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IMPACT OF WEIGHT TRAINING ON HEALTH RELATED PHYSICAL FITNESS COMPONENTS OF SCHOOL GOING GIRLS

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ABSTRACT
This study was undertaken to examine the impact of weight training on chosen health related physical fitness components of school going girls. For this purpose, 30 girls of 14-16 years were selected for experimentation. All the girls were equally and randomly assigned to:-(i) Weight training group; consists total 15 subjects (ii) Control group; consists total 15 subjects. Weight training group was allotted 10 weeks, 4 days per week, specific weight training programme. Control group did not underwent a specific training programme and they were advised to perform their daily routine tasks. (i) Dynamic Muscular Endurance & Strength (Arms and Shoulders) using Flexed arm hang (hold/sec) (ii) Muscular Endurance & Strength (Trunk) using Bent Knee Sit Ups (Number/min) and Cardiovascular Endurance using 12 min run/walk. To analyse the significant change (if any) between pre and post training scores, Paired t test was computed. To analyse the significant change (if any) between pre scores of weight training as well as control group and post training scores of weight training as well as control group Independent t test was computed. T-ratio, Mean and SD were computed and compared. The results indicate that weight training is effective to bring a significant impact on the selected health related physical fitness components i.e. Body Fat %, BMI, SMM, FFM, Flexibility, Muscular Endurance & Strength i.e. (i) Dynamic Muscular Strength & Muscular Endurance (Arms and Shoulders) (ii) Muscular Endurance & Strength (Trunk) and Cardiovascular Endurance. No significant changes were observed in TBW.

KEYWORDS: *Weight Training, Flexibility, Body composition, Cardio-vascular Endurance and Health Related Fitness Components.*

INTRODUCTION
Physical fitness is key factor for life. Health related physical fitness plays important role to perform daily routine tasks. Health related physical fitness involves body composition, muscular endurance, muscular strength, flexibility and cardiovascular endurance. Health related physical fitness improves physical health, mental health, immunity, power, metabolism and stamina.[1] Weight Training is considered an important method to increase physical fitness and health related fitness. It strengthens our muscles and organs. Regular weight training is helpful in burning fat, increasing flexibility, endurance and muscular strength.[2] McGovern, Michael B. (2018).[3] Concluded in his study that 12 weeks, 3 days per week of Circuit Weight Training have positive effect on health related Physical Fitness components including strength in terms of skin fold measurement and girth of Prepubescent girls and boys of grade 4th to 6th. No significant improvement was noticed in the maximal oxygen uptake capacity of fourth grade children of both groups. Strength of control group was also not changed. These findings indicated that muscular strength of prepubescent boys and girls can be improved through participation in a circuit weight training programme than by participation in a regular physical education program.

Westcott, L.W. (2012).[4] also examined in his study that resistance training protocol of ten weekswas effective to increase lean body weight by 1.4 kg, to improve resting metabolic rate by 7%, improvement in physical performance, speed of walk, movement control ability, self-esteem, functional independence and cognitive ability, increase in bone mineral density and cardiovascular health in terms of reduction of blood pressure (resting), fat weight by 1.8 kg, visceral fat and HbA_{1c}, it also lowers cholesterol level. Either, N., Morgan, et al (2015).[5] studied the impact of resistance training on skill competency as well as health-related fitness in adolescents of 15.4 (±5) years of age. 8-weeks (60 min twice, per week) programme was designed and all the students were categorized as: - Intervention group,

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having= 51 subjects and control group having = 45 subjects. The findings indicate that Waist circumference, cardio respiratory fitness, BMI, muscular fitness and flexibility were changed due to resistance training.

SAMPLE

15 healthy Girls of 14-16 years of age were randomly chosen from Sir Chottu Ram Modern Senior Secondary School, Ratangarh Majra, Sonipat, Haryana. All the girls were assigned to two equal groups (a) Weight Training Group/ Experimental Group, consist of 15 subjects (b) Control Group consist of 15 subjects.

TRAINING DESIGN

Experimental group/ weight training group was provided a selected training programme of 10 Weeks, 4 days per week (Wednesday, Saturday and Sunday were rest days). Training programme started from 6.30 am onwards (for 50-55 minutes) in the morning session. They were advised to do warm up for 15 minutes before going through the training procedure. Control group did not participate in any particular training protocol. The training for experimental group was designed in four phases including upper and lower body exercises. The first phase of the training included first three weeks of training, second phase included 4th to 6th weeks training, third phase included 7th and 8th weeks training and fourth phase included 9th to 10th weeks training programme. Load was increased by progressive method.
In 4 days per week training Programme, On Monday, all the girls enrolled for weight training programme were given upper body training. They were given selected exercises including incline bench press, flat dumb bell fly, Lat pull wide, dumb bell shoulder press, smith machine shrug, barbell curl and triceps push down. On Tuesday, they were provided lower body training including leg press, leg extension, seated curl, leg press calves raises, laying leg raises and crunch with eight reps in each set. On Thursday, they were given upper body training programme including incline dumb bell press, incline dumb bell fly, Lat pull narrow, barbell shoulder press, dumb bell shrug, incline dumb bell curl, triceps dip. On Friday, they were given lower body training programme including Squat, Romanian dead lift, reverse crunches, seated calf raise, Dumb bell lunge, standing calf raise and cable crunches.

Day-1(MON) UPPERBODY WarmUp15min (treadmill, cross-trainer etc.)								
Incline Bench Press	2x8	3x8	50% 1RM	3x10	60% 1RM	3x10	65%	120
Flat Dumb Fly	2x8	3x8	For all the	3x10	For all the	3x10	1RM	120
Lat Pull Wide	2x8	3x8	selected	3x10	selected	3x10	For all	120
Dumb Sho Press	2x8	3x8	exercises	3x10	exercise	3x10	the	120
SmithMachine Shrug	2x8	3x8		3x10		3x10	selected	120
Barbell Curl	2x8	2x10		2x10		2x10	exercises	090
Triceps Push Down	2x8	2x10		2x10		2x10		090
Cool down 10 Min								
Day-2 (TUE) LOWER BODY-								
Leg Press	2x8	3x8	50% 1RM	3x10	60% 1RM	3x10	65%1RM	120
Leg Extension	2x8	3x8	50% 1RM	3x10	60% 1RM	3x10	65%1RM	120
Seated Curl	2x8	3x8	50% 1RM	3x10	60% 1RM	3x10	65%1RM	120
Leg Press Calves Raises	2x8	3x8	50% 1RM 50% 1RM	3x10	60%1RM 60% 1RM	3x10	65%1RM 65%1RM	090
Seated Calf Raises	2x8	3x8		3x10		3x10		090
Lying Leg Raises	2x10	2x12		2x10		2x12		090
Crunch	2x10	2x12		2x10		2x12		090
Cool down 10 Min								

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Day-3(THU)								
UPPER BODY								
Warm Up 15 min (treadmill, cross trainer etc.)								
Incline Dumb Press	2x8	3x8	50% 1RM	3x10	60% 1RM	3x10	65%	120
Incline Dumb Fly	2x8	3x8	For all the	3x10	For all the	3x10	1RM For	120
Lat Pull Narrow	2x8	3x8	selected	3x10	selected	3x10	all the	120
Barbell Sho Press	2x8	3x8	exercises	3x10	exercise	3x10	selected	120
Dumb Shrug	2x8	3x8		3x10		3x10	exercises	120
Incline Dumb Curl	2x10	2x10		2x10		2x10		090
Triceps Dip	2x10	2x10		2x10		2x10		090
Cool down 10 Min								
Day-4 (FRI)								
LOWER BODY								
WarmUp 15 min (treadmill,cross trainer etc.								
Squat	2x8	3x8	50% 1RM	3x10	60% 1RM	3x10	65%	120
Dumb Lunge	2x8	3x8	For all the	3x10	For all the	3x10	1RM For	120
Dead Lift(Romanian)	3x8	3x10	selected	3x10	selected	3x10	all the	120
Calf Raise (Seated)	3x8	3x10	exercises	3x10	exercises	3x10	selected	090
Calf Raise (Standing)	3x8	3x10		3x10		3x10	exercises	090
Cable Crunch	2x10	2x12		2x10		2x12		090
Reverse Crunch	2x10	2x12		2x10		2x12		090
Cool down 10 Min								

Body Composition I.e. Body fat percent (Fat %), BMI, SMM, FFM and TBW, Flexibility, Muscular Endurance & Strength i.e. Dynamic Muscular Strength and Muscular Endurance (arm & Shoulders) & Muscular Endurance and strength (trunk) and Cardio respiratory Endurance were chosen as criterion variables.

Pre training scores of both groups were measured before allotment of the training protocol. The data were collected on Body Composition Variables including Body fat% (in %), BMI in Weight (kg.)/ height $(m)^2$, SMM in $Kg/(m)^2$, FFM in $Kg/(m)^2$ and TBW in Litres using Body Composition Analyser (IB 770), Flexibility was measured with Sit and reach test in centimetres, Muscular Endurance & Muscular Strength i.e. Dynamic Muscular Endurance & Strength (arms and Shoulders) were measured with flexed arm hang (hold/sec) and Muscular Endurance and strength (trunk) were measured using Bent Knee Sit Ups (Number/minute) & Cardio-Respiratory endurance was measured by the 12 minute run/walk in Meters.

After data collection paired t test was computed to verify the significant variation between pre and post training scores of weight training group as well as control group. To verify the significant changes (exists or not) between pre-test scores of weight training group and control group and post test scores of weight training group and control group, Independent t test was adopted

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RESULTS AND ANALYSIS

Table 1. Results of Pre versus post training scores for Weight training

SR. No	Variables	Test Items	Scores	N	Mean	S.D	t - value	Sig.
1 (a)	Body Composition	Body Fat%	Pre	15	26.98	2.48	10.990	.000
			Post	15	25.92	2.42		
(b)		BMI	Pre	15	19.75	2.25	3.695	.002
			Post	15	19.48	2.03		
(c)		SMM	Pre	15	13.26	1.64	-22.078	.000
			Post	15	14.67	1.63		
(d)		FFM	Pre	15	36.04	4.08	-8.817	.000
			Post	15	37.01	3.81		
(e)		TBW	Pre	15	24.07	2.99	-0.914	.376
			Post	15	24.10	3.01		
2.	Flexibility	Sit and Reach	Pre	15	6.80	5.14	-11.308	.000
			Post	15	8.53	5.34		
3 (a)	Dynamic Muscular strength and endurance (arms and shoulders)	Flexed Arm Hang	Pre	15	2.87	0.74	-13.228	.000
			Post	15	4.53	0.52		
(b)	Muscular endurance & strength (Trunk)	Bent Knee Sit Ups	Pre	15	14.20	3.10	-17.197	.000
			Post	15	18.53	3.76		
4	Cardiovascular endurance	12 min Run/Walk	Pre	15	1443	171.61	-18.198	.000
			Post	15	1616.67	172.86		

***level of significance= 0.05, Table value=2.144**

The table indicate that mean scores of pre and post-test for Body fat % are 26.98±2.48 and 25.92±2.42, BMI 19.75±2.25 and 19.48±2.03, SMM 13.26±1.64 and 14.67±1.63, FFM Pre and post-test mean scores are 36.04±4.08 and 37.01±3.81, TBW are 24.07±2.99 and 24.10±3.01. Sit and reach 6.80±5.14 and 8.53±5.34, Flexed Arm Hang are 2.87±0.74 and 4.53±0.52, Bent Knee Sit Ups 14.20±3.10 and 18.53±3.76 and 12 Min Run/Walk are 1443±171.61 and 1616.67±172.86 respectively. All the pre and post test scores are significant at 0.05 level of significance as p=.000, except TBW.

Changes were noticed between scores of pre as well as post-test for weight training group which are evident of significant improvement in selected health related variables after 10 weeks' weight training programme. Body Fat % t=10.990 (p=0.000) and BMI t = 3.695 (p=0.002) indicates significant decrease in body fat % and Body Mass Index, SMM t= -22.078 (p=0.000), FMM t= -8.817 (p=0.000), Sit and Reach t= -11.308 (p=0.000), Flexed Arm Hang t= -13.228 (p=0.000), Bent Knee Sit Ups t= -17.197 (p=0.000) and 12 Min Run/ Walk t= -18.198 (p=0.000) indicates significant increase in skeletal muscle mass, Fat free mass, in flexibility, Dynamic muscular endurance & strength (arms & Shoulders), Muscular Endurance & strength (trunk) and cardiovascular endurance performance. TBW t= -0.914 (p= .376) indicates no significant changes.

The formulated hypothesis suggested that no significant changes will be observed in pre and post training scores of selected health related components after 10 weeks of Weight training programme. The null hypothesis is rejected in case of Body Fat %, SMM, FMM, Sit and Reach, Flexed Arm Hang, Bent Knee Sit Ups and 12 Min Run/ Walk as significant changes exists between pre & post training scores. The nullhypothesis is accepted in case of TBW as no significant changes were observed between pre & post training scores after 10 weeks Weight training protocol.

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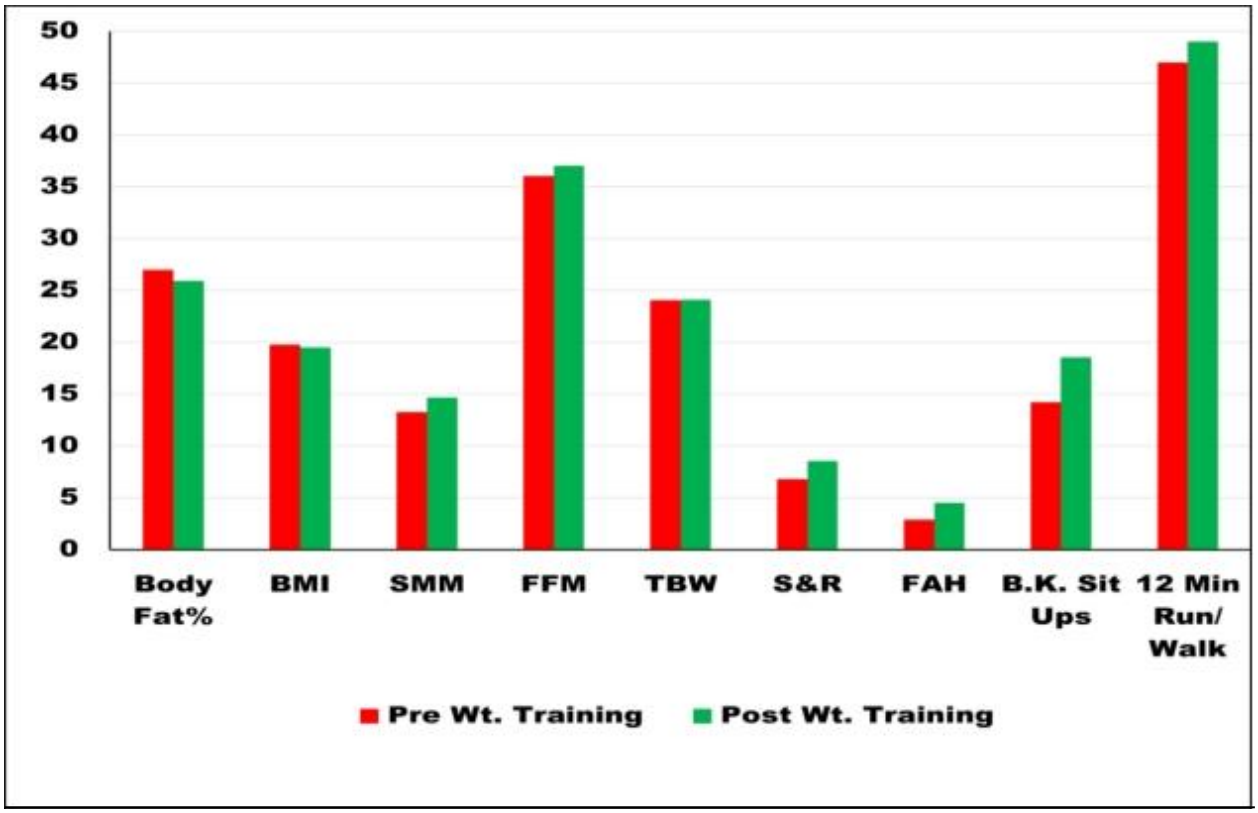


Fig. 1: Comparison of Pre versus post training scores of Weight training group

Table 2. Results of Pre versus post training scores for Control group

SR. No	Variables	Test Items	Scores	N	Mean	S.D	t - value	Sig.
1 (a)	Body Composition	Body Fat%	Pre	15	26.96	3.21		.719
			Post	15	26.94	3.20	0.367	
(b)		BMI	Pre	15	19.77	2.64	1.883	0.082
			Post	15	19.75	2.65		
(c)		SMM	Pre	15	13.31	0.44		.164
			Post	15	13.31	0.45	-1.467	
(d)		FFM	Pre	15	36.00	3.76		.384
			Post	15	36.01	3.77	-0.899	
(e)		TBW	Pre	15	24.06	2.50		.744
			Post	15	24.07	2.83	-0.333	

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2.	Flexibility	Sit and Reach	Pre	15	6.83	5.08	-.151	.882
			Post	15	6.80	4.70		
3 (a)	Dynamic Muscular strength and endurance (arms and shoulders)	Flexed Arm Hang	Pre	15	2.87	1.19	0.695	.499
			Post	15	3.00	0.76		
(b)	Muscular endurance & strength (Trunk)	Bent Knee Sit Ups	Pre	15	14.26	4.59	-0.435	.670
			Post	15	14.40	2.75		
4	Cardiovascular endurance	12 min Run/Walk	Pre	15	1443.33	143.75	-0.079	.938
			Post	15	1444	138.50		

***level of significance= 0.05, Table value =2.144**

The table signifies that mean scores of pre and post-test for Body fat % are 26.96±3.21 and 26.94±3.20, BMI are 19.77±2.64 and 19.75±2.65, SMM are 13.31±0.44and 13.31± 0.45, FFM are 36.00± 3.76 and 36.01±3.77, TBW are 24.06±2.50 and 24.07±2.83, Sit and reach are 6.83±5.08 and 6.80±4.70, Flexed Arm Hang are 2.87±1.19 and 3.00±0.76, Bent Knee Sit Ups are 14.26±4.59 and 14.40±2.75and 12 Min Run/Walk are 1443.33±143.75 and 1444±138.50 respectively. All the pre and post test scores (0.05 level) are not significant.

Significant changes were not noticed between pre and post test scores of control group which indicate no significant improvement in selected health related components after 10 weeks. Body Fat % t = 0.367 (p= .719) and BMI t = 1.883 (p= .082) indicates no significant decrease in body fat % and body mass index. SMM t= -1.467 (p= .164), FMM t= -0.899(p= .384) and TBW t = -0.333 (p= .744) indicates no significant increase in SMM, FFM and TBW. Sit and Reach t= -0.151(p= .882), Flexed Arm Hang t= -0.695 (p= .499), Bent Knee Sit Ups t_{30}= -0.435 (p= .670) and 12 Min Run/ Walk t_{30} = -0. 079 (p=.938) indicates no significant increase in flexibility, Dynamic muscular strength & endurance (arms & Shoulders),Muscular Endurance & strength (trunk) & cardiovascular endurance performance.
The formulated hypothesis stated that no significant changes will be observed in pre and post training data of control group for selected health related variables after 10 weeks. The null hypothesis is accepted for all selected health related variables including Body Fat %, BMI, SMM, FMM, TBW, Sit and Reach, Flexed Arm Hang, Bent Knee Sit Ups and 12 Min Run/ Walk as no significant changes exists between pre and post training scores after 10 weeks.

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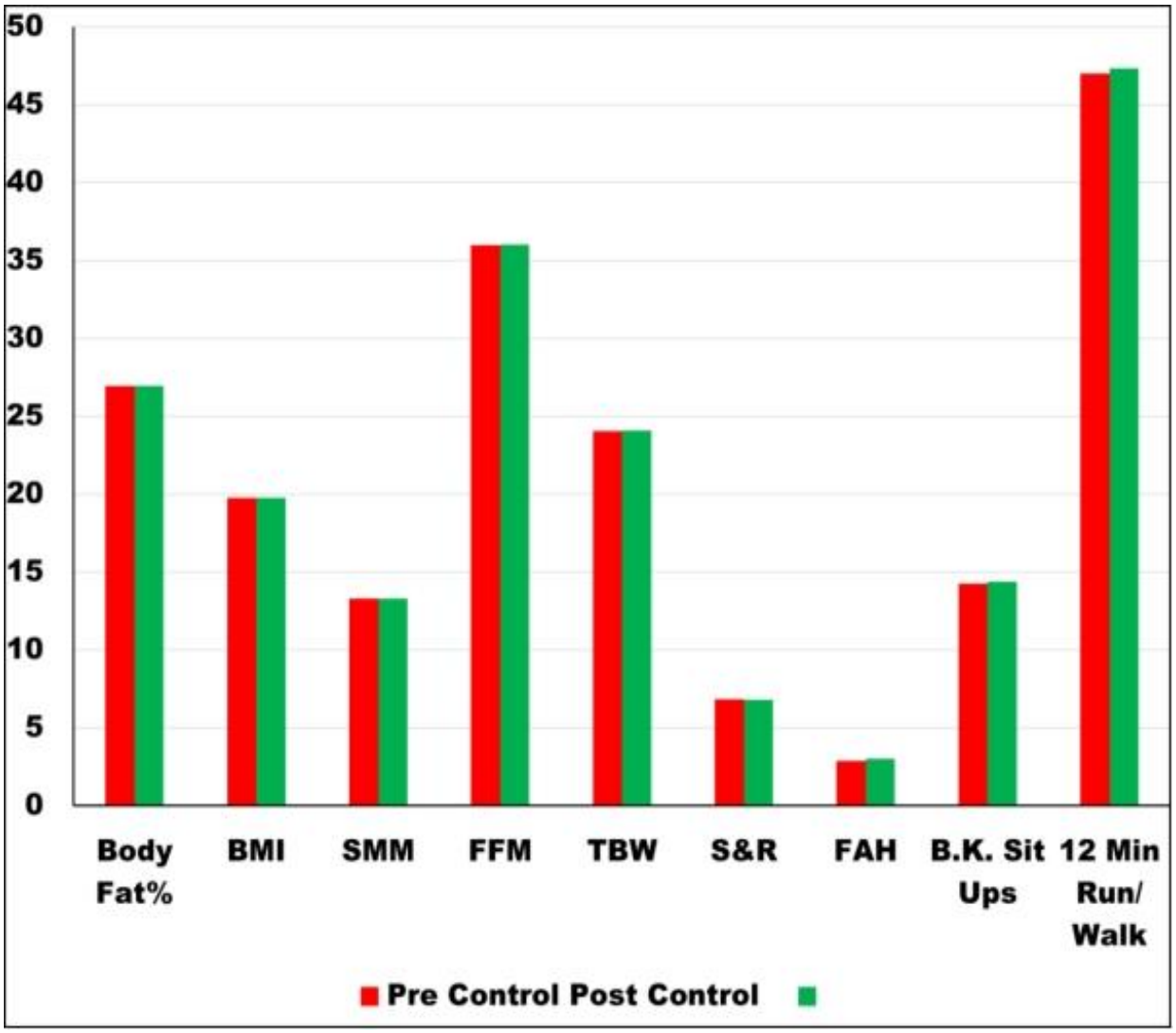


Fig. 2: Comparison of Pre versus post training scores of Control Group

Table. 3 Results of Pre training scores of Weight Training and Control Group

SR. No	Variables	Test Items	Scores	N	Mean	S.D	S.E.M	t - value	Sig.
1 (a)	Body Composition	Body Fat%	W.T.G	15	26.98	2.48	0.640		.246
			C.G	15	26.96	3.21	0.829	1.188	
(b)		BMI	W.T.G	15	19.75	2.25	0.582	0.047	.963
			C.G	15	19.77	2.64	0. 663		
(c)		SMM	W.T.G	15	13.26	1.64	0.423		.936
			C.G	15	13.31	0.44	0.447	-0.081	
		FFM	W.T.G	15	36.04	4.08	1.052	0.030	.976

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(d)			C.G	15	36.00	3.76	0.971		
(e)		TBW	W.T.G	15	24.07	2.99	0.772	-0.006	.995
			C.G	15	24.06	2.50	0.646		
2.	Flexibility	Sit and Reach	W.T.G	15	6.80	5.14	1.328	-0.018	.986
			C.G	15	6.83	5.08	1.310		
3 (a)	Dynamic Muscular strength & endurance (arms and shoulders)	Flexed Arm Hang	W.T.G	15	2.87	0.74	0.192	-0.001	.999
			C.G	15	2.187	1.25	0.307		
(b)	Muscular endurance & strength (Trunk)	Bent Knee Sit Ups	W.T.G	15	14.20	3.10	0.797	-0.055	.956
			C.G	15	14.26	4.59	0.936		
4	Cardiovascular endurance	12 min Run/Walk	W.T.G	15	1443	171.61	44.308	-0.005	.995
			C.G	15	1443.33	143.75	37.118		

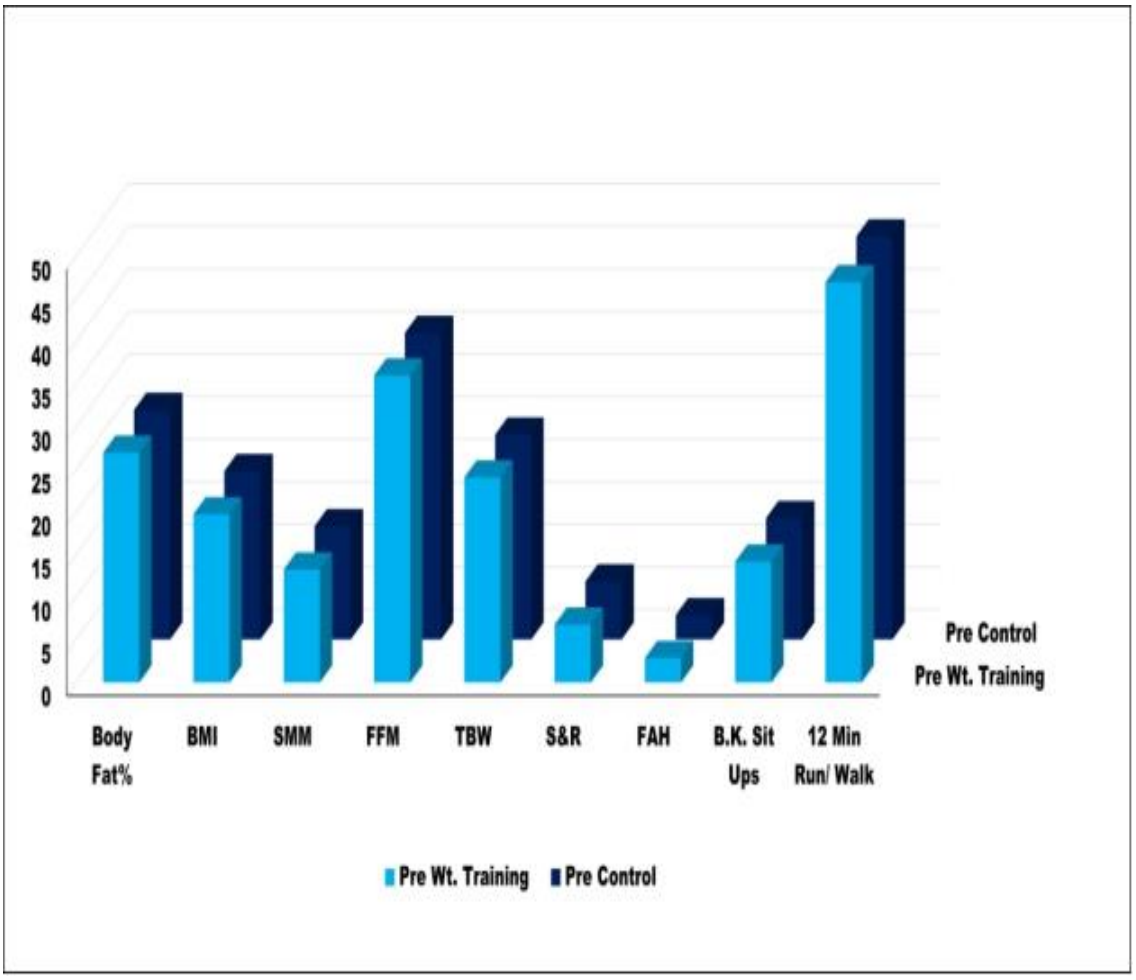
***level of significance= 0.05, Table value =2.048**

Findings of the study signifies that pre-test mean scores for Weight training group and Control Group for Body Fat% are (26.98± 2.48) and (26.96±3.21), for BMI are (19.75±2.25) and (19.77±2.64), for SMM are (13.26±1.64) and (13.31±0.44), for FFM are (36.04±4.08) and (36.00±3.76), for TBW are (24.07±2.99) and (24.06±2.50), for Sit and reach are (6.80±5.14) and (6.83±5.08), for Flexed arm hang are (2.87±0.74) and (2.87±1.19), for Bent knee sit up are (14.20±3.10) and (14.26±4.59), for 12 min Run/Walk are (1443±171.61) and (1443.33±143.75) respectively.

The results were not found significant at0.05 level as t value of Body Fat % is 1.188 (p=.246), t value of BMI is 0.047 (p=.963), t value of SMM is -0.081 (p=.936), t value of FFM is 0.030 (p=.976), t value of TBW is -0.006 (p=.995), t value of Sit and reach is -0.018 (p=.986), t value of Flexed Arm Hang is -0.001 (p=.999), t value of Bent knee sit up is -0.055 (p=.956), t value of 12 min Run/Walk is 0.005 (p=.995). The table Value at 0.05 level is 2.048 which is higher than t values of all selected health related components.

No significance difference exists in pre-test scores of weight training and control group. So, null hypothesis is accepted for all selected health related components i.e. Body Fat %, BMI, SMM, FMM, TBW, Sit and Reach, Flexed Arm Hang, Bent Knee Sit Ups and 12 Min Run/ Walk.

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+ **Fig. 3: Comparison of Pre-test scores of Weight Training & Control Group**

Table. 4 Results of Post training scores of Weight Training and Control Group

SR. No	Variables	Test Items	Scores	N	Mean	S.D	S.E.M	t - value	Sig.
1 (a)	Body Composition	Body Fat%	W.T.G	15	25.92	2.42	0.624		.323
			C.G	15	25.94	3.20	0.829	-1.005	
(b)		BMI	W.T.G	15	19.48	2.03	0.596	-0.146	.885
			C.G	15	19.75	2.65	0.683		
(c)		SMM	W.T.G	15	14.67	1.63	0.420		0.035
			C.G	15	13.31	0.45	0.447	2.21	
(d)		FFM	W.T.G	15	37.01	3.81	.984		.470
			C.G	15	36.01	3.77	.970	0.732	
(e)		TBW	W.T.G	15	24.10	3.10	0.780		.967
			C.G	15	24.07	2.83	0.645	0.042	
2.	Flexibility	Sit and Reach	W.T.G	15	8.53	5.34	1.381	0.943	.354

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			C.G	15	6.80	4.70	1.216		
3 (a)	Dynamic Muscular strength and endurance (Arms and shoulders)	Flexed Arm Hang	W.T.G	15	4.53	.52	0.133		.000
			C.G	15	3.00	.76	0.195	6.487	
(b)	Muscular endurance & strength (Trunk)	Bent Knee Sit Ups	W.T.G	15	18.53	3.76	0.952		001
			C.G	15	14.40	2.75	0.683	3.439	
4	Cardiovascular endurance	12 min Run/Walk	W.T.G	15	1616.67	172.86	44.633		.005
			C.G	15	1444	138.50	35.761	3.019	

***level of significance= 0.05, Table value = 2.048**

Findings of the study signifies that scores of post-test for Weight training group & Control Group for Body Fat% are (25.92± 2.42) and (26.94±3.20), for BMI are (19.48±2.03) and (19.75±2.65), for SMM are (14.67±1.63) and (13.31±0.45), for FFM are (37.01±3.81) and (36.01±3.77), for TBW are (24.10±3.10) and (24.07±2.83), for Sit and reach are (8.53±5.34) and (6.80±4.70), for Flexed arm hang are (4.53±0.52) and (3.00±.76), for Bent knee sit up (BKSU) are (18.53±3.76) and (14.40±2.75), for 12 min Run/Walk are (1616.67±172.86) and (1444±138.50) respectively.

The results were not significant at the level of 0.05 as t value of Body Fat % is -1.005 (p=.323), t value of BMI is -0.146 (p=.885), t value of FFM is 0.732 (p=.470), t value of TBW is 0.042(p=.967), t value of Sit and reach is 0.943 (p=.354). The table Value at 0.05 level is 2.048 which is higher than t values of all selected health related components i.e. Body Fat%, BMI, FFM, TBW and Sit and Reach, which shows no significant changes.

t value of SMM is 2.21(p=.035), t value of Flexed Arm Hang is 6.487 (p=.000), t value of Bent knee sit up is 3.439(p=.001), t value of 12 min Run/Walk is 3.019 (p=.005). The table Value at 0.05 level is 2.048 which is lower than t values of all selected health related components, which shows significant changes between post training data of weight training and control group.

Null hypothesis is accepted in case of body fat %, BMI, FFM, TBW and Sit and reach tests which is evident that there is no significant decrease in body fat % and body mass index and increase in FFM, TBW and flexibility of weight training group in comparison to control group after 10 weeks of weight training.

Null hypothesis is rejected in case of SMM, Flexed Arm Hang, Bent knee sit ups and 12 min Run/Walk. Which shows significant improvement in skeletal muscle mass, dynamic muscular endurance & strength (arms & shoulders), muscular endurance & strength (trunk) and cardiovascular endurance of weight training group in comparison to control group after 10 weeks of weight training.

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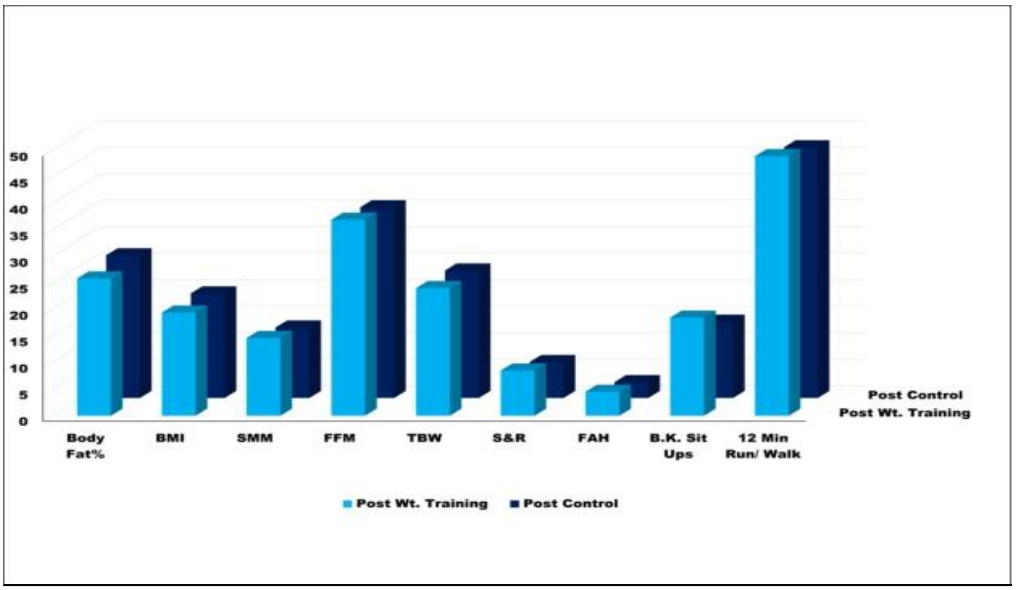


Fig. 4: Comparison of Post-test scores of Weight Training and Control Group

RESULTS

1. Significantchanges were found between pre and post training scores of weight training group for selected health related components i.e. Body Fat %, BMI, SMM, FMM, Sit and Reach, Flexed Arm Hang, BKSU and 12 Min Run/ Walk.
2. Significantdifference did not exist between pre and post training data of weight training group for selected health related component i.e. TBW.
3. Significantdifference did not exist between pre and post training data of control group for selected health related components i.e. Body Fat %, BMI, SMM, FMM, TBW, Sit and Reach, Flexed Arm Hang, BKSU and 12 Min Run/ Walk.
4. Significantdifference did not exist between pre-training data of weight training and control group for selected health related components i.e. Body Fat %, BMI, SMM, FMM, TBW, Sit and Reach, Flexed Arm Hang, BKSU and 12 Min Run/ Walk
5. Significantdifference did not exist between post test scores of weight training group as well as control group for selected health related components i.e. Body Fat %, BMI, FFM, TBW, Sit and Reach (flexibility).
6. Significantchanges were observed between post training data of weight training group and control group for selected health related components i.e. SMM, Flexed Arm Hang, BKSU and 12 Min Run/ Walk.

CONCLUSION

The study results are evident that weight training is effective in decreasing Body Fat%, Body Mass indexes well as Increasing Skeletal Muscle Mass (SMM), Fat Free Mass (FMM), Flexibility, cardiovascular endurance, Dynamic Muscular Strength & endurance (arms and shoulders) and Muscular Endurance & Strength (trunk.)

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