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Keywords: Resistance Training, Resistance Band, Dumbbells, 30-meter Flying Speed,60-Meter Speed.

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Contents

Introduction

Resistance training is a term defined as a specialized technique of physical training that involves advanced utilization with a wide array of resistive loads, various movement velocities, and a range of resistance training modalities composed of free weights (dumbbells and barbells), weight machines, medicine balls, elastic bands, and plyometric (Faigenbaum et al., 2009). The resistance training term must be differentiated from the weightlifting and power lifting, in which athletes, from time to time, train with the help of heavy loads and try to lift the maximum weight in competitions (Faigenbaum & Myer, 2010). The term "Progressive overload" is used to describe the increasing stress applied to the muscles with the help of resistive exercise. Resistance training may be altered by changing loads, repetitions, intensity, or type to improve sport performance and strength, both are important parts of athletic development (Picha et al., 2019).

As the studies continued, the techniques were finally implemented on the athletes to enhance more sports abilities. In the 1950s and 1960s, men's track and field was the first sport that incorporate strength and conditioning. Afterward, football started to use strength training in its annual rotation (Silvester, 1992). Sprinting is a fundamental capability that triggers performance in various sports; there is a capacious body of scientific literature ardent to sprint training. The enormous majority reported positive effects sprint sprint-related training interventions on sprinting abilities, which assumes that with a variety of training methodologies, sprinting performance can be easily improved (Rumpf et al., 2016).

Observation of elite athletes over time suggested that the majority of annual performance differences fall within the range of typical variation, the smallest worthwhile change, and are influenced by external factors (wind, temperature, altitude, timing methods) (Solberg et al., 2019). This disparity between published research and observed practice can be explained by publication bias, which favours positive findings, and training status partiality, where most experimental statistical data comes from studies on untrained or moderately proficient athletes (Petrakos et al., 2016). Many of the studies have evaluated the effects of resistance-based intervention on sprinting performance in team sports players. Studies on the sport of American football have examined a variety of training techniques throughout the course of a season, but the results of these investigations are uneven (Hoffman et al., 2009). Plenty of systematic review articles have intended to refine the effects of diverse modalities of training on sprint performance (Hrysomallis, 2012). These systematic reviews focus precisely upon the prevalence and effects of numerous resistance training modalities on sprinters' performance (Bolger et al., 2015). A sturdy association between one repetition maximum squat performance and 10-meter sprint race time was found (Wisløff et al., 2004), although in comparison, an insignificant and weak correlation among Smith machine squats and 10 to 40 meter sprint times in athletes was established by (Harris et al., 2008). These studies have utilized professional athletes, who have the tendency to create high strength and speed performance (Comfort et al., 2012). In most of the sports, speed performance is given much importance, with elite football players consuming almost 11 percent of the game sprinting, which is equal to a 10 to 15M sprint every 90 seconds (Meir et al., 2001), having the same outcomes found in rugby league (Cunniffe et al., 2009). The part of maximal strength in sprint speed in international football players showed a high level of connection among 1RM squat and 10M sprint time, and 30M sprint time. A study performed among elite athletes showed no improvement in the 20 & 30-meter flying from baseline for the free weight strength training with a mean ± SD of 1.24 ± 0.06 to a mean ± SD of 0.2 ± 2.5 at the end of week 8. A further study performed by reported a very small improvement in the 30-meter sprint among recreationally active women, with a mean ± SD of 5.75 ± 0.36 from baseline to a mean ± SD of 5.67 ± 0.34 at the 6th week. This is the first time to conduct this kind of study has been conducted in Pakistan. No study has been performed among the track & field athletes to observe performance. This area needs to be explored so that the athletes can benefit from the findings. The aim of this study was to reveal the effectiveness of resistance training in perspective speed, explosive strength among male athletes.

Methodology

The study is a multi-centred, design of a parallel group prospective, open-label randomised control trial (RCT). The aim of the investigation was explained to the participants, and consent forms were obtained before enrolling in the study by the investigator. Trials were conducted at Peshawar Sports Complex and Abdul Wali Khan University, Mardan, Khyber Pakhtunkhwa, Pakistan. The Ethical and Research Committee of the University of Lahore approved the protocol of the study. For participants eligibility criteria include male athletes aged (17-26), training age from 1-7 years, competing in athletics at the club, provincial, and collegiate levels. Professional athletes, however, were not included in this study.

The procedure of the trial consists of two phases. The first phase was screening and recruiting of the athletes, and the 2nd phase was training interventions. After enrolment, the individuals were requested to manually select an envelope from a basket that indicated group assignment. Participants have been randomized on a 1:1:1 basis, i.e., in the Control group and two interventional groups. The control group participants continue their routine training, while the remaining two intervention groups, one received elastic resistance band training (ERBT). However, intervention group 2 received Conventional resistance training (such as Dumbbells). Both the intervention groups, one and two, were treated with training sessions using elastic resistance bands using Resistance Bands (Half Squats, Dead Lifts, Lunges, Lateral Lunges, Hip Thrust) and conventional resistance training using dumbbells twice a week for a period of 8 weeks.

The data was collected at baseline and at week 8th. Study schedule for data assortment for control and intervention groups.

Data Analysis

Data were statistically analysed using SPSS, Version 22.

For normality of the data, were Shapiro-Wilk test was used. Due to the fact, the data were not normally distributed, the Kruskal-Wallis test was performed on the data.

Sample Size Calculation

To calculate the sample size for this Randomised Control Trial, Cohan's formula for sample size was used. The total sample size was n=48, in each group, take 16 participants in each arm. Considering a 20% dropout in each group, we got 60 participants altogether, with 20 participants in each arm.

Performance Assessment Criteria

30 Meter Flying Test

To measure speed of athletes in 30 meter flying test, the researcher set up 1st cone at 0 m, 2nd cone at 30 meter and 3rd cone at a distance of 60 meter along a straight line, timing gates (used android app Photo Finish https://photofinish-app.com/en/team/., (+/- 0.01s accuracy) by Arthur Voig (UK) at 30m and 60m acordingly. The test involves a 30-meter acceleration zone for participants to attain their maximum speed, and then maximal speed over the last 30 meters. The researcher encouraged athletes to put maximum effort into crossing the finish line. Athletes were allowed three trials only, and the best time was recorded. Time measurement starts when the athlete's torso crosses the 30 m marker and stops at the point it crosses the 60 m marker.

Researchers use the Android app Photo Finish (+/- 0.01s accuracy) by Arthur Voigt (UK) for accurate timing. The acceleration zone can be adjusted according to the fitness level of the athletes, as slower athletes require 20 to 25 meters; best athletes use more than 30 meters for acceleration.

60 Meters Speed Test

The purpose of the 60-meter speed test is to determine the acceleration and speed of the participant. In this test, athletes run a maximum distance of over 60 meters. The participants start the race from a standing position with one foot in front of the other behind the starting line. The researcher encouraged the athlete to run from the starting line to the finish line with maximum effort. The researcher uses the Android app Photo Finish (in 60m) with +/- 0.01s accuracy developed by Arthur Voigt (UK). The app was used by connecting with other mobiles; one mobile was kept at the starting point (0 meters), and another mobile was put on the finish line at a 60-meter tripod. The app has the option to start from blocks, which give commands automatically and record the time at the finish line. Athletes will be allowed two trials, and the best trial will be recorded.

Results

The Shapiro-Wilk Test was used for the Normality of the Data. For the variables 30m Flying Speed test 0.000, 60m Speed test 0.047, the p-values were less than 0.05, meaning that these variables likely do not follow a normal distribution.

Table 1

Participants' Demographic Characteristics (n=60)

Variable	Total (N)		Control		Resistance band		Dumbells group		p-value
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	
Gender									
Male	60	100	20	100	20	100	20	100	Not computed [a]
Female	0	0	0	0	0	0	0	0	
Age in years									
18-20	24	40	9	45	9	45	6	30	
21-23	23	38	7	35	7	35	9	45	0.897 [b]
24-above	13	22	4	20	4	20	5	25	
Height in cm									
168.50-171.50	12	20	9	45	1	5	2	10	
171.51-174.50	10	16.6	2	10	5	25	3	15	0.223 [b]
174.51-177.50	19	31.6	3	15	7	35	8	40	
174.51-177.50	6	10	3	15	2	10	2	10	

Variable	Total (N)		Control		Resistance band		Dumbells group		p-value
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	
180.51 and above	13	22.6	3	15	5	25	5	25	
Weight in Kg									
60-65 kg	6	10	2	10	4	20	0	0	
66-70 kg	25	42	8	40	8	40	9	45	
71-75 kg	18	30	6	30	6	30	6	30	0.426 [b]
76-80 kg	8	13	3	15	1	5	4	20	
81 and above	3	5	1	5	1	5	1	5	
Training age in years									
1-3 years	17	28	5	25	6	30	6	30	
4-6 years	34	57	12	60	10	50	12	60	<0.001 * [b]
7-9 years	9	15	3	15	4	20	2	10	
above 9 years	0	0	0	0	0	0	0	0	
BMI									
Less than 18.5	0	0	0	0	0	0	0	0	
18.5-24.9	60	100	20	100	20	100	20	100	<0.001 * [b]
25-29.9	0	0	0	0	0	0	0	0	
30 and above	0	0	0	0	0	0	0	0	
Education									
Matric	2	3	2	10	0	0	0	0	
Intermediate	33	55	8	40	10	50	15	75	0.380 [b]
Bachelors	17	28	6	30	9	45	4	20	
Masters	8	13	4	20	1	5	1	5	

*a: Chi-square test; b: ANOVA; * p-value= <0.05 statistically significant*

A total of 60 participants were recruited, having 20 participants in each group, i.e., Control, Resistance Band, and Dumbbells. All 60 participants were male. The majority of the participants, n= 24 (40%), were aged 18-20 years. Similarly, most of the participants, n=13 (23%), were of height 180.51 and above n=25 (42%) of the participants were of weight 66=70 kg. About the training age of the participants, most of the participants, n=35 (57%) had a training age of 4-6 years. About the BMI, all the participants were of normal BMI, i.e.,18.5 – 24.9; however, most of the participants, n=33 (55%), had having intermediate level of education. A statistically significant difference existed between the training age of the participants (p-value <0.001) and BMI (p-value = < 0.001), as shown in Table 1 Above.

Table 2

Comparison of Pre & Post 30m Flying & 60m Speed Test

Comparison of Pre & Post 30m flying Test			
	Control Group Mean ± SD	Resistance Band Group Mean ± SD	Dumbbells Group Mean ± SD
Pre-30m flying test	3.6025 ± 0.16412	3.5980 ± 0.22867	3.6255 ± 0.2305
Post-30m flying test	3.5995 ± 0.16449	3.1765 ± 0.16725	3.2770 ± 0.80194
Wilcoxon test			
Z	-1.279[b]	-3.923[b]	-3.925[b]
P-Value	0.201	0	0

Comparison of Pre & Post of 60m Speed Test			
	Control Group Mean ± SD	**Resistance Band Group Mean ± SD**	**Dumbbells Group Mean ± SD**
Pre-60m Speed test	7.8065 ± 0.32845	7.8825 ± 0.55623	7.7715 ± 0.36458
Post-60 Mbps Speed test	7.8005 ± 0.32858	7.4985 ± 0.50135	7.6760 ± 0.36890
Wilcoxon test			
Z	-1.979[b]	-3.921[b]	-3.932[b]
P-Value	0.048	0	0

The descriptive data for the 30m flying test (30MFT) for the participants in the resistance band, dumbbell, and control groups are shown in the following table. The mean (30MFT) time for the control group was 3.6025 with a standard deviation of 0.16412 before the 8WRTP and 3.5995 with a standard deviation of 0.16449 following the 8WRTP.The mean (30MFT) time for the Resistance Band Group was 3.5980 with a standard deviation of 0.2286 prior to the 8WRTP and 3.1765 with a standard deviation of 0.16772 following the 8WRTP.The mean (30MFT) time for the Dumbbells Group was 3.6255 with a standard deviation of 0.2305, and the mean (30MFT) time for the 8WRTP was 3.2770 with a standard deviation of 0.2305. The Wilcoxon signed-rank test statistics for the 30m Flying Test (30MFT) in all three groups are also shown in this table, both before and after the 8 Weeks Resistance Training Program (8WRTP). With a Z score of -1.279 and a p-value of 0.201 for the control group, it can be concluded that there was no discernible difference between the 30MFT findings obtained before and after the 8WRTP. While the Z score is -3.923 and the p-value is 0.000 for the resistance band Group, demonstrating a significant difference between the 30MFT findings prior to and following the 8WRTP. Similar results for the Dumbbells Group show a significant difference between the 30MST scores before and after the 8WRTP, with a Z score of -3.925, with a p-value of 0.000. Consequently. Significant deviation between 30MST findings before and after the 8WRTP is also shown, indicating. Therefore, both the resistance band and dumbbell groups' 30MFT outcomes can be concluded to have been significantly impacted by the 8WRTP. This table presents the descriptive statistics for the 30m flying test (30MFT) for the participants of the resistance band group, dumbbells group, and control group.

The control group's mean (60MST) time before the 8WRTP was 7.8065 with a 0.32845 standard deviation, while the mean of (60MST) time after the 8WRTP was 3.8005 with a 0.32858 standard deviation. The mean (60MST) time for the Resistance Band Group was 7.8825, Standard deviation of 0.55623 before 8WRTP, and it was 7.4985 with a standard deviation of 0.50135 after 8WRTP. The mean (60MST) time for the Dumbbells Group was 7.7715 with a standard deviation of 0.36458 before 8WRTP and 7.6760 with a standard deviation of 0.36890 after the 8WRTP. This suggests that, on average, the resistance band group had a greater improvement in speed performance as compared to the dumbbells group.

The Wilcoxon signed-rank test statistics for the 30m Flying Test (30MFT) in all groups are provided as well in this table, both before and after the 8 Weeks Resistance Training Program (8WRTP). The Z score is -1.979, and the p-value is 0.048 for the control group, showing that there was not a significant difference between the 30MFT outcomes before and after the 8WRTP. While the Z score is -3.921 and the p-value is 0.000 for the resistance band group, demonstrating a significant difference between the 30MFT findings prior to and following the 8WRTP. Similar results for the dumbbells group show a significant difference between the 30MST scores before and after the 8WRTP, with a Z score of -3.932, having a p-value of 0.000, further demonstrating a notable difference between 30MST outcomes obtained before and after the 8WRTP. Therefore, it can be concluded that the 30MFT outcomes in both the resistance band and dumbbell groups were significantly impacted by the 8WRTP.

Table 3

Comparison Within the Group for 30m Flying & 60m Speed Test

Comparison within the Groups for the 30m flying and 60m speed test								
	Pre-Test				Post- Test			
	Mean ± SD	X^2	Df	P-value	Mean ± SD	X^2	df	P-value
30m Flying Test								
Control Group	3.6025 ± 0.1641				3.5980 ± 0.1641			
Resistance Band Group	3.5980 ± 0.2286	0.319	2	0.853	3.0135 ± 0.7284	30.989	2	<0.001
Dumbbells Group	3.6255 ± 0.2305				3.2770 ± 0.8019			
60m Speed Test								
Control Group	7.8006 ± 0.3284				7.8005 ± 0.3285			
Resistance Band Group	7.8825 ± 0.5562	0.096	2	0.953	7.4985 ± 0.50135	5.261	2	0.072
Dumbbells Group	7.7715 ± 0.36458				7.6760 ± 0.36890			

In the 30m flying pre-test, Kruskal-Wallis' test was performed, and the results exhibited that there was no statistically significant difference in the 30m flying test between the groups (Control, Resistance band, and Dumbbells). $X^2 = 0.319$, df = 2, P 0.853, with a Mean ± SD was 3.6025 ± 0.1641 for the control group, 3.5980 ± 0.2286 for the resistance band, and 3.6255 ± 0.2305 for the Dumbbells group. For post 30m flying, Kruskal-Wallis' test was performed, and the results revealed a statistically significant difference in the 30m flying test between the control, resistance band, and dumbbells groups, $X^2 = 30.989$, df = 2, P <0.001. Mean rank score of 45.30 for the control group, 14.63 for the resistance band, and 31.58 for the Dumbbells group. Post hoc Tukey test was applied to find the difference among the groups. The results confirmed that there was a statistically significant improvement in

Resistance band versus Control group	P = < 0.001
Dumbbells versus control group	P = 0.006
Resistance band versus Dumbbells group	p = 0.039

In the 60m speed Pre-test, Kruskal-Wallis' test was performed, and the results revealed that there was no statistically significant difference in 60m speed test between the groups (Control, Resistance band, and Dumbbells). $X^2 = 0.096$, df = 2, P= 0.953, with a Mean and SD was 7.8006 ± 0.3284 for the control group, 7.8825 ± 0.5562 for the resistance band, and 7.7715 ± 0.36458 for the dumbbells group.

For a 60m Post-test, Kruskal-Wallis' test was performed, and the results showed that there was no statistically significant difference in the 30-meter flying test between the groups (Control, Resistance band, and Dumbbells). $X^2 = 5.261$, df = 2, P= 0.072, with a Mean and SD was 7.8005 ± 0.32858 for the control group, 7.4985 ± 0.50135 for the resistance band, and 7.6760 ± 0.36890for the dumbbells group.

Discussion

This is the first study of its kind to be performed on track & field athletes to observe an improvement in the 30-meter flying and 60-meter speed test in Pakistan. As running mechanics and body mass variations are more challenging to manage, it becomes more difficult to relate the performance outcome measurements from the research to the sprint performance of competitors. Because an athlete's ability to generate force when sprinting depends on their strength-to-weight ratio, this is partially attributable to a general disparity in emphasis on body composition. The total output of speed will be aided by a higher body mass to strength ratio (Jacobson et al., 2013). Results of the present study reveal that in the resistance band group at the baseline for the 30-meter flying, improved from baseline (mean ± SD) 3.5980 ± 0.2286 to (mean ± SD) 3.0135 ± 0.7284 at week 8^{th}. The present study findings reveal a statistically significant difference in the 60-meter speed test in the resistance band group. The results of the current study for both 30-meter flying and 60-meter speed test athletes are aligned with findings of another study on resistance training-enhanced speed performance.

For the 30-meter flying speed test of the athletes, findings showed that in the dumbbells group (mean ± SD) at baseline was 3.63 ± 0.23 and after of week eight, (mean ± SD) was 3.23 ± 0.80, there was an improvement in 30-meter flying speed, but it was not statistically significant. However, a study performed among elite athletes showed no improvement in the 20 and 30 meter flying speed test from baseline for the free weight strength training at the end of week 8th. A further study performed by reported a very small improvement in the 30-meter sprint among recreationally active women at the 6th week. The finding in the present study for 60-meter training with dumbbells was (mean ± SD) 7.77 ± 0.34 after eight weeks, improved to 7.68 ± 0.37, which shows a statistically significant difference from baseline to the 8th week.

Different neural adaptations, as well as transformations in muscle size and architecture, could all help to improve sprinting performance after resistance training. The study results of the above researchers for 30-meter sprint timing with mean ± SD were 4.56 ± 0.13 after week 8th, and were 4.30 ± 0.05. The above results showed significant improvement in sprinting (Aloui et al., 2019). According to the findings, elastic resistance band training might produce a similar amount of training loads as the resistance or plyometric training, as well as equivalent neural changes. The elastic resistance band training involves powerful eccentric contraction before each concentric contraction, with respective favourable adaptations in mechanical function. (Markovic & Mikulic, 2010). A study conducted by exploring the 8 weeks of resistance exercises (Machines and free weights) has no serious impact on the speed of kabaddi players. McBride et al. (2009) found that 1 RM/Body Mass is more importantly related to sprint in male athletes. However relation between sprint timing and strength was not as high as previously investigated by earlier researchers. Outcomes of the current study also harmonized with the research of (McBride et al., 2009) and (Hunter et al., 2005). Additionally, it is hypothesized that the elasticity of the resistance band generated a significant increase in the power production of the knee extensor and flexor, which was effectively transferred to running at maximum speed. Future research should aim to long term effects of resistance training on sprint performance, muscle activation.

Conclusion

Overall, remarkable improvement has been observed in both the experimental groups, the Resistance Band group (RBG) and the Dumbbells Group (DG). Dumbbells produce resistance due to gravity (downward). The athlete will need to position himself accurately to work the desired muscles. While resistance bands rely on the tension of the bands. By stretching the bands, force is created in the direction of stretching. Resistance bands produce resistance in horizontal and vertical planes and in any direction and any angle. It is therefore concluded that resistance bands can be used as an alternative to dumbbells (free weight) if a fitness club/centre is not available or while travelling, or in a pandemic situation. Resistance bands are easy to carry and have a low cost compared to Dumbbells. Athletes and coaches should consider resistance bands as an alternative training modality for improvement in speed performance.

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