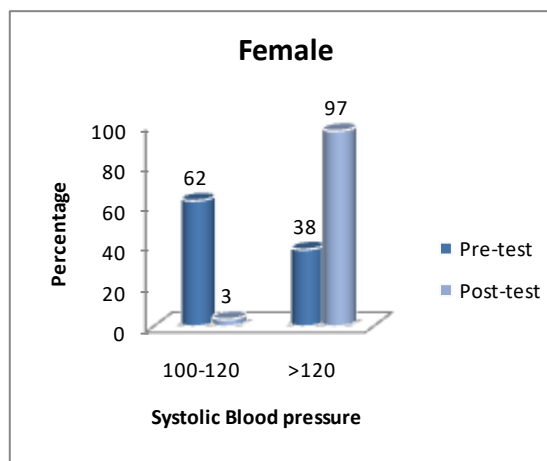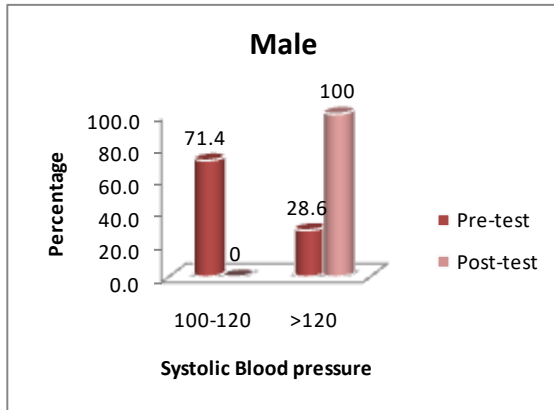

Graph 05(a):- SBP measured before and after stair climbing test in female subjects

Table 05(b):- SBP measured before and after stair climbing test in male subjects.

SBP (in mmHg)	Pre-test		Post-test	
	Number	%	Number	%
100-120	15	71.4	0	0
>120	6	28.6	21	100
Sub-total	21	100	21	100
Total	21		21	

Table 05(b):-Shows the SBP measured in Males there were 15 males in pre-test and there were no males in post test in the group SBP 100-120.There were 6 males in pre test and 21 males in post test in the group SBP of >120.
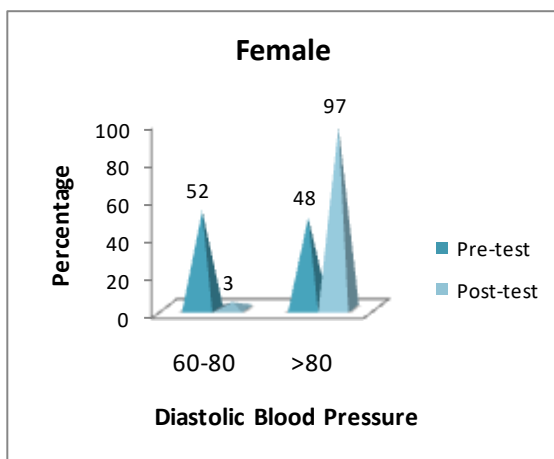

Graph 05(b):- SBP measured before and after stair climbing test in male subjects.

Table 06(a):- Diastolic Blood Pressure (DBP) measured before and after stair climbing test in female subjects.

DBP(in mmHg)	Pre-test		Post-test	
	Number	%	Number	%
60-80	15	52	1	3
>80	14	48	28	97
Sub-total	29	100	29	100
Total	29		29	

Table 06(a):- Shows the DBP measured in females there were 15 females in pre test and 1 female in post test in the group of DBP 60-80. There were 14 females in pre test and 28 females in the post test in the group of DBP >80.
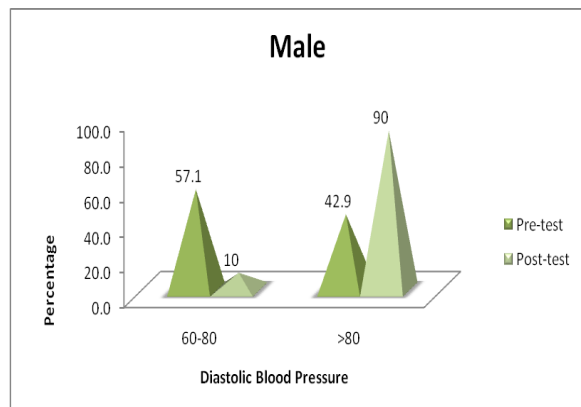

Graph 06(a):- DBP measured before and after stair climbing test in female subjects.

Table 06(b):- DBP measured before and after stair climbing test in male subjects.

| DBP(in mmHg)	Pre-test		Post-test	
	Number	%	Number	%
60-80	12	57.1	2	10
>80	9	42.9	19	90
Sub-total	21	100	21	100
Total	21		21	

Table06(b):-Shows the DBP measured in males there were 12 males in pre test and 2 males in post test in the group of DBP 60-80.There were 9 males in pre test and 19 males in post test in the group of DBP >80

Graph 06(b):- DBP measured before and after stair climbing test in male subjects.

Table 07(a):- Pulse Rate (PR) measured before and after stair climbing test in female subjects.

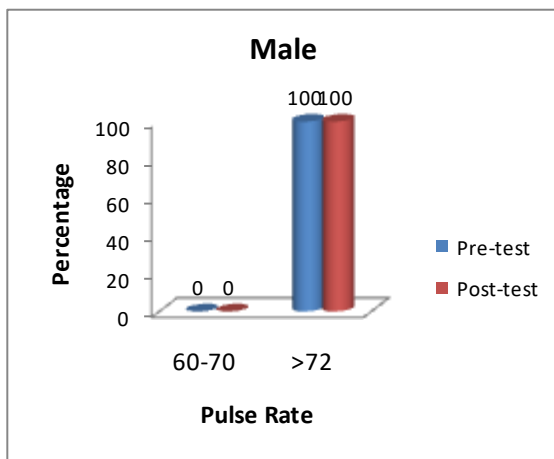| PR (beats per min)	Pre-test		Post-test	
	Number	%	Number	%
60-70	4	14	0	0
>72	25	86	29	100
Sub-total	29	100	29	100
Total	29		29	
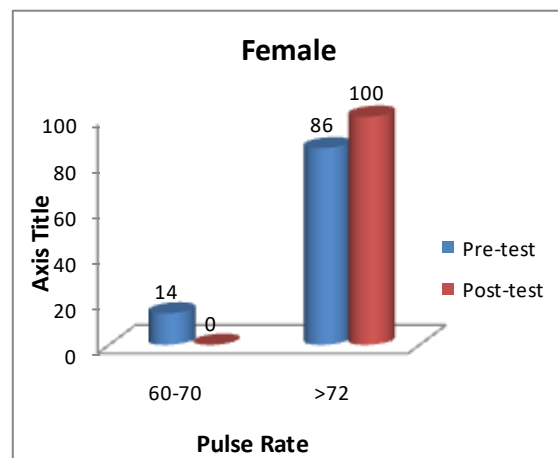
Graph 06(a):- DBP measured before and after stair climbing test in female subjects.

Table 07(a):- Shows the PR measured in female there were 4 females in pre test and there were no females in post test in the group of PR 60-70. There were 25 females in pre test and 29 females in post test in the group of PR >72.

Table 07(b):- PR measured before and after stair climbing test in male subjects.

PR (beats per min)	Pre-test		Post-test	
	Number	%	Number	%
60-70	0	0	0	0
>72	21	100	21	100
Sub-total	21	100	21	100
Total	21		21	

Table 07(b):-Shows the PR measured in males there were no males in pre test and there were no males in post test in the group of PR 60-70.There were 21 males in pre test and 21 males in post test in the group of PR >72.
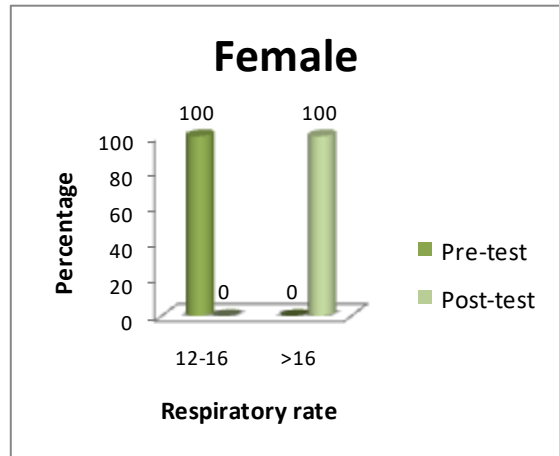

Graph 07(b):- PR measured before and after stair climbing test in male subjects.

Table 08(a):- Respiratoty Rate (RR) measured before and after stair climbing test in female subjects.

RR (breaths per min)	Pre-test		Post-test	
	Number	%	Number	%
12-16	29	100	0	0
>16	0	0	29	100
Sub-total	29	100	29	100
Total	29		29	

Table 08(a):-Shows the RR measured in females there were 29 females in pre test and there were no females in the post test in the group of RR 12-16. There were no females in pre test and 29 females in post test in the group of RR >16.
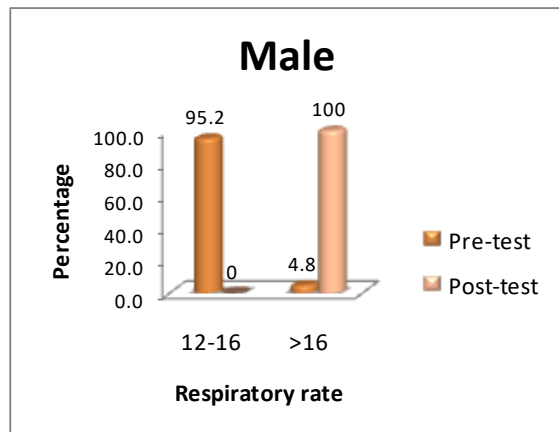

Graph 08(a):- RR measured before and after stair climbing test in female subjects.

Table 08(b):- RR measured before and after stair climbing test in male subjects.

RR (breaths per min)	Pre-test		Post-test	
	Number	%	Number	%
12-16	20	95.2	0	0
>16	1	4.8	21	100
Sub-total	21	100	21	100
Total	21		21	

Table 08(b):- Shows the RR measured in males, there were 20 males in pre test and no males in post test in the group of RR 12 – 16. There were 1 male in pre test and 21 males in post test in the group of RR >16.

Graph 08(b):- RR measured before and after stair climbing test in male subjects.

Table 09:- Descriptive statistics of SBP, DBP, PR & RR

Variables	Mean ± SD		Significance
	PRE	POST	
SBP	123 ± 8	140 ± 8	0.0001 (Significant)
DBP	83 ± 8	97 ± 9	0.0001 (Significant)
PR	80 ± 5	103 ± 13	0.0001 (Significant)
RR	15 ± 1	26 ± 3	0.843 (Not Significant)

Table 09:- Shows the descriptive statistics of SBP (Significant), DBP (Significant), PR (Significant) & RR (Not Significant)

DISCUSSION

Table 1 and Graph 1 shows the gender distribution. Table 1 shows the gender distribution in the study there were 29 female and 21 male out of 50.

Table 2 and Graph 2 shows the BMI (WHO Standard) distribution in the sample according to the gender. Table 2 shows the BMI (WHO Standard) distribution in males &females and there were 10 females and 5 males in the group of BMI <18.5 There were 19 females and 9 males in the group of 18.5-24.9. There were no females and 7 males in the group 25 -29.9. Totally 29 females and 21 males age group 18-25 normal healthy individual sample are selected.

Table 3 and Graph 3 shows the BMI(Asian Standard)distribution in the sample according to the gender .Table 3 shows the BMI (Asian Standard)distribution in males and females and there were 10 females &5 males in the group of BMI <18.5.There were 9 females and 7 males in the group of BMI 18.5-22.9.There were 4 females &2 males in the group of BMI 23.24.9 and there were no females and 7 males in the group of 25-29.9 .Totally 29 female & 21 males sample are selected.

Table 4 and Graph 4 shows the Distance covered by the sample according to the gender. Table 4 Shows the Distance covered in the males and females and there were 9 females and 4 males in the group <=446.There were 20 female and 11 male in the group >446 .Totally 29 females and 21 males are selected.

Table 5(a) and Graph 5 (a) shows the SBP measured before and after Stair climbing test in female sample. Table 5 (a) Shows the SBP measured in female there were 18 females in pre test and 1 female in post test in the group of BMI 100-120.There were 11 females in pre test and 28 females in post test in the group of SBP >120.Tottally 29 females sample are selected.

Table 5 (b) and Graph5(b) Shows the SBP measured before after stair climbing test Table 5(b)Shows the SBP measured in male there were 15male in pre test and there is no male in post test in the group SBP 100-120.There were 6male in pre test and 21 male in post test in the group SBP of >120.Totally 21 male sample are selected.

Table 6(a) and Graph 6 (a) Shows the DBP measured before and after Stair climbing test in female sample. Table 6 (a) shows the DBP measured in female there were 15females in pre test and 1 female in post test n the group of DBP 60-80.There were 14 females in pre test and 28 females in the post test in the group of DBP >80.Totally 29 female sample are selected.

Table 6(b) and Graph 6(b) Shows the DBP measured before and after Stair climbing test in male sample .Table 6 (b) shows DBP measured in males there were 12 males in pre test and 2 males in post test in the group of DBP 60-80.There were 9 males in pre test and 19 males in post test in the group of DBP >80.

Table 7(a) and Graph 7 (a) shows the PR measured before and after Stair climbing test in female sample. Table 7(a) Shows the PR measured in female there were 4 females in pre test and there is no female in post test in the group of PR 60-70 .There were 25 female in pre test and 29 females in post test in the group of PR >72.

Table7(b) and Graph 7 (b) Shows the PR measured before and after Stair climbing test in male sample .Table 7(b) shows the PR measured in males there were no males in pre test and there is no males in post test in the group of PR 60-70.There were 21 males in pre test and 21 males in post test in the group of PR >72.

Table 8 (a) and Graph 8 (a) shows the RR measured before and after stair climbing test in female sample. Table 8 (a) shows the RR measured in female sample. There were 29 female in pre test and there is no female in post test in the group of RR 12-

16. There is no female in pre test and 29 females in post test in the group of RR >16.

Table 8(b) and Graph 8(b) shows the RR measured before and after Stair climbing test in male sample. Table 8(b) shows the RR measured in male sample. There were 20 male in pre test and there is no male in post test in the group of RR 12-16. There were 1 male in pre test and 21 male in post test in the group of RR >16.

Table 9 shows the pre post analysis of outcome measures. There was a statistically significant increase in SBP ($p = 0.0001$), DBP ($p = 0.0001$) and PR ($p = 0.0001$). There was no statistically significant increase in RR ($p = 0.843$)

There was a little change in the vital when measured before and after the test with a significant change in outcome measures like SBP, DBP and PR. So this test there can be one of the effective tests of fitness level without requiring any expensive modalities and with minimum exertion.

CONCLUSION

The stair climbing test can be effectively used as a Cardio Respiratory fitness test with minimum change in the vitals. Also, this can be encouraged to be used in everyday life for maintaining physical activity in day to day life

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