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Cross Sectional Analytical Study of Effects of Resistance Training on the Improvement of Cardiovascular Endurance, Flexibility & Muscular Endurance in Adults

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Abstract

Resistant training is one of the most important way of workouts which is seeking attention in modern days exercise patterns. Such training is also associated with reduction in the risk of hypertension and allied metabolic diseases especially in population served by sedentary lifestyle. Thus the present study was designed to examine the effects of 3 months to 1 year resistance training on cardiovascular endurance, flexibility, muscular endurance and physical fitness which enables us to confirm changes in performances in adults. On successful completion of training it was observed that significant increase in strength, power and working abilities of participants enrolled. Major gain of the study was seen in participants aging 30-39years. This finding of the present study clearly demarcates the benefit of starting the resistance training at an earlier age is always favourable. Hence we conclude that in health promotion of resistance training more emphasis should be targeted to the population groups with lower physical activity levels who are at maximum risk of having cardiovascular and obesity like diseases.

Keywords: *Muscular endurance, cardiovascular endurance, flexibility, muscle strength, Resistance Training, physical fitness.*

Introduction

Strength and resistance training exercise is one of most important types of workout that is to be performed routinely. It is benefiting the individuals by increasing strength of bones, muscles and connective tissues; by lowering risk of cardiovascular injury and thus providing with better quality of life. [1]

Also reduction in the risk of hypertension is associated with planned workouts. Consistent involvement with resistance training can prevent chronic disease and mental illness during later adulthood. The origins of adulthood physical activity are suggested to be in adolescence physical activity. [2]

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Sedentary lifestyle is considered to be the reason for major health problems like metabolic disorders, obesity, Cardiovascular disorders of the later ages in life with increasing trend of in young adults. [3] It is clear that, along with nutrition and lifestyle modifications; exercise plays a significant role in overcoming these disorders. [4] Many research studies have shown that exercise specially resistance training in young adults is significantly increasing the measures of healthy life. [5]

A major concern is developing and investigating effective and practical interventions for those who are at the risk of developing health such problems. Thus, our aim was to examine how resistance training improve physical, social and mental performances in adults. [6]

In Indian setup we don't have the exact literature which will inform how much change will be there in the Physique parameters with exercise which we tried to conduit with the present study.

Method & Procedure: In this cross sectional analytical study sample size of 135 participants was

calculated considering confidence limit of 5% and confidence interval of 95%. 169 participants were selected randomly coming to the gymnasium in the age group of 30 to 49 years age.

All participants participated in a supervised resistance training program (6 day/week) for the duration of up to 1 year (6 months minimum). The participants were measured at base line and periodically at every 1st week of every month during the training program for body cardiovascular endurance, muscular endurance and flexibility.

In the fitness test, for the Muscular endurance, "Push up and "Curl Up" is used. For the Flexibility "Sit and Reach test" is used and for cardiovascular endurance Heart rate is used at resting and after treadmill. [5, 7]

Maximum heart rate is calculated by subtracting age of the individual from 220. For a 30-year-old person, for example: 220-30 = 190.[8]

The target zone for a 30-year-old person would be between 50 and 85 percent of his or her maximum heart rate:

- 50 percent: 190 x 0.50 = 95 bpm
- 85 percent: 190 x 0.85 = 162 bpm.

Following grades of exercise were considered as per K11 academy of fitness sciences standardized protocol.[9]

Table. 1: Different grades of exercises and their normal values

Age group	30-39								40-59							
Grade of exercise	4	3	2	1	4	3	2	1	4	3	2	1	4	3	2	1
Gender	**Male**				**Female**				**Male**				**Female**			
Push up	>48	34-38	17-33	06-16	>42	29-32	13-16	05-15	>34	25-34	15-24	08-14	>29	20-29	12-21	06-12
Curl up	50	40	25	10	40	25	15	06	40	25	15	5	30	15	10	04
Sit & reach	>40	28-40	22-28	15-22	>43	33-43	22-33	17-22	>40	28-40	22-28	15-22	>43	33-43	22-33	17-22

Where in grades of exercise 4: Excellent, 3: Good, 2: Average, 1: Poor.

Participants: After approval of Institutional ethics committee, written and informed consent were taken from the participant to join the study.

Inclusion criteria followed were:

(a) Healthy volunteers in an age group of 30-49 years.
(b) Absence of musculoskeletal limitations
(c) Absence of spinal pain.

Exclusion criteria followed were:

(a) Volunteers having history of previous surgery, diabetes, hypertension, asthma, cardiovascular and neuromuscular diseases. 9
(b) Participants not following regular gym or having more rest period (more than 1day/week).
(c) Participants who were not willing to take part in the study/follow study protocol.

Testing Protocols:

Participants were allotted training programmes as per their status and ability of the physical fitness and guidelines given by K11 gym.[9]

For all the groups the instruction was to "repeat day 1 & 2. Cardio every alternate day. Rest once a week". This regimen is a training guideline designed to maximize performance by minimizing reciprocal inhibition.

As over the time subject's fitness improved due to the strict continuous exercise module application and they were allotted to next higher level of exercise module.

Cardiovascular endurance: To assess the cardiovascular endurance, the participants resting level heart rate was noted and then the participants were asked to do the treadmill test for maximum of 10 minutes and there heart rate noted just after the test.

Muscular Endurance: To assess muscular endurance, the participants were asked to perform as many push-ups and curl ups as possible.

Training Procedure: The resistance training sessions consisted of total body workouts using a combination of different body weight and power exercises, as well as a variety of exercise equipment.

After obtaining the records results were interpreted by applying one way ANOVA with post hoc Tukey's test for and percentage of population benefitted by the resistance training (Flexibility) were also depicted in table 2 to 4 obtaining following results.

Result

There were no reported training injuries or excessive muscle soreness at any stage of the training program. We originally had 169 participants enrolled in the study out of which 23 withdrew and 11 were dropouts hence finally 62 females and 73 male were participated. For statistically significant results the participants were categorised depending upon their ages in two separate groups as 30-39 years and more than 40 years with upper age limit of 49 years. Improvement in percentage exercising patterns are compared amongst the population group as per period of exercise performed is shown in table 3 and 4 applying ANOVA and Tukey's post hoc test.

Physical fitness in the form of cardiovascular endurance it has been observed that when compared with the start-up group aging 30 to 39 years 97% of the participants improved their cardiovascular endurance at rest by doing 6 months of resistant training and nearly 89% participants improved after treadmill by doing minimum of 3 months of training hiking to good grades. While observing other group aging more than 40 years similar results were seen in 93.93% participants after 3 and 6 months respectively.

The fitness level in form of muscular endurance has been depicted in table 3 which clearly demarcates rise in the percentage of muscular endurance after 6 months of exercise from poor to good grades in nearly 86% participants on push up grades and 56.68% participants in curl up grades aging 30-39.While in the 40plus age group 81% on push up and 60.6% on curl ups shown improvement. ($p<0.05$).

Considering flexibility in terms of sit and reach test 72.5%participants aging 30-39 years and 33.33% aging more than 40 years improved flexibility after 3 months of training from poor to good grades as depicted in table 2.

Table 2 Flexibility-Sit reach

Age	30-39			>40		
Grade	**0 Weeks**	**3 Months**	**6 Months**	**0 Weeks**	**3 Months**	**6 Months**
1	38 (41.75%)	01 (1.25%)	00	18 (40.01%)	03 (7.69%)	02 (6.06%)
2	46 (50.55%)	12 (22.5%)	12 (16.44%)	17 (38.63%)	17 (43.58%)	14 (42.42%)
3	07 (7.69%)	58 (72.5%)	52 (71.23%)	05 (11.36%)	13 (33.33%)	11 (33.33%)
4	00	09 (11.25%)	09 (12.33%)	04 (9.09%)	06 (15.38%)	06 (18.18%)
Total	**91**	**80**	**73**	**44**	**39**	**33**

These results reveal that the implemented resistance training program produces significant changes in cardiovascular endurance, muscular endurance and flexibility in adults under consideration.

The time wise progress in exercising grades of the participants is depicted in table. 3. Analysis of variance (ANOVA) was applied to the data so as to observe statistical significance also Tukey's post hoc test was applied to observe after how many period of resistance training significant changes are occurring.

Table. 3: Exercise grading in the age group 30-39 and >40 as per advancement of the duration of exercise

Age	30-39			>40		
	0 Weeks	**3 Months**	**6 Months**	**0 Weeks**	**3 Months**	**6 Months**
CVEr	1.31± 0.80	2.07± 1.01	2.58±0.81	1.79±1.02	1.84±1.03	2.61±0.84
CVEt	1.22±0.62	2.76±0.76	3.46±1.02	1.47 0.9	2.79±0.76	3.5±1.04
MEp	1.38±0.43	2.34±0.70	2.67±0.74	1.27±0.49	2.13±0.55	2.7±0.73
MEc	1.13±0.37	2.20±0.65	2.29±0.65	1.16±0.37	1.9±0.48	2.36±0.7
Flx	1.68±0.61	2.74±0.75	2.75±0.73	1.88±0.94	2.45±0.87	2.45±0.87

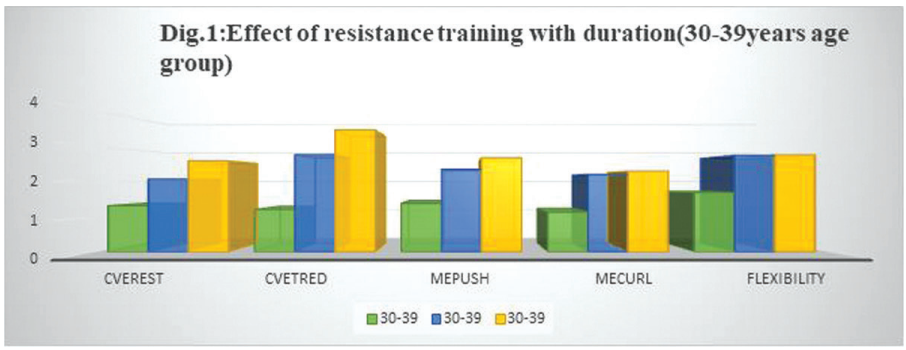
Where: **CVEr:** Cardiovascular endurance at rest, **CVEt:** Cardiovascular endurance after treadmill, **MEp:** Muscular endurance push up, **MEc:** Muscular endurance curl up, **FLX:** flexibility

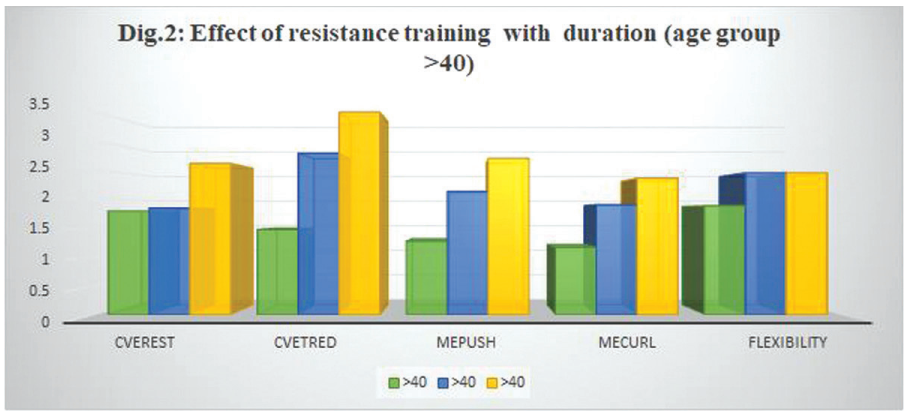
Table. 4. Post hoc Tukey's analysis

30 (p<0.05)						40 (p<0.05)					
CVEr 0 vs CVEr12	Yes	MEp0 vs MEp12	Yes	FLX 0 vs FLX12	Yes	CVEr0 vs CVEr12	No	MEp0 vs MEp12	Yes	FLEX 0 vs FLEX 12	Yes
CVEr 0 vs CVEr 24	Yes	MEp0 vs MEp24	Yes	FLX 0 vs FLX 24	Yes	CVEr0 vs CVERr24	Yes	MEp0 vs MEp24	Yes	FLEX 0 vs FLEX 24	Yes
CVEt 0 vs CVEt12	Yes	MEc0 vs MEc12	Yes	FLX12 vs FLX 24	No	CVEt0 vs CVEt12	Yes	MEc0 vs MEc12	Yes	FLEX 12 vs FLEX 24	No
CVEt 0 vs CVEt 24	Yes	MEc0 vs MEc24	Yes			CVEt0 vs CVEt24	Yes	MEc0 vs MEc24	Yes		
CVEr12 vs CVEr24	Yes	MEp12 vs MEp24	No			CVEr12 vs CVEr24	Yes	MEp12 vs MEp24	No		
CVEt12 vs CVEt 24	No	MEc12 vs MEp24	No			CVEt12 vs CVEt24	No	MEc12 vs MEc24	No		

Considering above results it could be clearly stated that a minimum of 12 weeks of resistance training is required for getting improved cardiovascular endurance, muscular endurance and flexibility in 30-39 years age group. With advancement of age the resistance training needs to be performed for more duration of time for improved physical grades.

Above results represented Graphical represented as:





Discussion

In present study resistance training program which has been trailed is concomitant with minimum or no injury to any age group people with application of proper age associated training guidelines.[10]

Exercise under appropriate training is related with intensified muscular power, working capacity and psychosocial well behaviour in people. This clearly demarcates gain of current study with Faigenbaum. A; that improvement on the basis of resistance training on physical and psychosocial health of the individual.[5]

Along with this reduction in cardiovascular accidents and increase in cardiovascular endurance raise the chances of healthy survival in adult humans. Results of the present study are in accordance with Alter DA and Niebaure J having increased percentage of cardiovascular endurance after doing minimum of 3 months of the resistance training. [11, 12]

According to Walter R Frontera age related reduction in muscular endurance is attributed to reduction in muscle mass i.e. sarcopenia which is results from inadequate exercise. In present study we found favourable results that muscular endurance increases after a minimum of 3 months of resistant training which will definitely add to the benefit for healthy lifestyle. [13] Also it will benefit to retain motor function by recruiting the motor units and increasing their firing activity and also reduces age related sarcopenia as suggested by frank Mayer. [17]

Significant results in flexibility were more in the age group of 30-39 years as compared to the other group the due to increased age. But with ongoing resistant training adults got benefitted in improving their flexibility also which goes well in accordance with Wells. K. F. [14]

In conjugation with Phil Page before start of exercise if stretching is performed; it not only helps in improving the flexibility grades in form of increased range of motion but also enhances strength and performance, similar results were observed here for improving flexibility grades. [15]

Although numerous studies have investigated the effects of exercise, relatively few have used resistance training models. This study adds to the body of literature by showing that resistance training programs can effectively benefit physical performance in young adults.

The major solution to increase the endurance and flexibility is resistant training; but to measure its long durational effects extensive research is required which is beyond the scope and limitations of this study hence we tried to put a stepping stone towards healthier lives in adults improving their physical lifestyle.

Hence we conclude that Short-term resistance training can significantly improve flexibility and increase strength and power in Participants this finding is in well accordance with Michael R. Mcguigan. [16] In health promotion of resistance training more emphasis should be targeted to the population groups with lower physical activity levels who are at maximum risk of having cardiovascular and diabetes like hazardous diseases.

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