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EFFECT OF TRAINING ON BODY COMPOSITION AND PHYSICAL FITNESS OF BOYS FROM MILITARY SCHOOL

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ABSTRACT

For this study, total 200 boys (10-12 yrs: 100 and 13-15 yrs: 100) were purposively chosen from a well known military training school of Nagpur (Maharashtra). Repeated observations were made over a period of one year with two study periods (at 0 and 12 months). Based on total skinfold thickness (SFT) at biceps, triceps, subscapular and suprailiac, body density (BD), body fat% (BF%) and fat free mass (FFM) was derived. Subjects from both age groups showed significant ($p<0.01$) annual increment in the height and weight. Boys were found taller and heavier in comparison with reference standards for age. For boys aged 13-15 yrs, significant ($p<0.01$) reduction in total SFT with increment in BD and FFM was noticed which indicated positive effect of military training on body composition. Significant improvement ($p<0.01$) in the performance of subjects for sit ups and squats tests was observed which indicate benefits of regular military training on physical fitness.

Keywords: skinfold thickness, body density, body fat, fat free mass, physical fitness

INTRODUCTION

The human body evolved to be physically active that means human bodies require physical activity to remain healthy. Regular physical activity is associated with a healthier and longer life. Childhood obesity is a growing global concern and physical exercise may help decrease the effects of childhood obesity (Wong, P. C. H. et al., 2008). Physical fitness is generally achieved through exercise, correct nutrition and enough rest. It has been proved that exercising leads to better physical ability later in life and an overall development of the individual. The sound health in young children can be achieved at school level by starting regular training. Sports training schools and military training schools can be best choice to attain sound physical dimensions (Steinbeck, K. S., 2001).

The monitoring of this dimensional development can be best done by assessing the anthropometric indices of the children. Prediction of fat mass and fat free mass from skinfold thicknesses is an acceptable method for the assessment of body composition (Slaughter, M. H. et al., 1988). Based on the skinfold thicknesses at biceps, triceps, subscapular and suprailiac; elite researchers (Durnin, J. V. G. A. and Rahaman, M. M., 1967) have developed "*golden standards*" for deriving body density which is otherwise very difficult in the field studies and requires sophisticated equipments and great technique.

Exercise has profound impact on body composition during growth as in all other periods of life. A physically active life develops lean body mass at the expense of fat in children (Sen, J. et al., 2011). Anthropometric measures of body composition are based on the measurement of two compartments of the body, the body fat and fat-free mass. Healthy young children or adolescents who engage themselves in an exercise program may lose fat that is not reflected in body weight changes because of concurrent gains in fat-free mass (FFM). The skinfolds have been simply derived to quantify the amount of muscularity & adiposity (Sen, J. et al., 2011; Sen, J. and Mondal, N., 2013).

When children tend to have a balanced life with inclusion of play, the body fat % reduces. It is shown that the school-based fitness oriented curriculum resulted in improved body composition in non-obese children and data demonstrated that school-based fitness curricula can benefit both obese and non-obese children. Carrel, A. L. et al. (2009) stated that partnerships with schools to promote fitness should be part of a public health approach to improving children's health. Sports training have a positive effect on overall physical fitness and health in prepubertal children (Alberga, A. S. et al., 2013). It has been reported that increased

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muscle mass and strength usually improves health-related quality of life (Tuba, M., 2015). Properly guided physical activities like those provided in schools under professional guidance can help improving the physical fitness level of children and adolescents.

This study was undertaken to study effect of regular military training on body composition and physical fitness of boys.

MATERIALS AND METHODS

This research involved studying the same group of military school going boys over a period of one year. Data was measured at the beginning (0 Month) and at the end (12 Month) of the study period.

Sample Size:

Young boys regularly attending a military school (age group 10 to 15 years) were purposively chosen from a well known military training school of Nagpur city. Total 200 (two hundred) boys were selected, out of which 100 were from age group 10-12 yrs (mean age: 11.24±0.71) and 100 were from 13-15 yrs age group (mean age: 13.79±0.63).

Anthropometric Measurements:

Body measurements like height and weight of subjects were recorded. Skinfold thicknesses (SFT) at biceps, triceps, subscapular and suprailiac skinfolds were measured. Based on SFT, body density (BD), body fat% (BF%) and fat free mass (FFM) were calculated using standard equations given by Durnin, J. V. G. A. and Rahaman, M. M. (1967), Siri, W. E. (1956) and Wickramasinghe, V. P. et al. (2010), respectively. All body indices were measured using standard procedures and equipments.

Physical Fitness:

The development of subject's abdominal muscles was assessed using sit ups test (Davis et al., 2000) whereas their leg strength was evaluated through squats test (Arnot, R. & Gaines, C., 1984).

Statistical Analysis:

Mean, standard deviation and percentage were calculated. Within group comparisons were done using matched pair *z* test.

Level of significance was tested at both 5% & 1% levels.

RESULTS AND DISCUSSION

Data on physical measurements of subjects is shown in Table 1. Annual increment in the height of subjects from age groups 10-12 and 13-15 yrs was found to be 7.98 cm and 5.96 cm, respectively. This increment was found to be significant (z=7.26 and 12.47 for age groups 10-12 and 13-15 yrs, respectively, $p<0.01$).

Annual gain in the weight was more in older subjects as compared to younger subjects. Within group comparison for periodical measurements of body weight of subjects during 0 and 12 months showed significant differences (z=4.74 and 8.17 for 10-12 and 13-15 yrs respectively, $p<0.01$).

For data during 12 month's study period, age wise comparisons (10+, 11+, 12+, 13+ and 14+ yrs) for observed height and weight of subjects were done with the reference standards of Indian Council of Medical Research (ICMR) & National Institute of Nutrition (NIN), (2009) and National Nutrition Monitoring Bureau (NNMB), (2002). Results are demonstrated in Figures 1 and 2.

Mean values of height & weight of subjects from age groups 10+, 11+, 12+ 13+ and 14+ yrs were found higher than the reference values. Percentage excess ranged between 5.58 to 11.02 for height and 35.36 to 48.94 for weight. Subjects under study were found taller and heavier than the reference values. This positive effect is attributed to regular military training.

Mean total skinfold thickness was 21.49±3.37 and 22.37±2.44 mm for boys aged 10-12 yrs and was 32.53±3.37 and 28.53±2.75 mm for boys aged 13-15 yrs, respectively during 0 and 12 months of the study period (Table 1). Periodical comparison within age group showed significant difference (z=11.4 for 10-12 yrs and z=7.76 for 13-15 yrs, $p<0.01$). Older subjects (13-15 yrs) possessed higher values of

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total skinfolds than younger subjects (10-12 yrs) during 0 as well as 12 months of the study period.

Mean body density of subjects aged 10-12 yrs was calculated as 1.0685±0.0072 and 1.0668±0.0041 g/ml during 0 and 12 months of study period, respectively. For older subjects aged 13-15 yrs, mean body density was calculated as 1.0563±0.0037 and 1.0599±0.0031 g/ml during 0 and 12 months of study period, respectively. For subjects aged 13-15 yrs, body density was found to be increased from 0 to 12 months of the study period ($z=7.41$). This increase was noted to be highly significant ($p<0.01$) indicating positive effect of military training which lead to increment in body density with increment of FFM and reduction of BF%. Similar results were noted for boys aged 10-12 yrs, however, this group also showed gain in BF%. Body density had negative correlation with height ($r= -0.3964$ for 10-12 yrs, $p<0.01$ and -0.1540 for 13-15 yrs, $p>0.05$) as well as with weight ($r= -0.5010$ and -0.3355 for subjects aged 10-12 and 13-15 yrs, respectively).

Mean BF% of subjects (13-15 yrs) during 0 and 12 months of the study period was recorded as 18.62±1.38 and 17.03±1.29, respectively. BF% among boys (9.5±1.6 yrs old) studied by Ara, I. et al. (2004) was 20.4±7.9. A physically active life develops lean body mass or FFM at the expense of fat. For subjects from age group 13-15 yrs, mean BF% showed decreasing trend which was highly significant ($z=7.43$, $p<0.01$). Mean BF showed annual decrease of 1.59%. In contrast to the observation of older subjects, BF% of younger boys showed significant annual increment ($z=2.03$, $0.01<p<0.05$). For subjects from age groups 10-12 and 13-15 yrs, BF% reflected very significant ($p<0.01$) and direct relationship with weight ($r=0.5006$ and 0.3354, respectively). Younger boys had stronger correlation of BF% with weight.

For both age groups of subjects, mean FFM was increased at the end of the study period. This increase from 0 to 12 months was found to be significant (z=6.19 for 10-12 yrs and z=11.02 for 13-15 yrs, p<0.01). Older subjects had greater FFM values than younger subjects. FFM showed significant (p<0.01) positive correlations with height (r=0.8556 and 0.3020) and weight (r=0.9621 and 0.9716) for subjects aged 10-12 and 13-15 yrs, respectively.

McGuigan, M. R. et al. (2009) observed a significant decrease in absolute percent body fat of 2.6% (p=0.003) and a significant increase in lean body mass of 5.3% (p=0.07) among 48 overweight children who participated in eight weeks of resistance training.

Abdominal muscle strength and endurance is important for core stability and back support. This sit up test measures the strength and endurance of the abdominals and hip-flexor muscles (http://www.topend sports.com/ testing/tests/home-situp.htm).

Table 2 presents data for sit ups test. Mean numbers of sit ups by subjects in 30 seconds were recorded as 16.95±4.83 and 24.67±5.67 for age group of 10-12 yrs and 13.27±3.67 and 21.14±4.00 for age group of 13-15 yrs, respectively during 0 and 12 months of the study period. Within group significant improvement for the results of sit ups test was noted for subjects from both age groups (z=8.07 and 11.72, respectively, p<0.01). Subjects from age group 10-12 yrs showed better performance for sit ups test than 13-15 yrs students (z=4.69 and 4.07 during 0 and 12 month respectively, p<0.01). This might be attributed to the greater flexibility at tender age.

At the end of the study period, majority of subjects (58% and 37%) from age group 10-12 yrs and 13-15 yrs, respectively were categorized as "excellent" as far as performance for sit ups test is concerned. Among older subjects (13-15 yrs) who were engaged in prolonged military training as compared to younger subjects (10-12 yrs), results of sit ups test demonstrated positive correlation with weight and height (r=0.2367,

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$0.01<p<0.05$ and $r=0.0200$, $p<0.05$, respectively). Among older boys (13-15 yrs), test results of sit ups also showed positive correlation with FFM ($r=0.6826$, $p>0.01$). Results of fitness tests clearly depict that regular military training lead to improvement in fitness level of subjects.

Dahab, K. S. and McCambridge, T. M. (2009) stated that children can improve strength by 30% to 50% after just 8 to 12 weeks of a well-designed strength training program.

Squats test monitors the development of person's leg strength. Strong legs are essential for staying mobile as activities increase. It requires the use of the majority of the muscles in the body (http://ericsaintonge.com/benefits-squat-exercise/). Based on the results of this test, the strength of the leg of subjects was estimated and the results are shown in Table 3. Mean time taken for performing the squats was 22.00±5.33 and 81.00±6.50 seconds by the subjects from age group of 10-12 yrs and 16.00±3.67 and 25.00±4.55 seconds by the subjects from age group of 13-15 yrs during study periods of 0 and 12 months, respectively. This improvement was found to be significant ($z=8.65$ and 10.64 for subjects aged 10-12 and 13-15 yrs, respectively, $p<0.01$).

For results of squats test, comparison between younger and older subjects revealed significant difference ($z=6.45$ and 6.22, respectively, $p<0.01$). Subjects from younger age group (10-12 yrs) showed better performance than older age group (13-15 yrs). The flexibility of the body at the younger age and the high competitive spirit contributed to the better performance by the students of the younger age group.

Table 3 also shows performance assessment of subjects based on the results of squats test. At the end of the study (12 month), it was found that 26% and 5% of subjects from the age group of 10-12 and 13-15 yrs, respectively, were categorized "excellent", whereas 28% and 15%, respectively were categorized

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"good". 10% and 8% subjects aged 10-12 and 13-15 yrs, respectively were categorized "above average" and 16% and 24% subjects aged 10-12 and 13-15 yrs, respectively were categorized "average". At the end of the study period, none of the younger subjects (10-12 yrs) were rated "poor". Thus, it can be said that regular physical training at young age can strengthen the leg muscles.

Results of the present study suggest that regular exercise has a positive effect on body weight and body composition parameters like BF% and FFM.

Table 1: Data on Height, Weight, Total Skinfold Thickness (Biceps + Triceps + Subscapular + Suprailiac), Body Density, Body Fat% and Fat Free Mass of Subjects

Sr. No.	Study Period	Age Groups (Yrs)					
		10-12 (n=100)			**13-15** (n=100)		
		M±SD	**Range**	**z Values#**	**M±SD**	**Range**	**z Values#**
1	**Height (cm)**						
i	0 Month	**150.60**±9.35	135.29-172.63	**7.26***	**166.13**±2.68	154.66-170.76	**12.47***
ii	12 Month	**158.58**±7.83	145.20-176.50		**172.09**±2.40	163.00-177.40	
2	**Weight (kg)**						
i	0 Month	**41.80**±5.71	26.79-61.07	**4.74***	**56.69**±4.51	40.29-67.34	**8.17***
ii	12 Month	**47.85**±6.18	29.50-66.60		**64.83**±4.52	48.20-75.30	
3	**Total Skinfold Thickness (Biceps + Triceps + Subscapular + Suprailiac)(mm)**						
i	0 Month	**21.49**±3.37	12.40-32.64	**11.4***	**32.53**±3.37	21.14-41.35	**7.76***
ii	12 Month	**22.37**±2.44	15.70-30.35		**28.53**±2.75	18.61-35.09	
4	**Body Density (g/ml)**						
i	0 Month	**1.0685**±0.0072	1.0560-1.0830	**2.07****	**1.0563**±0.0037	1.0494-1.0681	**7.41***
iv	12 Month	**1.0668**±0.0041	1.0580-1.0764		**1.0599**±0.0031	1.0539-1.0717	
5	**Body Fat (%)**						
i	0 Month	**13.27**±1.96	7.07-18.77	**2.03****	**18.62**±1.38	13.44-21.72	**7.43***
iv	12 Month	**14.00**±1.34	9.86-17.87		**17.03**±1.29	11.90-19.66	
6	**Fat Free Mass (FFM) (kg)**						
i	0 Month	**29.87**±3.30	21.52-41.31	**6.19***	**40.00**±2.24	31.90-45.36	**11.02***
iv	12 Month	**34.16**±3.56	24.76-46.14		**45.56**±2.34	36.89-50.95	

- values are for within group comparison (i.e. comparison between data taken during 0 and 12 months of the study period); *Significant at both 5% and 1% levels ($p<0.01$); ** - Significant at 5% level but insignificant at 1% level ($0.01<p<0.05$); Values without any mark indicate insignificant difference at both 5% and 1% levels ($p>0.05$).

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Table 2: Data for Sit Ups Test

Sr. No.	Study Period	No. of Sit Ups in 30 Seconds M±SD (Range)	z Values#	Data for Sit Ups Test: Performance Assessment of Subjects Based on No. of Sit Ups in 30 Seconds					
				Excellent	Above Average	Average	Below Average	Poor	TOTAL
				No. & %	No. & %	No. & %	No. & %	No. & %	
1	**Age Group 10-12 Yrs** (n=100)								
i	0 Month	**16.95**±4.83 (7.00-36.00)	**8.07***	26	6	26	18	24	**100**
ii	12 Month	**24.67**±5.67 (11.00-45.00)		58	26	11	4	1	**100**
2	**Age Group 13-15 Yrs** (n=100)								
i	0 Month	**13.27**±3.67 (4.00-26.00)	**11.72***	6	7	22	29	36	**100**
ii	12 Month	**21.14**±4.00 (11.00-35.00)		37	30	26	6	1	**100**
								z value¶	**4.69***
								z value■	**4.07***

- values are for within group comparison (i.e. comparison between data taken during 0 and 12 months of the study period); ¶ - z value is for between age group comparison during **0 month** of the study period (i.e. comparison between subjects from age groups 10-12 and 13-15 yrs during 0 month of the study period); ■ - z value is for between age group comparison during **12 month** of the study period (i.e. comparison between subjects from age groups 10-12 and 13-15 yrs during 12 month of the study period; *Significant at both 5% and 1% levels (p<0.01).

Table 3: Data for Squats Test

Sr. No.	Study Period	Time Taken (seconds) M±SD (Range)	z Values#	Data for Squats Test: Performance Assessment of Subjects Based on No. Squats Completed							
				Excellent	Good	Above Average	Average	Below Average	Poor	Very Poor	TOTAL
				No. & %	No. & %	No. & %	No. & %	No. & %	No. & %	No. & %	
1	**Age Group 10-12 Yrs** (n=100)										
i	0 Month	**22.00**±5.33 (8.00-40.00)	**8.65***	4	10	12	11	6	22	32	**100**
ii	12 Month	**81.00**±6.50 (14.00-53.00)		26	28	10	16	7	11	0	**100**
2	**Age Group 13-15 Yrs** (n=100)										
i	0 Month	**16.00**±3.67 (9.00-31.00)	**10.64***	0	1	2	4	9	27	57	**100**
ii	12 Month	**25.00**±4.55 (15.00-42.00)		5	15	8	24	14	23	11	**100**
										z value¶	**6.45***
										z value■	**6.22***

- values are for within group comparison (i.e. comparison between data taken during 0 and 12 months of the study period); ¶ - z value is for between age group comparison during **0 month** of the study period (i.e. comparison between subjects from age groups 10-12 and 13-15 yrs during 0 month of the study period); ■ - z value is for between age group comparison during **12 month** of the study period (i.e. comparison between subjects from age groups 10-12 and 13-15 yrs during 12 month of the study period; *Significant at both 5% and 1% levels (p<0.01).

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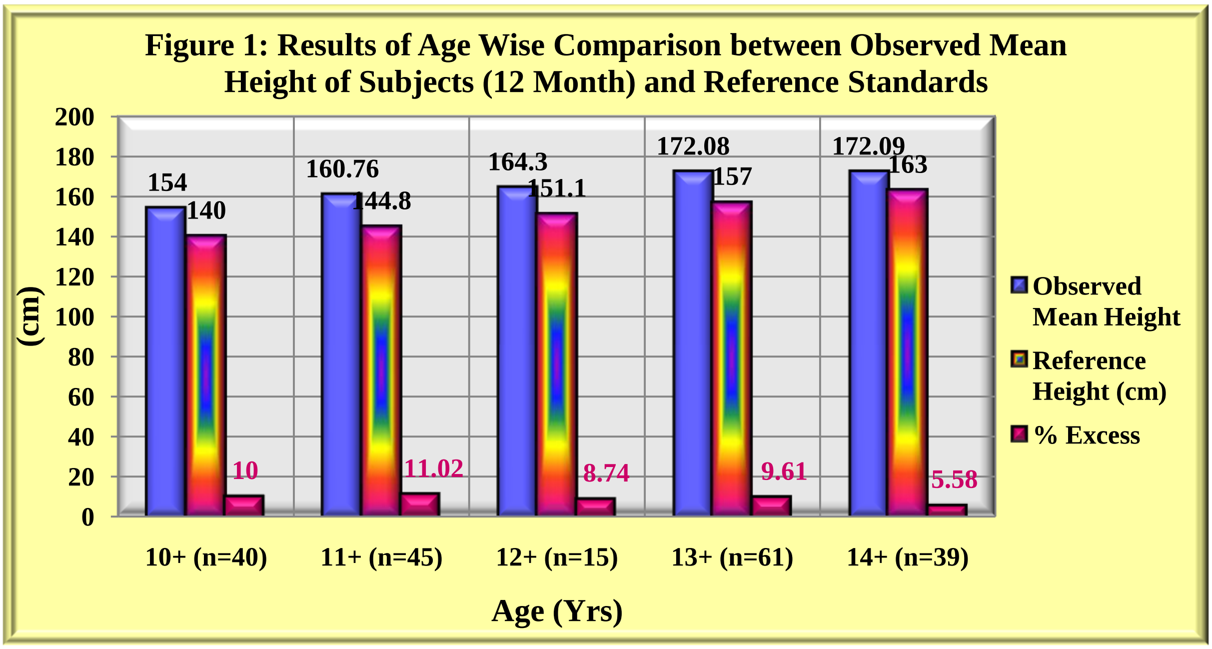

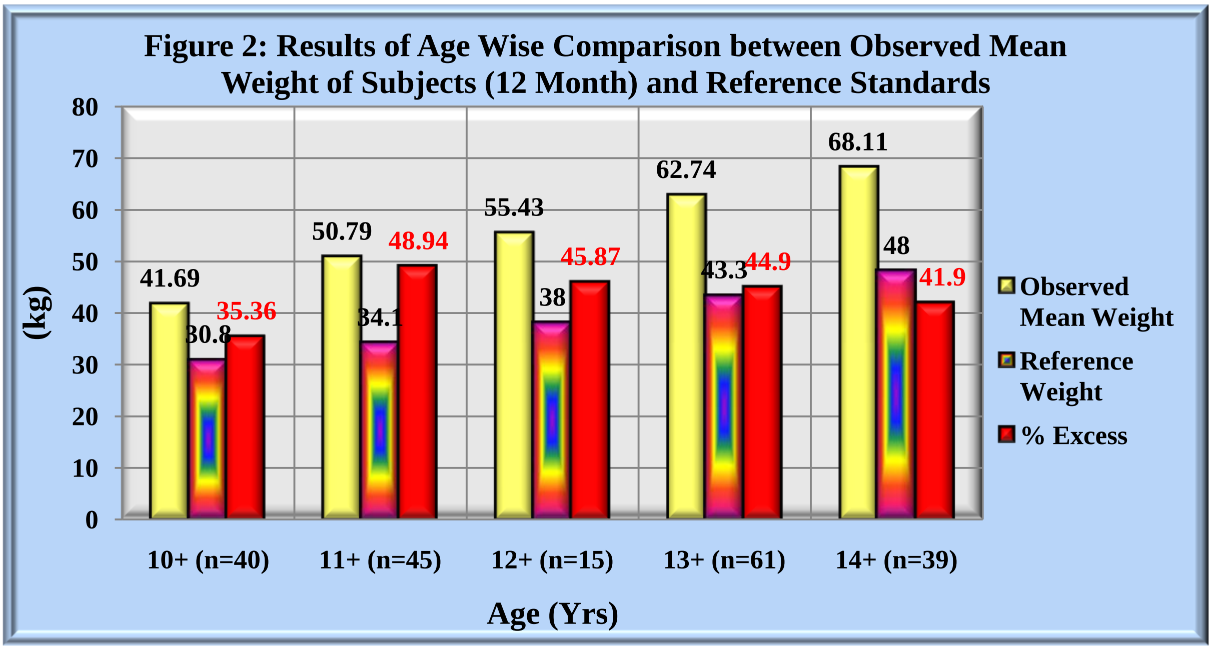

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