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Ujjwal Mahapatra
Research Scholar, Department of
Physical Education, University
of Kalyani, West Bengal, India

Dr. Kanchan Bandopadhyay
Retired Professor, Department of
Physical Education, University
of Kalyani, West Bengal, India

Effects of anaerobic training on selected anthropometric variables among teen agers

Ujjwal Mahapatra and Dr. Kanchan Bandopadhyay

Abstract

The purpose of the study was to find out the effects of anaerobic training on selected anthropometric variables among teen agers. The anthropometric variables were as Stature, Sitting height, Acromiale radiale, Radiale stylium radiale, Trochanterion-tibiale laterale, Tibiale mediale-sphyrium tibiale, Arm circumference, Thigh circumference and Calf circumference. To achieve the purpose of the study, two hundred ten (n = 210) teen ager boys were selected at random from three different schools of Basirhat subdivision under North 24 Parganas district, West Bengal. They were divided into six experimental groups consisted of twenty (20) subjects in each group and six control groups consisted of fifteen (15) subjects in each group. Anaerobic training consisted of selected anaerobic exercise for twelve (12) weeks was assigned as treatment to the entire experimental group. The selected criterion variables were assessed using standard procedures, before and after training regimen. Data were analyzed with mean, S.D. and pair t-test using SPSS version 20. The level of significance was set at 0.05. The results showed that all the anthropometric variables improved significantly due to 12-week anaerobic training.

Key-words: Anaerobic training, Anthropometric variables and Teen agers.

1. Introduction

Considering the physiological phenomenon training is generally of three kinds such as aerobic, anaerobic or a combination of aerobic-anaerobic.

Anaerobic exercise is the physical exercise which includes brief activities based on strength, such as sprints or weight lifting, while aerobic exercise is focused on the activities of resistance. Such as the marathon or cycling in the background. Anyway, the first stage of any exercise is anaerobic.

Anaerobic appoints the property of 'life without air', from Greek an – (no), aer (air) and bios (life), and refers to the exchange of energy without oxygen in a living tissue. Anaerobic exercise is a brief and activity of great intensity where anaerobic metabolism takes place in the muscles. Examples of anaerobic exercise: lifting weights, sprint run or any exercise that consists of a brief effort is an anaerobic exercise. Anaerobic exercise is typically used by little endurance sports athletes to acquire power, and by body builders to gain muscle mass. The muscles that are being trained under the anaerobic exercise are developed differently from biological level, acquiring more performance in activities of short duration and high intensity.

There are two types of anaerobic energy systems: the ATP-CP system, which uses phosphate of creatine for the first ten seconds of the exercise, and lactic acid (or anaerobic glycolysis) system that uses glucose in the absence of oxygen. (<http://edukalife.blogspot.com>).

Anthropometry is the study of shape and size of various body parts of an individual. Such as length, height, circumference etc. the application of the scientific principles of anthropometry to improve individual performance capacity has been well established (Frank and Mc Ardle, 1988) [2].

The purpose of the present study was to find out the effects of 12-week anaerobic training on selection anthropometric variables among teen agers.

2. Materials and methods

2.1 Subjects

Total two hundred ten (n = 210) teen agers boys, age ranged 13 to 18 years was selected at random as subjects from three different schools of Basirhat subdivision under North 24

Correspondence
Ujjwal Mahapatra
Research Scholar, Department of
Physical Education, University
of Kalyani, West Bengal, India

Parganas district, West Bengal.

2.2 Criterion measures

Various anthropometric measures of subjects were considered as the criterion measures such as Stature, Sitting height, Acromiale radiale, Radiale stylium radiale, Trochanterion-tibiale laterale, Tibiale mediale-sphyrion tibiale, Arm circumference, Thigh circumference and Calf circumference. Data on all the criterion measures were collected by standard procedure (Jones, Olds, Stewart and Carter, 2006).

2.3 Experimental design

In the present study, two hundred ten (n=210) subjects were selected at random from six age groups, i.e. 13–18 years. There were six experimental groups such as Gr. E₁₃, Gr. E₁₄, Gr. E₁₅, Gr. E₁₆, Gr. E₁₇ and Gr. E₁₈. Experimental groups were consisted of twenty (n=20) subjects each and on the other hand Control groups were comprised of fifteen (n=15) subjects each. Pre-tests were conducted on the criterion measure. Twelve weeks anaerobic training was employed among experimental groups and post tests were conducted after completion of experimental period.

The anaerobic training programme such as weight training

(Biceps Curling, Half Squat, Front & Back Press, Step ups, Bench Press etc.) Plyometrics Exercise (Jump Training), Sprint for 20 seconds and then walk for 60 seconds, totaling 20 minutes, Run up a inclined land as fast as you can for 30 seconds, then walk down slope for a total of 12 intervals, stair climbing, sprinting activities, sit-ups, interval training etc. was assigned as treatment to all the experimental groups. The duration of the experimental period was 12 weeks excluding the days required for initial and final test. The treatment was given thrice (Monday, Wednesday and Friday) in a week in the afternoon session for a duration of approximately 65 minutes which include warm up (General) 15 minutes, anaerobic exercise 40 minutes and cooling down 10 minutes. (www.livestrong.com, www.buzzle.com)

2.4 Statistical analysis

The mean and standard deviation (S. D.) were calculated for the analysis of the data as descriptive statistics. Statistical significance of two groups, mean difference was tested by pair t-test. All the statistics were calculated by using SPSS version 20. The level of significance was set at 0.05.

3. Results and Discussion

Table 1: Comparison of means in Stature after twelve weeks anaerobic training among different age groups

Age Group (Years)	Group	M ₁ (cm)	SD ₁	M ₂ (cm)	SD ₂	MD	SE _D	t	t at 0.05
13	E ₁₃	142.60	8.24	143.90	8.19	1.30	0.13	10.18*	2.09
	C ₁₃	143.80	5.35	145.13	5.45	1.33	0.13	10.58*	2.14
14	E ₁₄	151.90	9.43	152.70	9.56	0.80	0.12	6.84*	2.09
	C ₁₄	151.80	5.82	152.33	5.81	0.53	0.13	4.00*	2.14
15	E ₁₅	160.90	6.29	161.30	6.27	0.40	0.11	3.56*	2.09
	C ₁₅	158.80	9.58	159.47	9.52	0.67	0.19	3.57*	2.13
16	E ₁₆	161.65	6.81	162.10	6.46	0.45	0.11	3.94*	2.09
	C ₁₆	162.47	4.55	162.73	4.42	0.27	0.12	2.26*	2.13
17	E ₁₇	162.70	5.56	163.60	5.56	0.90	0.07	13.08*	2.09
	C ₁₇	163.60	5.18	163.87	5.25	0.27	0.12	2.26*	2.14
18	E ₁₈	165.55	4.70	166.05	4.38	0.50	0.17	2.94*	2.09
	C ₁₈	165.40	4.31	165.93	3.88	0.53	0.24	2.26*	2.14

*Sig. at 0.05 level, NS = Not significant.

Stature improved significantly both among experimental and control group.

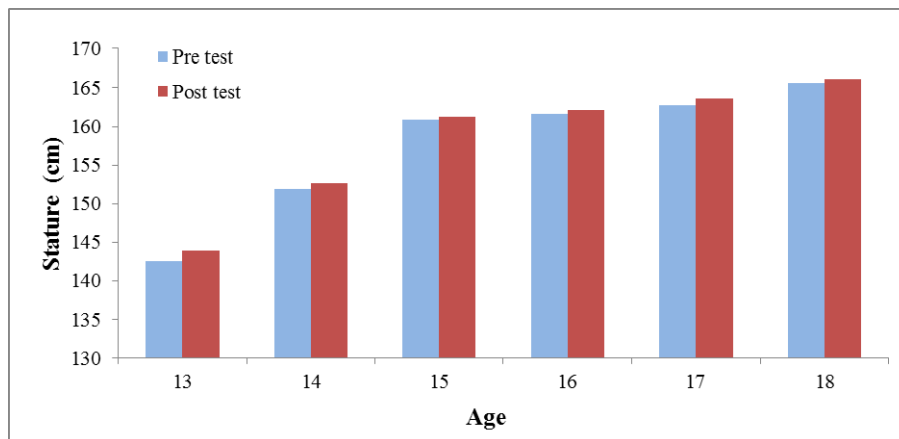


Fig 1: Comparison of means in Stature after twelve weeks anaerobic training in 13 – 18 years experimental age groups

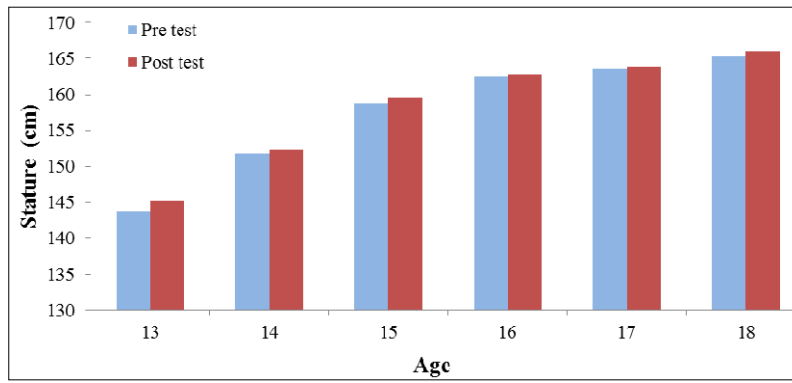


Fig 2: Comparison of means in Stature after twelve weeks among 13 – 18 years control age groups

Table 2: Comparison of means in sitting height after twelve weeks anaerobic training among different age groups

Age Group (Years)	Group	M ₁ (cm)	SD ₁	M ₂ (cm)	SD ₂	MD	SE _D	t	t at 0.05
13	E ₁₃	72.30	4.85	73.35	4.87	1.05	0.17	6.19*	2.09
	C ₁₃	72.27	3.03	73.07	3.15	0.80	0.17	4.58*	2.14
14	E ₁₄	75.50	5.48	76.75	5.53	1.25	0.10	12.58*	2.09
	C ₁₄	75.63	2.83	76.47	2.70	0.83	0.13	6.61*	2.14
15	E ₁₅	79.70	2.92	80.85	2.96	1.15	0.08	14.04*	2.09
	C ₁₅	79.67	5.68	80.87	5.77	1.20	0.11	11.22*	2.14
16	E ₁₆	82.65	3.07	84.20	2.69	1.55	0.46	3.40*	2.09
	C ₁₆	82.50	4.41	83.07	4.25	0.57	0.07	8.50*	2.14
17	E ₁₇	85.00	3.10	85.95	2.74	0.95	0.20	4.79*	2.09
	C ₁₇	84.97	2.95	85.60	2.95	0.63	0.09	6.97*	2.14
18	E ₁₈	85.95	1.50	87.35	1.98	1.40	0.46	3.02*	2.09
	C ₁₈	86.10	3.11	87.33	2.61	1.23	0.80	1.54 ^{NS}	2.14

*Sig. at 0.05 level, NS = Not Significant.

Sitting height of all groups improved significantly except Gr. C₁₈

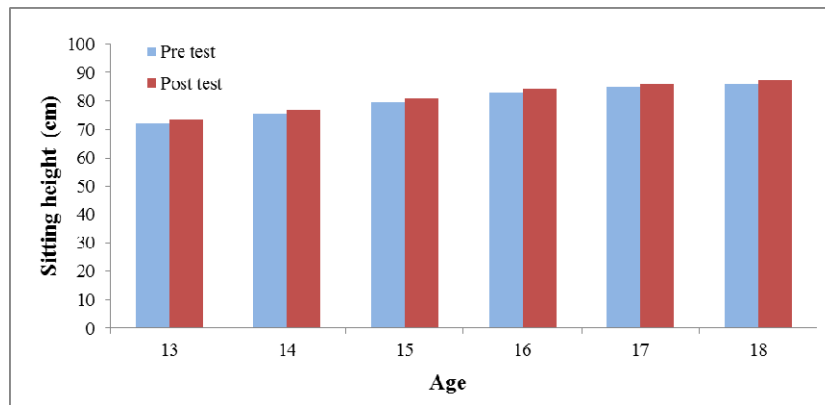


Fig 3: Comparison of means in sitting height after twelve weeks anaerobic training in 13 – 18 years experimental age groups

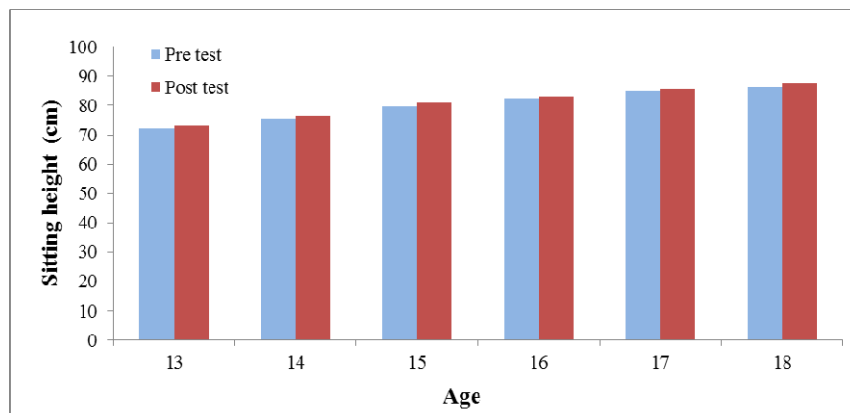


Fig 4: Comparison of means in sitting height after twelve weeks among 13 – 18 years control age groups

Table 3: Comparison of means in Acromiale radiale after twelve weeks anaerobic training among different age groups

Age Group (Years)	Group	M ₁ (cm)	SD ₁	M ₂ (cm)	SD ₂	MD	SE _D	t	t at 0.05
13	E ₁₃	27.70	2.15	28.75	2.17	1.05	0.15	6.84*	2.09
	C ₁₃	28.80	1.78	29.80	1.61	1.00	0.29	3.42*	2.14
14	E ₁₄	29.70	2.39	30.00	2.18	0.30	0.11	2.85*	2.09
	C ₁₄	29.73	1.71	30.00	1.51	0.27	0.12	2.26*	2.13
15	E ₁₅	31.30	1.56	31.75	1.65	0.45	0.11	3.94*	2.09
	C ₁₅	31.60	2.10	31.87	2.17	0.27	0.12	2.26*	2.13
16	E ₁₆	32.65	1.53	32.85	1.60	0.20	0.09	2.18*	2.09
	C ₁₆	32.80	1.08	33.07	1.10	0.27	0.12	2.26*	2.14
17	E ₁₇	32.70	2.20	32.90	2.29	0.20	0.09	2.18*	2.09
	C ₁₇	32.27	1.71	33.20	1.57	0.93	0.32	2.96*	2.14
18	E ₁₈	32.45	2.04	33.10	1.71	0.65	0.28	2.29*	2.09
	C ₁₈	32.20	1.70	32.93	0.88	0.73	0.44	1.66 ^{NS}	2.14

*Sig. at 0.05 level, NS = Not Significant.

Acromiale radiale improved significantly among all the groups except Gr. C₁₈.

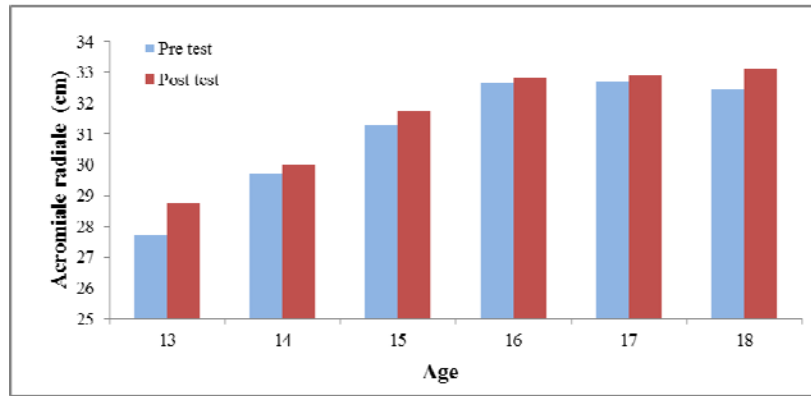


Fig 5: Comparison of means in Acromiale radiale after twelve weeks anaerobic training in 13 – 18 years experimental age groups

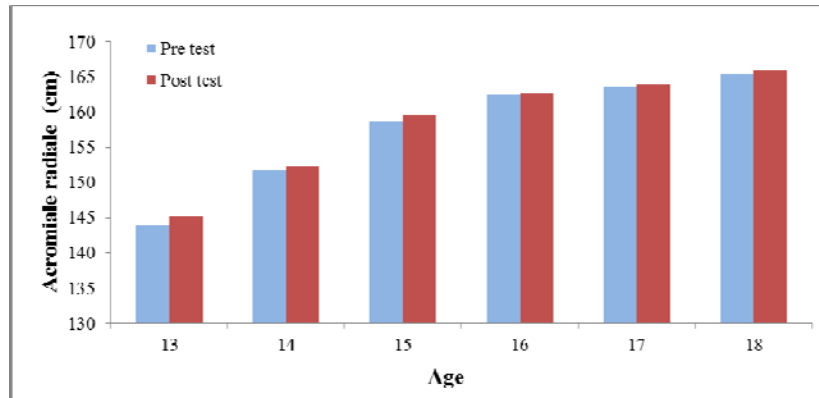


Fig. 6: Comparison of means in Acromiale radiale after twelve weeks among 13 – 18 years control age groups

Table 4: Comparison of means in Radiale styliion radiale after twelve weeks anaerobic training among different age groups

Age Group (Years)	Group	M ₁ (cm)	SD ₁	M ₂ (cm)	SD ₂	MD	SE _D	t	t at 0.05
13	E ₁₃	21.60	2.01	22.15	1.79	0.55	0.18	2.98*	2.09
	C ₁₃	22.73	1.94	22.80	2.01	0.07	0.21	0.32 ^{NS}	2.14
14	E ₁₄	23.10	1.89	23.15	1.84	0.05	0.05	1.00 ^{NS}	2.09
	C ₁₄	23.67	1.68	23.73	1.67	0.06	0.07	0.86 ^{NS}	2.14
15	E ₁₅	24.05	1.70	24.35	1.57	0.30	0.13	2.35*	2.09
	C ₁₅	24.33	1.76	24.40	1.68	0.07	0.07	1.00 ^{NS}	2.14
16	E ₁₆	24.05	1.96	24.35	1.76	0.30	0.11	2.85*	2.09
	C ₁₆	24.73	1.44	25.07	1.33	0.33	0.21	1.58 ^{NS}	2.14
17	E ₁₇	23.70	1.69	24.05	1.54	0.35	0.15	2.33*	2.09
	C ₁₇	23.73	1.33	23.80	1.32	0.07	0.07	1.00 ^{NS}	2.14
18	E ₁₈	24.95	1.39	25.55	1.61	0.60	0.21	2.85*	2.09
	C ₁₈	24.60	1.30	24.67	1.35	0.07	0.07	1.00 ^{NS}	2.14

*Sig. at 0.05 level, NS = Not Significant.

Significant improvement was observed in Radiale styliion radiale among all the experimental groups except Gr. E₁₄. But no significant improvement was observed among control group.

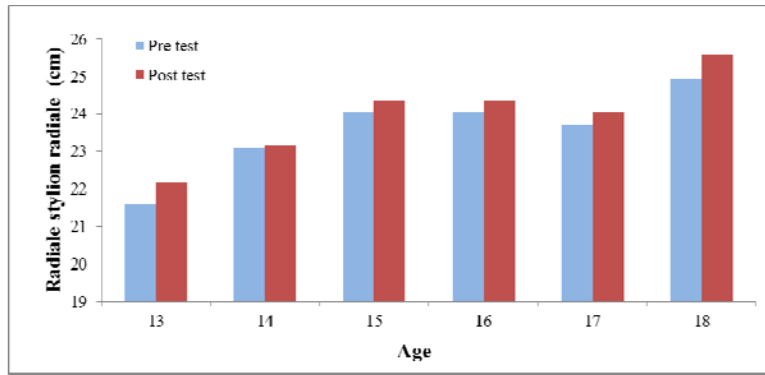


Fig 7: Comparison of means in Radiale styliion radiale after twelve weeks anaerobic training in 13 – 18 years experimental age groups

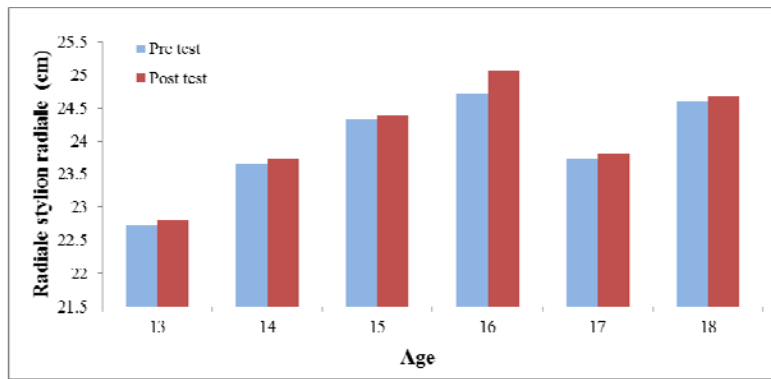


Fig 8: Comparison of means in Radiale styliion radiale after twelve weeks among 13 – 18 years control age groups

Table 5: Comparison of means in Trochanterion – tibiale laterale after twelve weeks anaerobic training among different age groups

Age Group (Years)	Group	M ₁ (cm)	SD ₁	M ₂ (cm)	SD ₂	MD	SE _D	t	t at 0.05
13	E ₁₃	33.98	2.48	34.80	2.68	0.82	0.15	5.64*	2.09
	C ₁₃	33.40	1.81	34.17	2.06	0.77	0.18	4.38*	2.14
14	E ₁₄	36.83	3.01	37.00	3.01	0.17	0.05	3.20*	2.09
	C ₁₄	36.47	2.00	36.27	1.78	0.20	0.10	2.10 ^{NS}	2.14
15	E ₁₅	38.05	2.67	38.10	2.66	0.05	0.03	1.45 ^{NS}	2.09
	C ₁₅	38.03	2.97	38.23	2.29	0.20	0.49	0.41 ^{NS}	2.14
16	E ₁₆	38.60	2.15	38.73	2.16	0.13	0.05	2.52*	2.09
	C ₁₆	38.77	2.88	38.80	2.86	0.03	0.03	1.00 ^{NS}	2.14
17	E ₁₇	39.38	2.19	39.50	2.23	0.13	0.05	2.52*	2.09
	C ₁₇	38.90	3.16	38.97	3.18	0.07	0.05	1.47 ^{NS}	2.14
18	E ₁₈	40.98	2.74	41.03	2.79	0.05	0.05	1.00 ^{NS}	2.09
	C ₁₈	40.43	4.35	40.53	4.30	0.10	0.07	1.38 ^{NS}	2.14

*Sig. at 0.05 level, NS = Not Significant.

Gr. E₁₃, E₁₄, E₁₆ and E₁₇ improved significantly in Trochanterion–tibiale laterale.

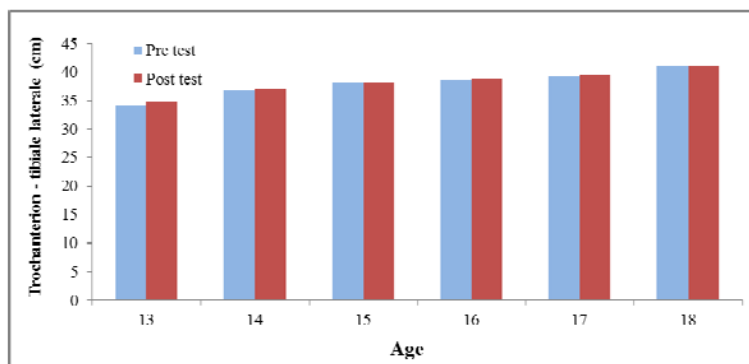


Fig. 9: Comparison of means in Trochanterion – tibiale laterale after twelve weeks anaerobic training in 13 – 18 years experimental age groups

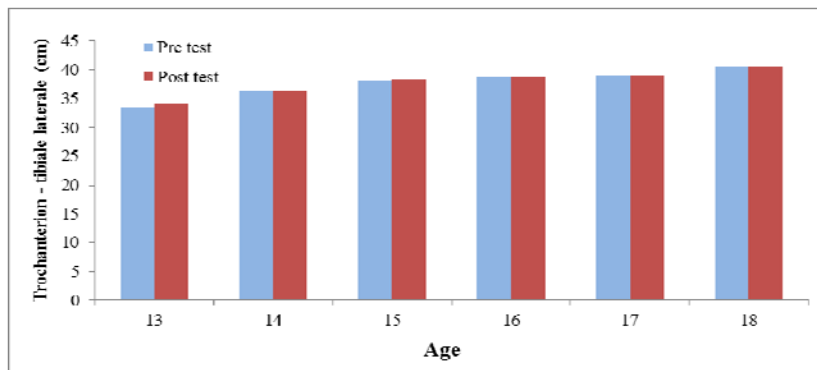


Fig 10: Comparison of means in Trochanterion – tibiale laterale after twelve weeks among 13 – 18 years control age groups

Table 6: Comparison of means in Tibiale mediale–sphyrion tibiale after twelve weeks anaerobic training among different age groups

Age Group (Years)	Group	M ₁ (cm)	SD ₁	M ₂ (cm)	SD ₂	MD	SE _D	t	t at 0.05
13	E ₁₃	33.88	2.32	34.70	2.52	0.83	0.15	5.64*	2.09
	C ₁₃	33.33	1.70	34.00	1.87	0.67	0.13	5.29*	2.14
14	E ₁₄	36.58	2.80	36.75	2.79	0.17	0.05	3.20*	2.09
	C ₁₄	36.10	1.80	36.13	2.50	0.03	0.63	0.05 ^{NS}	2.14
15	E ₁₅	37.65	2.53	37.70	2.52	0.05	0.03	1.45 ^{NS}	2.09
	C ₁₅	37.67	2.79	37.80	2.18	0.13	0.45	0.30 ^{NS}	2.14
16	E ₁₆	38.15	2.05	38.28	2.06	0.13	0.05	2.52*	2.09
	C ₁₆	38.27	2.88	38.30	2.86	0.03	0.03	1.00 ^{NS}	2.14
17	E ₁₇	38.90	2.14	39.03	2.19	0.13	0.05	2.52*	2.09
	C ₁₇	38.43	3.13	38.50	3.14	0.07	0.05	1.47 ^{NS}	2.14
18	E ₁₈	40.48	2.74	40.53	2.79	0.05	0.05	1.00 ^{NS}	2.09
	C ₁₈	39.93	4.35	40.03	4.30	0.10	0.07	1.38 ^{NS}	2.14

*Sig. at 0.05 level, NS = Not Significant.\

Significant improvement was observed in Tibiale mediale–sphyrion tibiale among Gr. E₁₃, C₁₃, E₁₄, E₁₆ and E₁₇.

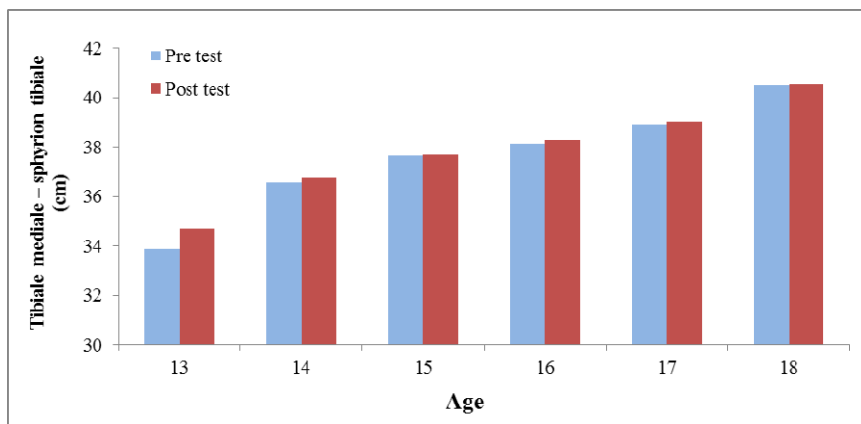


Fig 11: Comparison of means in Tibiale mediale – sphyrion tibiale after twelve weeks anaerobic training in 13 – 18 years experimental age groups

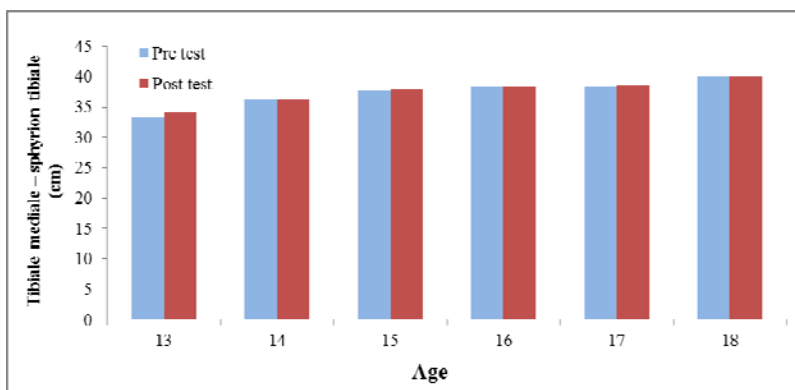


Fig 12: Comparison of means in Tibiale mediale – sphyrion tibiale after twelve weeks among 13 – 18 years control age groups

Table 7: Comparison of means in Arm circumference after twelve weeks anaerobic training among different age groups

Age Group (Years)	Group	M ₁ (cm)	SD ₁	M ₂ (cm)	SD ₂	MD	SE _D	t	t at 0.05
13	E ₁₃	18.75	2.10	19.60	2.19	0.85	0.18	4.68*	2.09
	C ₁₃	18.33	1.18	18.60	0.99	0.27	0.15	1.74 ^{NS}	2.14
14	E ₁₄	20.50	2.28	21.15	2.39	0.65	0.13	4.95*	2.09
	C ₁₄	20.73	1.58	20.93	1.28	0.20	0.11	1.87 ^{NS}	2.14
15	E ₁₅	22.40	1.57	22.70	1.42	0.30	0.11	2.85*	2.09
	C ₁₅	21.53	1.88	21.80	1.90	0.27	0.12	2.26*	2.14
16	E ₁₆	23.65	1.69	23.90	1.68	0.25	0.22	1.37 ^{NS}	2.09
	C ₁₆	23.13	2.33	23.07	2.31	0.06	0.07	1.00 ^{NS}	2.14
17	E ₁₇	23.95	1.19	24.25	1.33	0.30	0.11	2.85*	2.09
	C ₁₇	23.93	0.96	24.13	0.92	0.20	0.11	1.87 ^{NS}	2.14
18	E ₁₈	23.15	1.50	23.35	1.60	0.20	0.09	2.18*	2.09
	C ₁₈	24.07	1.16	24.27	1.16	0.20	0.14	1.38 ^{NS}	2.14

*Sig. at 0.05 level, NS = Not Significant.

Arm circumference improved significantly among Gr. E₁₃, E₁₄, E₁₅, C₁₅, E₁₇ and E₁₈.

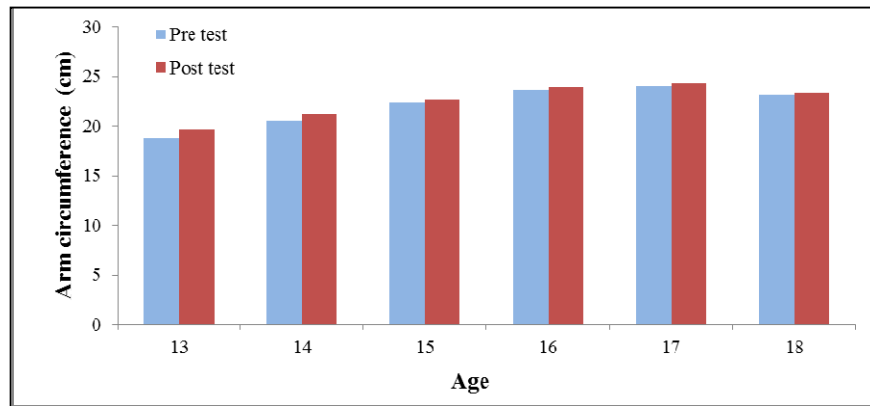


Fig 13: Comparison of means in Arm circumference after twelve weeks anaerobic training in 13 – 18 years experimental age groups

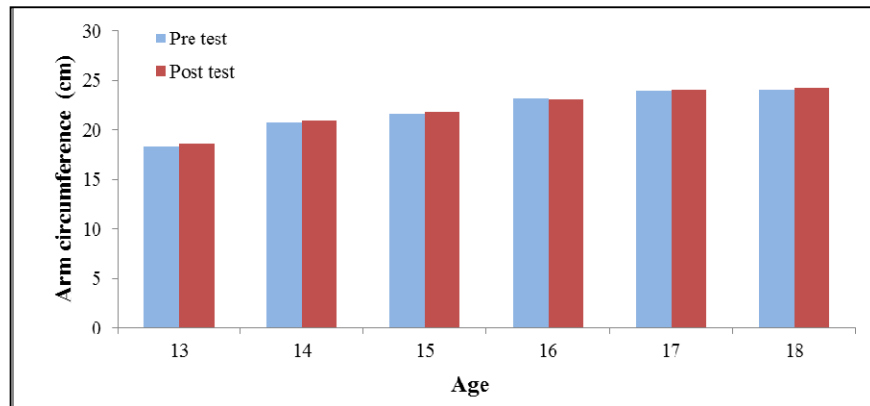


Fig 14: Comparison of means in Arm circumference after twelve weeks among 13 – 18 years control age groups

Table 8: Comparison of means in Abdomen circumference after twelve weeks anaerobic training among different age groups

Age Group (Years)	Group	M ₁ (cm)	SD ₁	M ₂ (cm)	SD ₂	MD	SE _D	t	t at 0.05
13	E ₁₃	60.05	4.70	59.30	4.66	0.75	0.14	5.25*	2.09
	C ₁₃	60.47	3.07	60.73	3.75	0.26	0.33	0.81 ^{NS}	2.14
14	E ₁₄	62.35	4.69	61.65	4.59	0.70	0.15	4.77*	2.09
	C ₁₄	61.47	3.16	62.20	3.26	0.73	0.15	4.78*	2.14
15	E ₁₅	66.15	4.09	65.65	4.11	0.50	0.11	4.36*	2.09
	C ₁₅	65.20	4.33	65.67	4.20	0.47	0.38	1.24 ^{NS}	2.14
16	E ₁₆	66.35	3.30	65.70	3.26	0.65	0.13	4.95*	2.09
	C ₁₆	66.93	4.22	67.13	4.49	0.20	0.11	1.87 ^{NS}	2.14
17	E ₁₇	67.60	5.16	67.10	5.32	0.50	0.17	2.94*	2.09
	C ₁₇	66.27	3.13	66.13	2.36	0.14	0.65	0.20 ^{NS}	2.14
18	E ₁₈	67.45	3.91	66.95	3.90	0.50	0.17	2.94*	2.09
	C ₁₈	69.27	2.71	68.80	2.04	0.47	0.29	1.61 ^{NS}	2.13

*Sig. at 0.05 level, NS = Not Significant.

Abdomen circumference decreased significantly among Gr. E₁₃, E₁₄, C₁₄, E₁₅, E₁₆, E₁₇ and E₁₈.

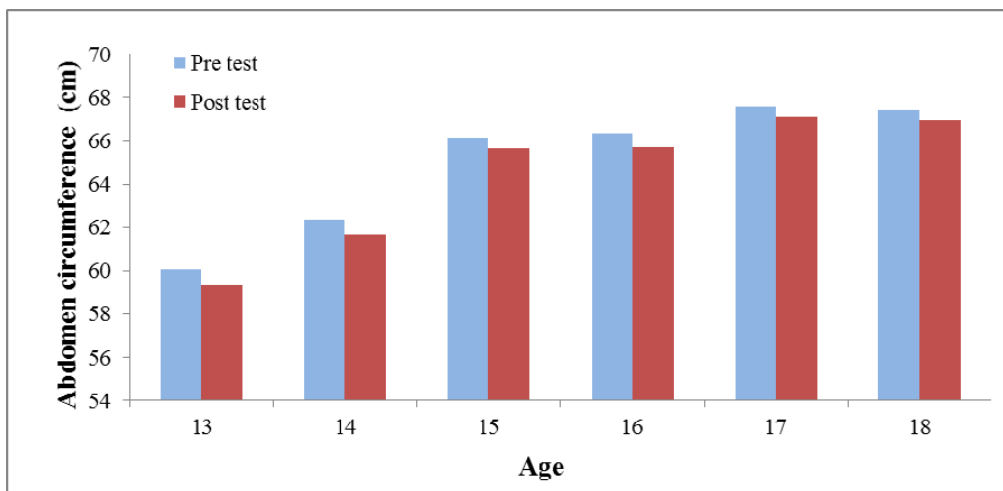


Fig 15: Comparison of means in Abdomen circumference after twelve weeks anaerobic training in 13 – 18 years experimental age groups

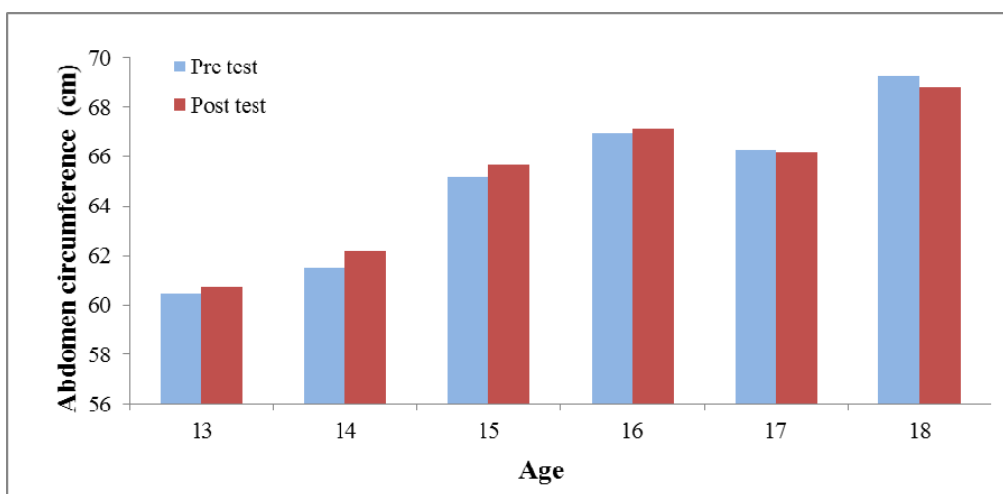


Fig 16: Comparison of means in Abdomen circumference after twelve weeks among 13 – 18 years control age groups

Table 9: Comparison of means in Thigh circumference after twelve weeks anaerobic training among different age groups

Age Group (Years)	Group	M ₁ (cm)	SD ₁	M ₂ (cm)	SD ₂	MD	SE _D	t	t at 0.05
13	E ₁₃	34.45	4.29	35.05	4.10	0.60	0.27	2.26*	2.09
	C ₁₃	33.07	3.84	33.27	2.99	0.20	0.49	0.41 ^{NS}	2.13
14	E ₁₄	38.80	4.80	39.40	4.85	0.60	0.13	4.49*	2.09
	C ₁₄	36.73	2.46	37.13	2.50	0.40	0.16	2.45*	2.13
15	E ₁₅	41.70	2.70	42.15	2.56	0.45	0.11	3.94*	2.09
	C ₁₅	39.47	4.05	39.67	4.20	0.20	0.11	1.87 ^{NS}	2.13
16	E ₁₆	42.65	2.23	43.45	2.46	0.80	0.17	4.66*	2.09
	C ₁₆	41.80	4.81	41.93	5.02	0.13	0.13	1.00 ^{NS}	2.13
17	E ₁₇	45.05	5.27	45.60	5.58	0.55	0.11	4.82*	2.09
	C ₁₇	43.87	2.03	44.00	2.00	0.13	0.09	1.47 ^{NS}	2.13
18	E ₁₈	42.50	2.28	43.25	2.05	0.75	0.26	2.88*	2.09
	C ₁₈	44.80	2.62	45.40	2.38	0.60	0.25	2.36*	2.13

*Sig. at 0.05 level, NS = Not Significant.

Thigh circumference improved significantly among Gr. E₁₃, E₁₄, C₁₄, E₁₅, E₁₆, E₁₇, E₁₈ and C₁₈.

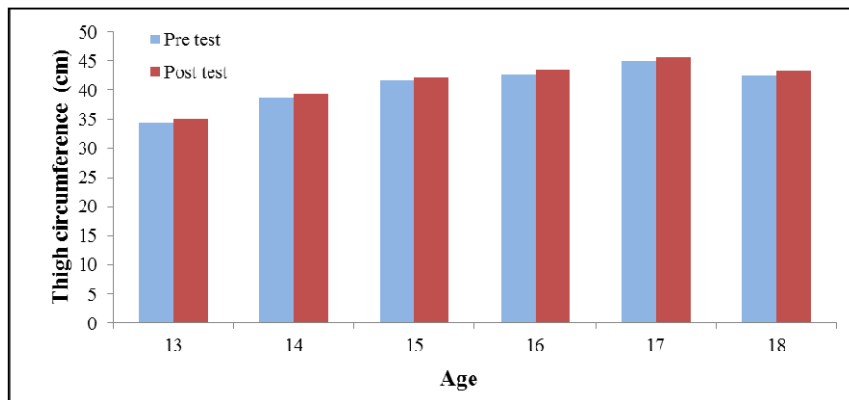


Fig 17: Comparison of means in Thigh circumference after twelve weeks anaerobic training in 13 – 18 years experimental age groups

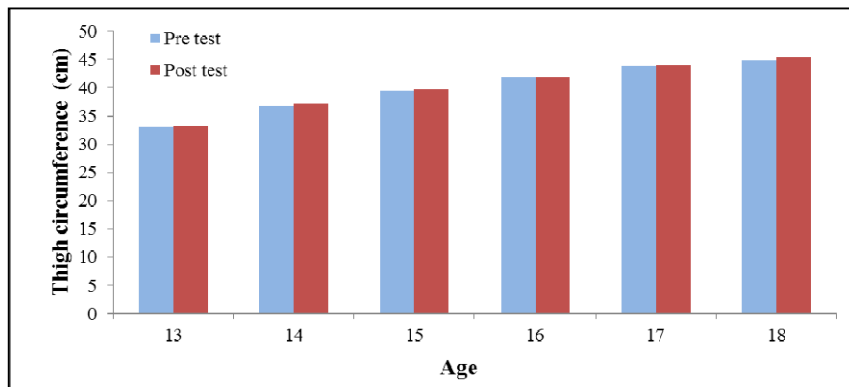


Fig 18: Comparison of means in Thigh circumference after twelve weeks among 13 – 18 years control age groups

Table 10: Comparison of means in Calf circumference after twelve weeks anaerobic training among different age groups

Age Group (Years)	Group	M ₁ (cm)	SD ₁	M ₂ (cm)	SD ₂	MD	SE _D	t	t at 0.05
13	E ₁₃	26.30	2.34	27.10	2.25	0.80	0.16	5.14*	2.09
	C ₁₃	26.40	1.68	26.93	1.83	0.53	0.13	4.00*	2.14
14	E ₁₄	28.40	2.70	29.15	2.60	0.75	0.12	6.10*	2.09
	C ₁₄	27.80	2.04	28.87	3.09	1.07	0.65	1.64 ^{NS}	2.14
15	E ₁₅	30.40	1.35	30.80	1.40	0.40	0.11	3.56*	2.09
	C ₁₅	29.73	2.74	30.07	2.87	0.34	0.13	2.65*	2.14
16	E ₁₆	30.50	2.06	31.50	1.99	1.00	0.07	13.78*	2.09
	C ₁₆	30.93	2.19	31.13	2.42	0.20	0.11	1.87 ^{NS}	2.14
17	E ₁₇	31.80	2.69	32.30	2.99	0.50	0.11	4.36*	2.09
	C ₁₇	31.67	1.59	32.00	1.31	0.33	0.13	2.65*	2.14
18	E ₁₈	31.30	1.59	32.00	1.65	0.70	0.11	6.66*	2.09
	C ₁₈	32.13	1.60	32.33	1.68	0.20	0.14	1.38 ^{NS}	2.14

*Sig. at 0.05 level, NS = Not Significant.

Significant improvement was observed in Calf circumference among Gr. E₁₃, C₁₃, E₁₄, E₁₅, C₁₅, E₁₆, E₁₇, C₁₇ and E₁₈.

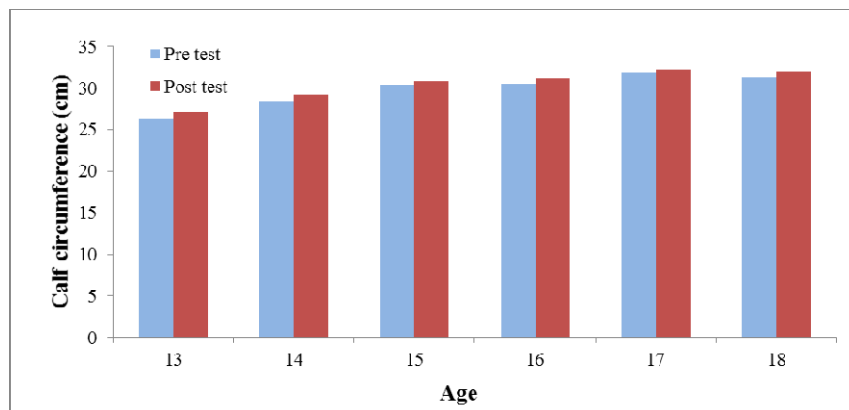


Fig 19: Comparison of means in Calf circumference after twelve weeks anaerobic training in 13 – 18 years experimental age groups

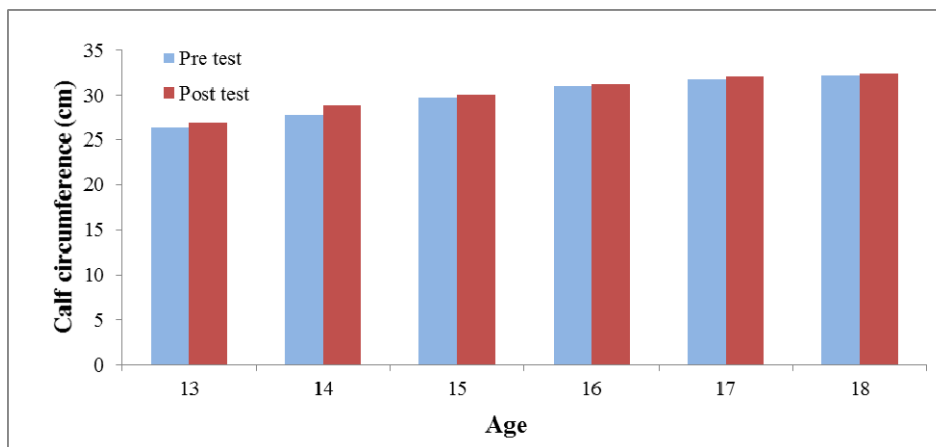


Fig 20: Comparison of means in Calf circumference after twelve weeks among 13 – 18 years control age groups

Discussion

Stature of both experimental and control groups improved significantly among teen agers. The improvement of 13 years experimental age group was superior among all other age groups. It is asserted that increment in Stature is pre-dominantly better among early teen agers. Same observation was also noticed in sitting height. Both the experimental as well as control groups improved significantly in sitting height. But the average increment in sitting height for experimental group was higher than that of control group. Matthew (2017) opined that the growth of girls tends to slow down by the age of 14, the average teen age boy will continue growing rapidly, until the age of 16. Similar observations were noticed in the present study also.

The linear distance between Acromiale radiale among all the subjects of the experimental groups improved significantly. The 13 years age group was superior in improvement of linear distance of Acromiale radiale among all the experimental groups.

The length of the forearm or the measurement Radiale stylium radiale improved significantly after 12 weeks anaerobic training among all the experimental groups except Gr. E₁₄. No significant improvement was observed among all the control groups.

The upper part of the leg, i.e. Trochanterion-tibiale laterale, was increased significantly among Gr. E₁₃, Gr. E₁₄, Gr. E₁₆ and Gr. E₁₇ respectively.

The lower part of the leg, i.e. Tibiale mediale-sphyrium tibiale was increased significantly among Gr. E₁₃, Gr. E₁₄, Gr. E₁₆ and Gr. E₁₇ respectively. A gradual progression in Tibiale mediale-sphyrium tibiale in relation to increment in age was noticed.

Anaerobic training improved the Arm circumference among all the experimental groups except Gr. E₁₆.

Significant decrement was observed in Abdomen circumference after 12 weeks anaerobic training among all the experimental groups.

Anaerobic training improved both Thigh circumference and Calf circumference among Gr. E₁₃, Gr. E₁₄, Gr. E₁₅, Gr. E₁₆, Gr. E₁₇ and Gr. E₁₈ respectively. Thigh circumference and Calf circumference are pre-dominantly dependent on Quadriceps and Gastrocnemius muscle. Twelve weeks anaerobic training improved the cross sectional area of the muscle fiber and as a result a total improvement of Quadriceps as well as Gastrocnemius muscle respectively. Chakraborty and Bharati (2008) found in their study the Calf circumference of Sabar tribes of 13–18 years age groups. Similar observations were noticed in the present study also.

Conclusion

The findings of the present study pointed out that anthropometric variables like Stature, Sitting height, Acromiale radiale, Radiale stylium radiale, Trochanterion-tibiale laterale, Tibiale mediale-sphyrium tibiale, Arm circumference, Thigh circumference and Calf circumference of teen ager boys were significantly improved due to 12 weeks anaerobic training. Based on the result of the study it may be opined that significant improvement among a few anthropometric variables of the control group were improved significantly due to natural growth factors of this age group.

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