Comparative Study of Complex Training and Conventional Training in Developing Linear Power among School Children

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Abstract

The effects of complex training and conventional training in developing linear power among school children have been compared. For this purpose a group of 72 boys of 14 to 16 years of age was selected at random out of a universe of 200 children, who were medically fit. AAHPERD youth fitness test was conducted to assign the 72 boys into 3 different groups of 24 each namely complex training group, conventional training group and control group by using snake system based on their performance rankings. To verify that the groups were equated, mean and standard deviations were also calculated and assigned the groups for different treatments on random basis as A, B and C. With this setting, complex training was given to group A and conventional training was given to group B and group C control group did not participate in any of the training programmes, for a period of 12 weeks duration. This process was repeated and for a period of every two-week the data was collected along with pre-test, mid-test and post-test data from the experimental groups and control group on selected motor performance variables. A two way Analysis of Variance (ANOVA) was applied to determine the differences if any among the training methods and duration intervals for experimental and control groups. The Duncan Multiple Range Test (DMRT) was applied wherever applicable on the results of ANOVA to find the hierarchy among the methods of training and the duration intervals. As a result of the above analysis, the boys trained through complex training method gave more significant increase in the linear power as compared to conventional training method and 'No' training group that is control group. It was concluded that the linear power developed through complex training method was much faster than conventional training method within 12 weeks of training period. In fact, it was twice better than the other.

Key Words: Linear Power, Resistance Training, Plyometrics

Introduction

Children involved in sports should be encouraged to participate in a variety of activities and develop in a wide range of skills. The success of young children can serve as a powerful inducement for others to follow. Most Olympic sports have selection processes that attempt to identify future champions and initiate specialised training at the younger age. This means that preparation for competition at the highest level is starting for many sports persons in their early teens and many of them achieve high standards of performance reaching finals or even the victory rostrum. This suggests that growing children can accept training loads compatible with performances, required for success at world level *(Anderson, 200).*

The adolescent period is the most important period to exercise because of the fact that there takes place hormonal changes, growth and development, neural adaptations, inter and intra muscular coordination besides a higher level of stimulus to learn among them. It is because of all these substantiated facts; the study is directed towards the age group of 14 to 16 years. There are empirical evidences to show that sports

persons normally gain strength and power through the conventional training method refers to periodised strength training followed by anatomical adaptations which is followed by maximum strength and progresses to power conversion phase, which in turn followed by a maintenance phase and concludes with a regeneration phase *Bompa (1994),* and it is a longer process. He further reported that explosive movements are required in many sports and are typically performed at high speeds against resistance. *Blakey & Southard (1987)* reported that resistive training improves leg power.

The complex training method is a workout system, which combines strength and plyometric for an optimal positive effect to improve the linear power *(Chu, 1996). Burgener (1998)* and *Chu et al (2000)* advocated the value of complex training to develop overall body control. According to *Brown et al (1986),* plyometric training (depth jumps) with coordinated arm movement and leg drive helps to enhance vertical jump. *Duke & BenEliyahu (1992),* conducted similar study and suggested that it would be logical to combine resistance training, plyometrics and speed training in the same session to increase power. Anecdotal evidence suggests that this is the optimal method for maximum power conversion. *Gemar (1998)* reported that resistance training and plyometric training on high school children showed significant differences in the performance of vertical jump, standing broad jump and 30 meters sprint. *Zepeda and Gonzalez (2000)* reported that plyometric training enhances speed within 3 to 8 weeks period and resembles the training effect produces as a result of 30 to 50% of 1RM of three weeks.

Fleck & Steven (2000) observed that extensive studies are also needed to examine the response of females, children and men to periodised resistance training programs and also to periodised models other than the conventional resistance or power training model. *Burger et al (2000)* also reported that complex training is just as effective if not more effective as conventional training in a 7 week study. *Faigenbaum et. al. (1999)* revealed that children can experience similar gains in upper body strength and endurance within 8 weeks of training using conventional strength training and complex training.

From the above cited literature and investigations, it is evident that there is a significant difference in the development of power by using both conventional training method and complex training method. As many earlier studies have revealed that short-term resistance training will not hamper the growth and development of the children, it was proposed in the present study to conduct a comparative study of complex training and conventional training in developing linear power among school children in the age group of 14 to 16 years for the benefit of posterity.

Objectives

1. To study the effectiveness of conventional training method in developing linear power.
2. To find out the relative effectiveness of complex training method and conventional training method in developing linear power.
3. To suggest an optimum combination of the two training methods for future adaptation.

Hypotheses

1. The conventional training method is not significantly effective in developing linear power.

2. The complex training method is not significantly effective in developing linear power.
3. There is no significant difference between complex training and conventional training methods in developing linear power.

Materials and Methods

The sample:
Step 1: Selection of boys 14 to 16 years of age.
Step 2: Screening for medical fitness test by a registered medical practitioner to ensure their medical fitness.
Step 3: The sample unit consisted of 72 boys selected at random out of a universe of 200 children who were medically fit.
Step 4: In order to equate the groups AAHPERD youth fitness was conducted to assign the 72 boys into 3 different groups namely complex training group, conventional training group and control group by using snake system based on their performance rankings.
Step 5: To verify that the groups were equated, mean and standard deviations were also calculated.
Step 6: Assigning the groups for different treatments on random basis as A, B and C.

A two way Analysis of Variance (ANOVA) was applied to determine the differences if any among the training methods and duration intervals for experimental and control groups. For comparison purposes percentiles, mean and standard deviation and t-values have also been calculated. The Duncan Multiple Range Test (DMRT) was applied wherever applicable on the results of ANOVA to find the hierarchy among the methods of training and the duration intervals. ANOVA, Mean, Standard deviation (SD), and t - tests have been computed using SPSS - 10.0 software. The percentile analysis was carried out using The Unscrambler 9.01 software**.** The level of significance was fixed at 0.05.

Results and Discussion

The results of the study are given in the following percentile values and mean ± standard deviation in graphical form of linear power in centimeters are illustrated in Fig. 1, Fig. 2 and Fig. 3. These figures explain the increase in linear power by conventional and complex training methods. As evidenced by the Fig. 1, there is no significant effect on the increase of linear power for control group.

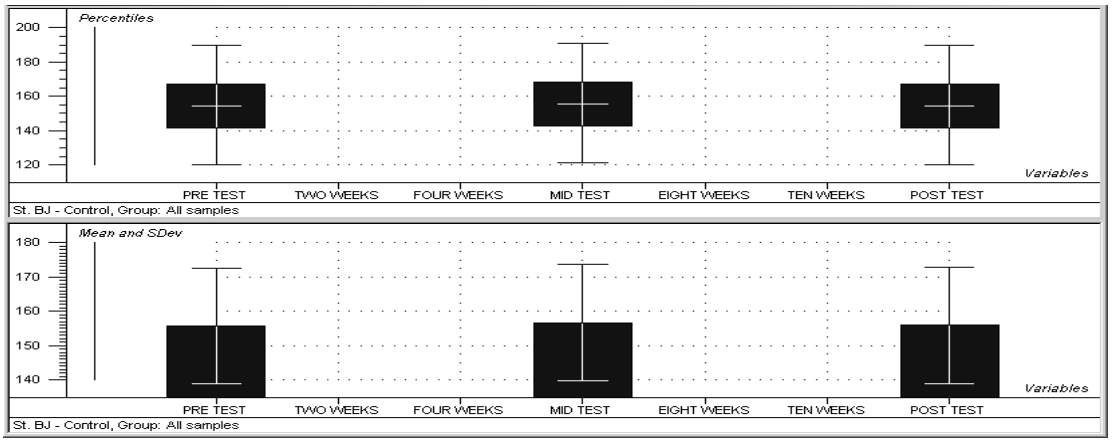

Figure 1. Percentiles and Means ± SD Values of linear power for control group

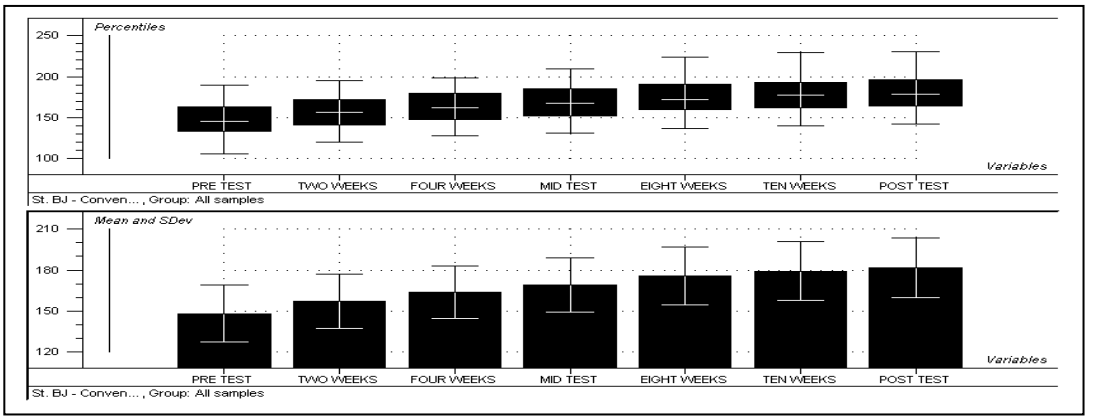

Figure 2. Percentiles and Means ± SD Values of linear power for conventional training group

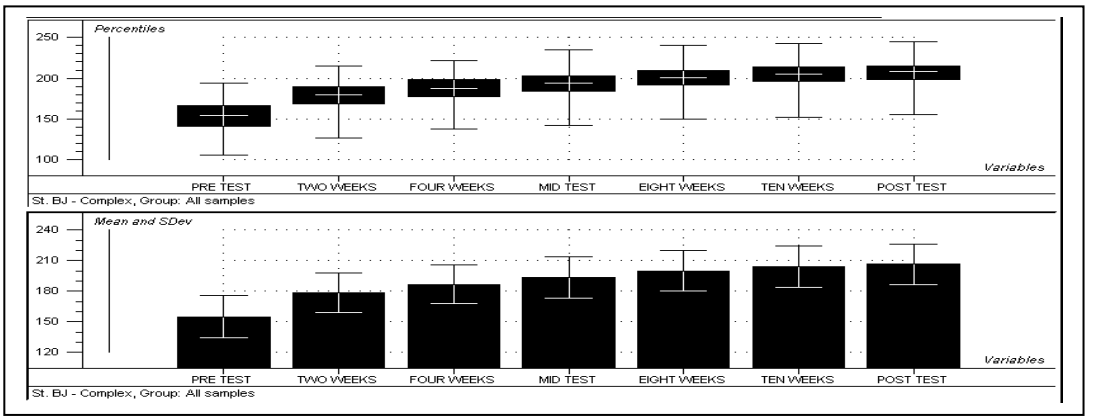

Figure 3. Percentiles and Means ± SD Values of linear power for complex training group.

The above percentiles graph show that the distribution of subjects around the median have narrower limits from Pre test to Mid test and thereafter it became slightly broader up to Post test under complex training method compared to conventional training method. This proves that the rate of increase in linear power is faster under complex training method than the conventional training method. Therefore from Fig. 2 and Fig. 3, it may be concluded that the complex training method gives the rapid increase in the linear power during the first two weeks period and then it is consistent in the increase of linear power.

Table 1. Mean Values of Linear Power Distance (in centimeters) with SD and t-values

Tests	Control		Conventional		Complex		t-value	ρ - Value
Pre test	155.79	16.89	148.03	20.95	154.71	20.63	1.08	-
2 weeks	155.69	16.88	157.00	19.82	178.33	19.29	3.70	$\rho < 0.01$
4 weeks	155.63	16.89	163.75	19.27	186.75	19.10	4.07	$\rho < 0.01$
Mid test	156.63	16.96	169.25	19.93	193.50	20.13	4.11	$\rho < 0.01$
8 weeks	155.69	16.89	175.71	21.40	199.92	19.72	3.99	$\rho < 0.01$
10 weeks	155.79	16.88	179.21	21.52	203.92	19.99	4.03	$\rho < 0.01$
Post test	155.92	17.01	181.67	21.68	206.29	20.05	4.00	$\rho < 0.01$

Table 1 reveals the mean and standard deviation (SD) values of control, conventional and complex training methods. Also provided in the table are the t-values and their significance for comparing the conventional and complex training methods. The average linear power distance performance of the subjects during Pre test 148.03 ± 20.95 cms under conventional training group was not significantly different from that of complex training group 154.71 ± 20.63 cms. From the second week period onwards, there had been high significant difference (P<0.01) between the conventional and complex training methods. Also at the at Post test the average linear power distance performance of the subjects belonged to the complex training group 206.29 ± 20.05 cms, which is significantly more than that of conventional training group 181.67 ± 21.68 cms that is significant at 1 percent level.

Hence it can be inferred that the complex training method improves linear power distance performance very quickly, when compared to conventional training method within the twelve-week duration of training period.

Table 2. ANOVA Results of Linear Power Variable

SOURCE	Type III sum of squares	Df	Mean Square	F	Sig	ρ - Value
Methods	93200.4	2	46600.2	9425,3	.000	ρ < 0.01
Duration	44286.2	6	7381.0	1492.9	.000	ρ < 0.01
Duration * Methods	24468.7	12	2039.9	412.6	.000	ρ < 0.01
Duration * Subjects	793. 9	138	5.75	1.16	.147	NS
Methods *Subjects	146132.9	46	3176.8	642.5	.000	ρ < 0.01

Table 2 shows the results of the two way ANOVA for the linear power variable. The ANOVA results include the main effects namely the different methods of training and the duration intervals.

The results indicated that,

The different methods of training are significantly different (ρ<0.01).

The duration intervals are significantly different (ρ<0.01)

The interaction between the subjects and methods (ρ<0.01) and methods and duration (ρ<0.01) are significantly different.

The interaction between subjects and duration intervals are not significantly different.

The subjects were initially homogenized with respect to their physical fitness level, based on the six fitness variables considered in this study. It was expected that the same to be maintained during the entire duration of training period. The interaction between the subjects and duration is being not significant as revealed by ANOVA established this fact.

As the training methods and duration intervals are significantly different, the Duncan Multiple Range Test (DMRT) was applied on the results of ANOVA to find the hierarchy among the methods of training and the duration intervals.

Table 3 indicates that the DMRT results for duration intervals of the total sample of the subjects. The averages furnished in the above table are harmonic means of the linear power distance achieved by the subjects to perform standing broad jump over the two methods of training during the seven duration intervals. It is clearly evident from the table that the different duration intervals of the study were significantly

different between each other. On the average, there had been significant increase in the linear power distance in the standing broad jump achieved by the subjects at all duration intervals. The least average linear power performed by the subjects at the Pre test was 152.86 cms and the maximum linear power distance achieved was 181.29 cms at the Post test**.**

Table 3. DMRT Results of Duration of Training of Linear Power Variable

Test	Duration	1	2	3	4	5	6	7
Post test	7.00	181.3						
	6.00		179.9					
	5.00			177.4				
	4.00				173.1			
	3.00					168.8		
	2.00						163.8	
Pre test	1.00							152.9

Source: Compiled Means in the same group are not significantly different.

Table 4 reveals that the DMRT results of methods of training of subjects in the total sample across the seven duration intervals of training.

Table 4. DMRT Results of Methods of Training of Linear Power Variable

GROUPS	METHODS	SUB SET		
		1	2	3
Complex	3.00	189.0595		
Conventional	2.00		167.8095	
Control	1.00			156.2202

Source: Compiled Means in the same group are not significantly different.

The averages furnished in the above table are harmonic means of the linear power distance achieved by the subjects over the seven duration intervals of training. It may be seen from the table that the two methods of training are significantly different among each other in increasing the linear power distance achieved by the subjects to perform standing broad jump. The complex training method showed the maximum average linear power distance 189.05 cms compared to conventional training method 167.80 cms and control group 156.22 cms. This indicates that the complex training method develops the linear power more quickly when compared to conventional training method in a given time duration.

Since the means of complex training method and conventional training method are significantly more that of control and also the complex training method yielded better results than the conventional training method, it implies that the complex training method is more effective in developing the linear power variable, although they do not differ between themselves.

Findings:

The findings concerned with the linear power performance for different tests conducted at different periods among the experimental groups and control group revealed the following results.

There was no significant difference among the complex training

group, conventional training group and control group before administering the experimental treatment that is Pre test. But there were differences in linear performance between the three groups at mid test and Post test.

Among the tests conducted for the conventional training method at different interval periods, during the Pre test to Post test period the linear power performance was uniformly increased and the rate of increase was being almost the same for every two every week period.

Among the tests conducted for the complex training method at different interval periods, there was faster increase in the linear power performance for the first two-week period and thereafter, the rate of increase became uniform and consistent till Post test. In the case of the control group there were no significant improvement observed in the linear power performance between the Pre test and all the other tests conducted at different intervals that is Mid test and Post test. It was found that the rate of increase in linear power performance was faster under complex training method than conventional training method. The complex training method yielded a greater linear power distance performance compared to the conventional training method and control group. This proves that the complex training method develops the fastest increase in the linear power distance performance when compared to conventional training method and control group.

The findings related to the linear power performance of two experimental groups conventional and complex training methods have shown significant increase and among them, complex training method had shown faster increase in linear power distance performance compared to conventional training method within the twelve week duration of training period. The reason could be the link between power and plyometric exercises which is caused by five critical components. These components are slow velocity strength, high velocity strength, and rate of force development, stretch shortening cycle and inter-muscular coordination and skill. Therefore combining resistance training and plyometrics is the most effective method in maximizing power development as it allows more components of explosive power to be developed. This finding is in concurrence with the results of *Newton and William (1994).* Similarly, the present study is in conformity with the study of *Radcliffe (1994), Bielik et. al (1986), Chu (1996)* and National strength and conditioning association (NSCA) round table discussion on plyometrics with resistance training (complex training). Thus the hypotheses stand vindicated.

Conclusions

The study leads us to arrive at the following conclusions;

1. Resistance training (conventional training method) should be performed at a high speed if explosive power is to be developed.
2. Combining resistance training and plyometrics that is complex training method one can increase more than resistance or plyometrics alone in developing linear power.
3. Combining resistance training and plyometrics that is complex training method is the optimal method for maximum power conversion.
4. The rate of increase in linear power performance during the first two-week period was significantly more

for complex training method as compared to conventional training method within 12 weeks duration of training period.

Thus, it may be concluded that the linear power developed through complex training method is much faster than conventional training method within 12weeks duration of training period. Infact, it is twice better than the other.

References

Anderson, Steven J. 2000. Physical Education Policy Statement Pediatrics, The McMillan and Company, New York. 154-157.

Bielik, K. Erin, Donald A. Chu, A., et. al. 1986. Practical Considerations for utilising plyometrics. *National Strength Coaches Association Journal,* **8(3):** 14-24.

Blakey, J.B. & Southard, D. 1987. The combined Effects of Weight Training and Plyometrics on Dynamic Leg Strength and Leg Power. *Journal of Applied Sport Science Research*. **1(1):** 14-16.

Bompa, T.Ed. 1994. Theory and Methodology of Training the Key to Athletic Performance, Kendall Hunt Book Company, London.

Brown, M.E., Mayhew, J.L., & Boleach, L.W. 1986. The effect of plyometric training on the vertical jump of high school boys' basketball player. *Journal of Sports Medicine and Physical Fitness*. **26(1):** 1-4.

Burgener, Mike. 1998. Complex Training at Ponderosa High School. *National Strength and Conditioning Journal,* **11:** 46-47.

Burger, T., Boyer-Kendrick, T. and Dolny, D. 2000. Complex training compared to a combined weight training and plyometric training program. *Journal of Strength and Conditioning Research,* **14(3):** 360 -361.

Chu, A. Donald, A., et. al., 2000. Electromyographic and Kinetic Analysis of Complex Training Variables, *Journal of Strength and Conditioning,* **14(4):** 451-456.

Chu, D. 1996. Explosive Power & Strength Complex Training for Maximum Results. Champaign IL: Human Kinetics Publishers, Inc.

Duke, S. and BenEliyahu, D. 1992. Plyometrics: Optimizing athletic performance through the development of power as assessed by vertical leap ability: an observational study. *Chiropractic Sports Medicine,* **6(1),** 10-15.

Faigenbaum, A.V., O'Connell, J., La Rosa, R., and Westcott, W. 1999. Effects of strength training and complex training on upper-body strength and endurance development in children. *Journal of Strength Conditioning Research,* **13(3):** 424.

Fleck, S. & J. Steven. 2000. Periodised strength training a critical review. *Journal of Strength and Conditioning Research,* **13:** 424.

Gemar, J. A. 1998. The Effects of Weight Training and Plyometric Training on Vertical Jump, Standing Broad Jump and 30 Meters Fly Run. *Physical Education and Sports Journal,* **12(2):** 22-26.

Newton, R. & William, J.K. 1994. Developing Explosive Muscular Power: Implications for a Mixed Methods Training Strategy. *Strength and Conditioning*. **16(5):** 20-30.

Radcliffe, J. 1994. A Power Perspective. *National Strength & Conditioning Association*. **16(5):** 46-47.

Zepeda, P. and Gonzalez, J. 2000. Complex training: Three weeks pre-season conditioning in division I female basketball players. *Journal of Strength and Conditioning Research,* **14(3):** 372.