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Comparative effects of varying intensities of resistance training on explosive strength and explosive power in soccer players

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Abstract
This study investigates the effects of three intensities of resistance training (low, medium, and high) on the explosive strength and explosive power of soccer players. Sixty male athletes from the East Bengal Football Club, Kolkata, India, aged 18-25 years, were randomly assigned to four groups: Low Intensity Resistance Training (LIRT), Medium Intensity Resistance Training (MIRT), High Intensity Resistance Training (HIRT), and a Control Group (CG). Over a 12-week training period, explosive strength was measured using the vertical jump test, and explosive power was measured using the broad jump test. Analysis of covariance (ANCOVA) and post hoc analysis with Scheffe's test were performed to determine significant differences between groups. Results showed that all three training intensities significantly improved explosive strength and explosive power compared to the control group, with the High Intensity Resistance Training (HIRT) group displaying the most substantial gains. These findings highlight that high-intensity resistance training is particularly effective in enhancing explosive performance in young athletes.

Keywords: Explosive strength, explosive power, resistance training, soccer players, vertical jump test, broad jump test

Introduction
The relevance of resistance training on the increments of strength levels in children and youngsters is well expressed in the results obtained on a meta-analysis study, which makes it possible to conclude that children and youngsters' muscular strength has increased because of resistance training programs [1]. Resistance training is often performed in a traditional training style using deliberate relatively longer repetition durations or in an explosive training style using maximally intended velocities and relatively shorter repetition durations [2]. The authors observed a significant improvement in jumping ability because of strength training characterized by the absence of specific exercises for the improvement of jump performance [3]. Such tasks have served as indirect measures of explosive strength [4]. The effects of FW resistance and plyometric training on young athletes have recently been reviewed, but no clear training-mode differences were apparent in muscular strength or vertical jump performance [5]. Explosive strength is a combination of strength and speed. It can be defined as the ability to overcome resistance with high speed [6]. Training exercises which include stopping, starting, and changing direction and have explosive nature can help athletes to improve agility. Plyometric training exercises improve agility in kabbadi players [7]. The improvement in the neuromuscular function is even more important than muscle hypertrophy in elderly, and this goal should be focused when prescribing RT in this population [8]. Finally, although RT is an effective exercise intervention to improve neuromuscular function and functional abilities, RT should be combined to any type of endurance exercise to improve cardiovascular function, because aging is associated with declines in both neuromuscular and cardiovascular functions [9]. Resistance training involves athletes who express their strength through the body's lever system by converting chemicals into kinetic energy and through neuromuscular coordination. Power can be identified as the ability to release maximum force in the shortest possible time [10]. Explosive power is the ability to exert great muscular strength in a very short time which is vital for athletes to win the competition [11]. Complex training combining RT and PLT uses

post activation potentiation and stretch-shortening cycle to enhance the explosive power and maximum strength of athletes and seems to be a good choice for the improvement of explosive power [12]. Therefore, it is hard to improve both strength and speed (i.e., explosive power) [13]. Complex Training has a significant effect on the improvement of explosive power. However, there are still great controversies concerning which training method is better [14].

Selection of subjects

Sixty male soccer players (ages 18-25) from East Bengal Football Club, Kolkata, India, volunteered for the study and were randomly divided into four groups:

- **Group I:** Low Intensity Resistance Training (LIRT), $N_1 = 15$
- **Group II:** Medium Intensity Resistance Training (MIRT), $N_2 = 15$
- **Group III:** High Intensity Resistance Training (HIRT), $N_3 = 15$
- **Group IV:** Control Group (CG), $N_4 = 15$

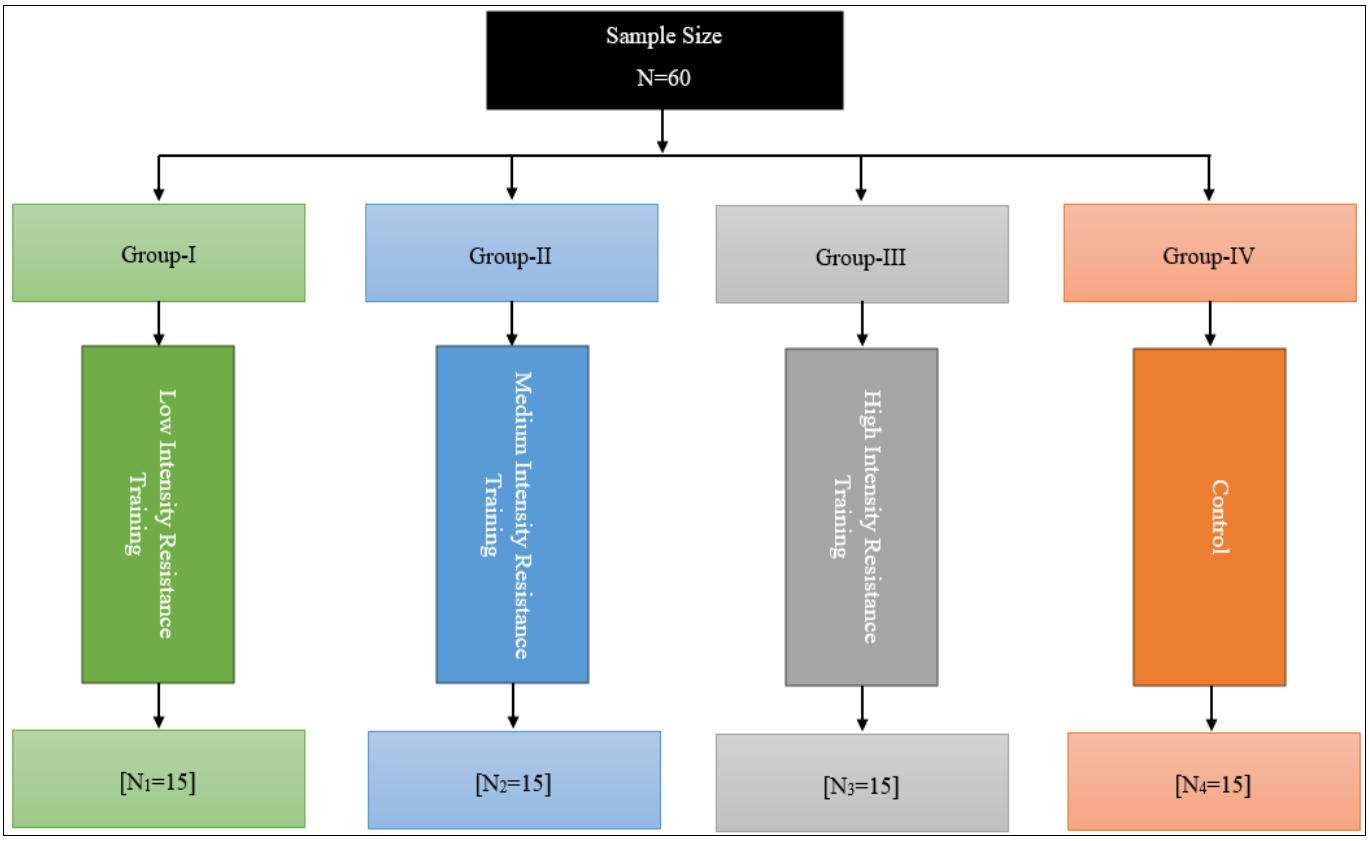

Fig 1: Distribution of Subjects (N=60)

Selection of variables

Dependent variables

- Explosive strength
- Explosive power

Independent variables

- 12-Weeks Low Intensity Resistance Training (LIRT)
- 12-Weeks Medium Intensity Resistance Training (MIRT)
- 12-Weeks High Intensity Resistance Training (HIRT)

Experimental design

The study was conducted on Sixty (N=60), subjects. The selected subjects were divided into four groups, Experimental Group-I, Experimental Group-II, Experimental Group-III and Control Group-IV consisting of 15 football players in each group. Subjects in Group-I were football players who were indulged in Low Intensity Resistance Training. Group-II were football players who were indulged in Medium Intensity Resistance Training, Group-III were football players who were indulged in High Intensity Resistance Training. However, Group-IV were football players who were acted as control one. The control group was not given any distinct treatment. Fitness variables (*viz*., Explosive Strength and Explosive Power) were measured twice (pre & post). Group-I, Group-II and Group-III were subjected to a Low Intensity Resistance Training, Medium Intensity Resistance Training and High Intensity Resistance Training respectively for 12-weeks.

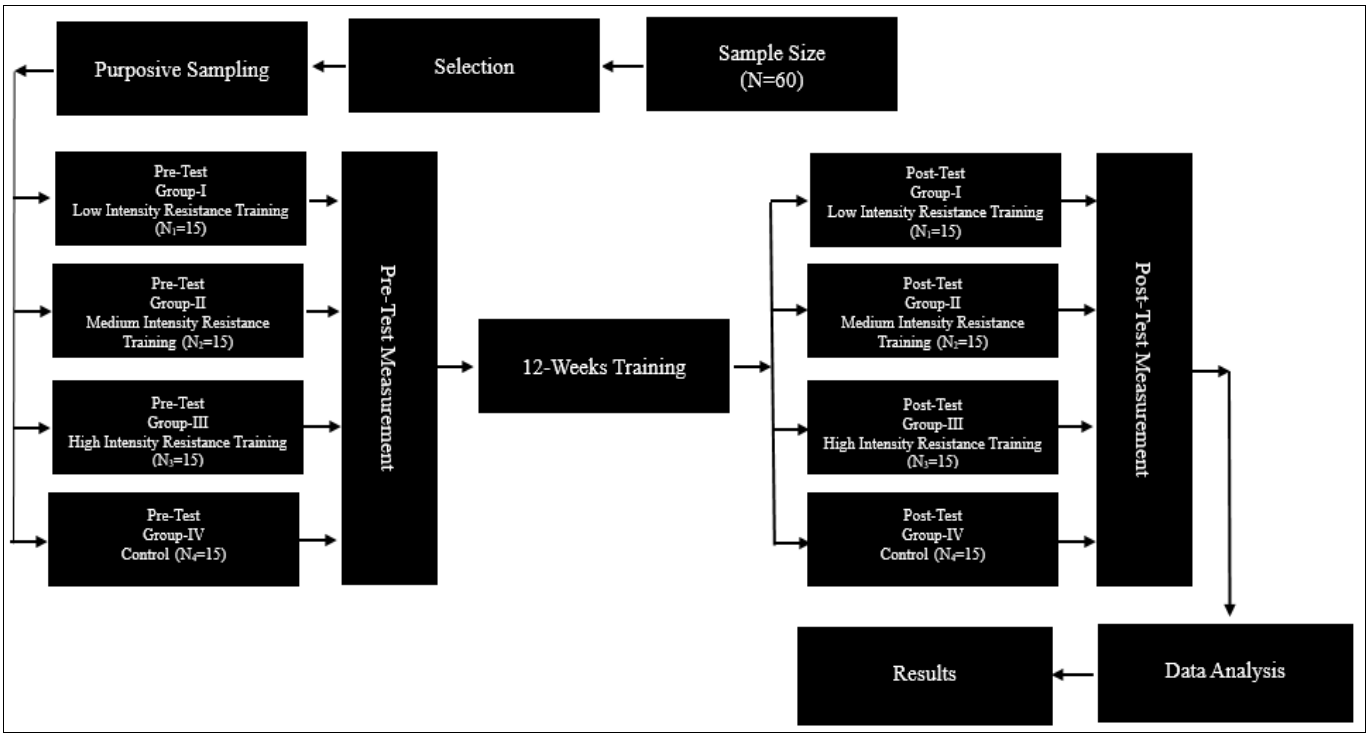

Fig 2: Study flow chart

Test administration

Explosive Strength

- Vertical Jump Test: Participants marked their reach and jump heights on a wall using chalk. The highest difference in three trials was recorded as the score.

Explosive Power

- Broad Jump Test: Participants jumped forward from a standing position, with the best attempt out of three used as the score.

Statistical Techniques

ANCOVA was used to assess the significance of group differences, with Scheffe's post hoc test identifying specific group differences. Statistical analyses were conducted using SPSS version 27, with a significance level set at 0.05.

Results

Table 1: Computation of 't' ratio on explosive strength of Low Intensity Resistance Training Group (LIRT), Medium Intensity Resistance Training Group (MIRT), High Intensity Resistance Training Group (HIRT) and Control Group (CG) (Scores in centimeters)

Groups	Pre - test mean	Pre - test S.D (±)	Post - test mean	Post - test S.D (±)	't' ratio
Low intensity resistance training group (LIRT)	34.59	0.87	38.36	0.46	15.99*
Medium intensity resistance training group (MIRT)	34.62	0.85	38.44	0.42	14.98*
High intensity resistance training group (HIRT)	34.64	0.79	38.60	0.32	18.31*
Control group (CG)	34.58	0.81	34.40	0.80	0.55

Table-1 shows that the 't' ratio's on explosive strength of LIRT, MIRT, HIRT were 15.99, 14.98 and 18.36 respectively. Since these values were higher than the required table value of 2.145, it was found to be statistically significant at 0.05 level of confidence for degrees of freedom1and 14. Further the obtained 't' ratio between pre and posttest of control group 0.55 was lesser than the required table value of 2.145, found to be not statistically significant. From the results it was inferred that all three LIRT, MIRT and HIRT produced a significant improvement in explosive strength of soccer players.

Table 2: Analysis of covariance on pre, post and adjusted posttest means on explosive strength of Low Intensity Resistance Training Group (LIRT), Medium Intensity Resistance Training Group (MIRT), High Intensity Resistance Training (HIRT) and Control Group (CG) (Scores in centimeters)

Test	Low intensity resistance training group (LIRT)	Medium intensity resistance training group (MIRT)	High intensity resistance training group (HIRT)	Control Group (CG)	Source of variance	df	Sum of Square	Mean Square	F-ratio
Pre-test mean	34.59	34.62	34.64	34.58	B / S	3	0.051	0.017	0.02
					W / S	56	38.93	0.69	
Post-test mean	38.36	38.44	38.60	34.40	B / S	3	186.93	62.31	37.13*
					W / S	56	16.70	0.28	
Adjusted post-test mean	38.36	38.44	38.60	34.39	B / S	3	186.91	62.30	93.57*
					W / S	55	16.04	0.29	

Table-2 reveals the computation of 'F' ratios on pretest, posttest and adjusted posttest means of LIRT, MIRT, HIRT and CG on explosive strength. The obtained 'F' ratio for the

pretest means of LIRT, MIRT, HIRT and CG on explosive strength was 0.02. Since, the 'F' value was less than the required table value of 2.76 for the degrees of freedom 3 and 56, it was found to be not significant at 0.05 level of confidence. Further, the 'F' ratio for posttest means of LIRT, MIRT, HIRT and CG on explosive strength was 37.13. Since, the 'F' value was higher than the required table value of 2.76 for the degrees of freedom 3 and 56, it was found to be statistically significant at 0.05 level of confidence. The obtained 'F' ratio for the adjusted posttest means of LIRT, MIRT, HIRT and CG on explosive strength was 93.57. Since the 'F' value was higher than the required table value of 2.76 for the degrees of freedom 3 and 55, it was found to be statistically significant at 0.05 level of confidence. From the results it was inferred that there was significant difference in improvement of speed among LIRT, MIRT, HIRT.

Table 3: Scheffe's post hoc test for the differences between the paired adjusted post-test means of explosive strength

Low Intensity Resistance Training Group (LIRT)	Medium Intensity Resistance Training Group (MIRT)	High Intensity Resistance Training Group (HIRT)	Control group (CG)	Mean difference	Confidence interval
38.36	38.44			0.08	0.48
38.36		38.60		0.24	
38.36			34.39	3.97*	
	38.44	38.60		0.16	
	38.44		34.39	4.05*	
		38.60	34.39	4.21*	

Table-3 reveals the mean differences between the paired adjusted posttest means of all groups. The mean difference between LIRT and CG, MIRT and CG, HIRT and CG were 3.97, 4.05 and 4.21 respectively. The values of mean difference were higher than the confidential interval value of 0.48, it was found to be statistically significant at 0.05 level of confidence. Further, the mean difference between LIRT and MIRT, LIRT and HIRT, MIRT and HIRT was 0.08, 0.24 and 0.16 respectively. The value of mean difference was less than the confidential interval value of 0.48, it is found to be statistically not significant at 0.05 level of confidence. From these results it was inferred that HIRT produced better improvement on explosive strength of soccer players than the other training groups of LIRT, MIRT and CG. Mean values of pre, post and adjusted posttest of LIRT, MIRT, HIRT and control group on explosive strength was presented in Figure-3.

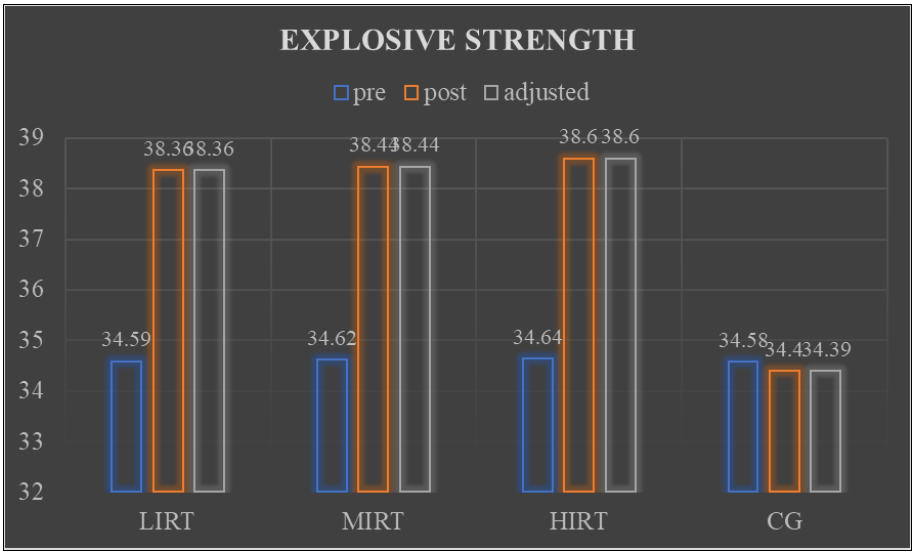

Fig 3: Bar diagram showing pre, post and adjusted posttest means of low intensity resistance training group, medium intensity resistance training group, high intensity resistance training group and control group on explosive strength (Scores in centimeters)

Table 4: Computation of 't' ratio on explosive power of Low Intensity Resistance Training Group (LIRT), Medium Intensity Resistance Training Group (MIRT), High Intensity Resistance Training Group (HIRT) and Control Group (CG) (Scores in meters)

Groups	Pre - test mean	Pre - test S. D (±)	Post - test mean	Post - test S. D (±)	't' ratio
Low Intensity Resistance Training Group (LIRT)	1.17	0.06	1.26	0.09	4.82*
Medium Intensity Resistance Training Group (MIRT)	1.18	0.06	1.38	0.14	6.89*
High Intensity Resistance Training Group (HIRT)	1.19	0.04	1.50	0.13	8.88*
Control Group (CG)	1.18	0.08	1.16	0.06	0.65

Table-4 shows that the 't' ratio's on explosive power of LIRT, MIRT, HIRT were 4.82, 6.89 and 8.88 respectively. Since, these values were higher than the required table value of 2.145, it was found to be statistically significant at 0.05 level of confidence for degrees of freedom1and 14. Further the obtained 't' ratio between pre and posttest of control group 0.65 was lesser than the required table value of 2.145, found to be not statistically significant. From the results it was

inferred that, all the three LIRT, MIRT and HIRT produced a significant improvement in explosive power of soccer players.

Table 5: Analysis of covariance on pre, post and adjusted posttest means on explosive power of Low Intensity Resistance Training Group (LIRT), Medium Intensity Resistance Training Group (MIRT), High Intensity Resistance Training (HIRT) and Control Group (CG) (Scores in seconds)

Test	Low Intensity Resistance Training Group (LIRT)	Medium Intensity Resistance Training Group (MIRT)	High Intensity Resistance Training Group (HIRT)	Control Group (CG)	Source of variance	df	Sum of square	Mean square	F-ratio
Pre-test mean	1.17	1.18	1.19	1.18	B / S	3	0.04	0.01	0.31
					W / S	56	0.23	0.04	
Post-test mean	1.26	1.38	1.50	1.16	B / S	3	0.99	0.33	25.97*
					W / S	56	0.71	0.13	
Adjusted post-test mean	1.27	1.38	1.49	1.17	B / S	3	0.90	0.30	28.12*
					W / S	55	0.59	0.01	

Table-5 reveals the computation of 'F' ratios on pretest, posttest and adjusted post test means of LIRT, MIRT, HIRT and CG on explosive power. The obtained 'F' ratio for the pre test means of LIRT, MIRT, HIRT and CG on explosive power was 0.31. Since, the 'F' value was less than the required table value of 2.76 for the degrees of freedom 3 and 56, it was found to be not significant at 0.05 level of confidence. Further, the 'F' ratio for post test means of LIRT, MIRT, HIRT and CG on explosive power was 25.97. Since, the 'F' value was higher than the required table value of 2.76 for the degrees of freedom 3 and 56, it was found to be statistically significant at 0.05 level of confidence. The obtained 'F' ratio for the adjusted post test means of LIRT, MIRT, HIRT and CG on explosive power was 28.12. Since the 'F' value was higher than the required table value of 2.76 for the degrees of freedom 3 and 55, it was found to be statistically significant at 0.05 level of confidence. From the results it was inferred that there was significant difference in improvement of explosive power among LIRT, MIRT, HIRT.

Table 6: Scheffe's post hoc test for the differences between the paired adjusted post-test means of explosive power

Low Intensity Resistance Training Group (LIRT)	Medium Intensity Resistance Training Group (MIRT)	High Intensity Resistance Training Group (HIRT)	Control Group (CG)	Mean difference	Confidence interval
1.27	1.38			0.11*	0.09
1.27		1.49		0.22*	
1.27			1.17	0.10*	
	1.38	1.49		0.11*	
	1.38		1.17	0.21*	
		1.49	1.17	0.32*	

Table-6 reveals the mean differences between the paired adjusted post test means of all groups. The mean difference between LIRT and MIRT, LIRT and HIRT, LIRT and CG, MIRT and HIRT, MIRT and CG, HIRT and CG were 0.11, 0.22, 0.10, 0.11, 0.21 and 0.32 respectively. The values of mean difference were higher than the confidential interval value of 0.09, it was found to be statistically significant at 0.05 level of confidence. From these results it was inferred that HIRT produced better improvement on explosive strength of soccer players than the other training groups of LIRT, MIRT and CG. Mean values of pre, post and adjusted post test of LIRT, MIRT, HIRT and control group on explosive strength was presented in Figure-4.

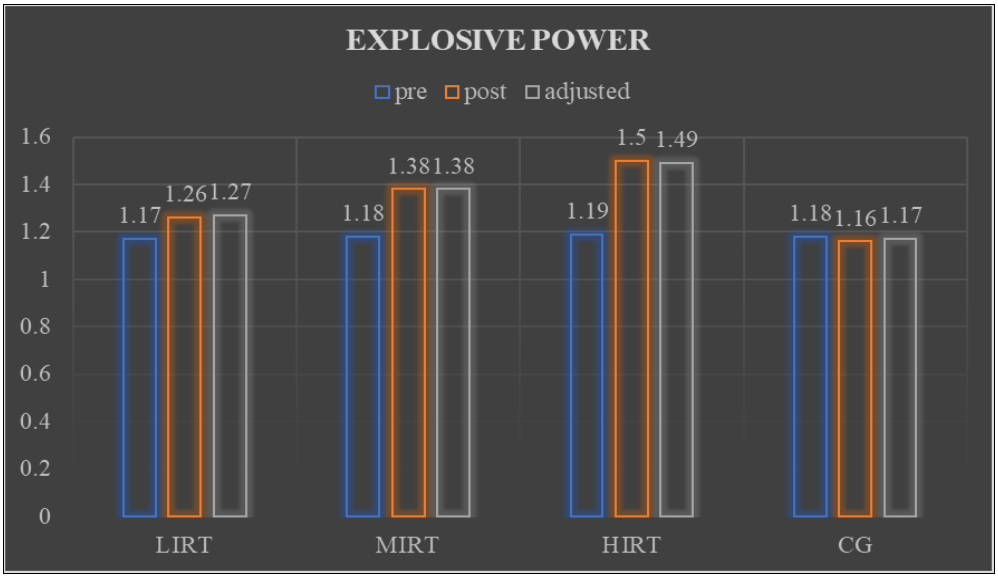

Fig 4: Bar diagram showing pre, post and adjusted post test means of low intensity resistance training group, medium intensity resistance training group, high intensity resistance training group and control group on explosive power (Score sin meters)

Conclusion

This study confirms that high-intensity resistance training significantly enhances explosive strength and power in soccer players, outperforming both low and medium intensity protocols. The findings support the use of high-intensity training to maximize explosive capabilities essential in competitive sports, particularly for athletes focused on power-oriented tasks.

References

1. Payne VG, Morrow JR, Johnson L, Dalton SN. Resistance training in children and youth: A meta-analysis. Res Q Exerc Sport. 1997;68:80-88.
2. Griffiths B, Grant J, Langdown L, Gentil P, Fisher J, Steele J *et al*. The effect of in-season traditional and explosive resistance training programs on strength, jump height, and speed in recreational soccer players. Res Q Exerc Sport. 2019;90(1):95-102.
3. Christou M, Smilios I, Sotiropoulos K, Volaklis K, Pilianidis T, Tokmakidis SP *et al*. Effects of resistance training on the physical capacities of adolescent soccer players. J Strength Cond Res. 2006;20(4):783-791.
4. Diallo O, Dore E, Duche P, Van Praagh E. Effects of plyometric training followed by a reduced training programme on physical performance in prepubescent soccer players. J Sports Med Phys Fitness. 2001;41(3):342-348.
5. Lesinski M, Prieske O, Granacher U. Effects and dose-response relationships of resistance training on physical performance in youth athletes: a systematic review and meta-analysis. Br J Sports Med. 2016;50(13):781-795.
6. Kumar BA, Singh A, Sandhu J. Effect of combined resistance and plyometric training program on explosive strength in Indian taekwondo players. Saudi J Sports Med. 2017;17(3):158-161.
7. Parry MS, Bashir S, Hayyat FS. Effect of 12 weeks of plyometric and resistance training on agility, speed and explosive power in kabaddi players. J Multidiscip Subj. 2019;13(1):1590-1593.
8. Cadore EL, Pinto RS, Oliveira AR, Izquierdo M. Explosive type of contractions should not be avoided during resistance training in elderly. Exp Gerontol. 2018;102:81-83.
9. Cadore EL, Izquierdo M, Alberton CL, Pinto RS, Conceicao M, Cunha G, *et al*. Strength prior to endurance intersession exercise sequence optimizes neuromuscular and cardiovascular gains in elderly men. Exp Gerontol. 2012;47:164-169.
10. Reddy R, Reddy CBM, Sivananda K. Scientific analysis on the effects of combination of intensity training with progressive resistance training, progressive resistance training and intensity training on explosive power (vertical). J Xi'an Univ Archit Technol. 2019;11(1):120-123.
11. Maffiuletti NA, Aagaard P, Blazevich AJ, Folland J, Tillin N, Duchateau J *et al*. Rate of force development: physiological and methodological considerations. Eur J Appl Physiol. 2016;116:1091-1116.
12. Carter J, Greenwood M. Complex training reexamined: Review and recommendations to improve strength and power. Strength Cond J. 2014;36(2):11-19.
13. Hammami M, Gaamouri N, Shephard RJ, Chelly MS. Effects of contrast strength vs. plyometric training on lower-limb explosive performance, ability to change direction and neuromuscular adaptation in soccer players. J Strength Cond Res. 2019;33(8):2094-2103.
14. Lloyd RS, Radnor JM, Croix MBDS, Cronin JB, Oliver JL. Changes in sprint and jump performances after traditional, plyometric, and combined resistance training in male youth pre-and post-peak height velocity. J Strength Cond Res. 2016;30(5):1239-1247.