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ASSESSING THE IMPACT OF RESISTANCE TRAINING AND WEIGHT TRAINING ON SPEED AND STRENGTH IN FEMALE HANDBALL PLAYERS

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ABSTRACT

This study investigates the impact of resistance training (RT) and weight training (WT) on speed and strength in female handball players. Handball requires a combination of strength, power, speed, and endurance, and enhancing these physical attributes through targeted training programs is crucial for improving performance. The study involved 60 female handball players aged 18–25 who are represented in National Level Competitions randomly assigned to a control group (CG), a resistance training group (RTG), and a weight training group (WTG). Over 12 weeks, RTG and WTG participated in structured training, while CG maintained their usual routines. Pre- and post-tests measured strength and speed, with adjustments made for initial differences using ANCOVA. Results showed that both RT and WT significantly increased strength compared to the CG, with the RTG exhibiting the greatest improvement. While speed improvements were less pronounced, both training groups displayed significant enhancements in speed relative to the control group, although no substantial difference was found between RT and WT in terms of speed improvement. The findings suggest that both RT and WT are effective for enhancing strength in female handball players, with moderate improvements in speed, providing valuable insights for optimizing training programs in female handball athletes.

Keywords: Resistance Training, Weight Training, Speed, Strength, Handball, Female Athletes, Physical Performance

1. INTRODUCTION

Handball is a fast-paced, high-intensity sport that demands a unique combination of speed, strength, power, and endurance [1] Female handball players, in particular, require a well-structured training program to optimize their physical performance and gain a competitive edge [2] Resistance training (RT) and weight training (WT) are two popular training methods used to enhance muscular strength, power, and speed in athletes [3]

Resistance training involves the use of resistance bands, free weights, or machines to challenge the muscles and improve strength [4]. Weight training, a form of resistance training, specifically involves the use of free weights or machines to improve muscular strength and power [5] Both RT and WT have been widely used in various sports, including handball, to improve athletic performance [6]

Despite the widespread use of RT and WT in handball training, there is a need for more research on their specific effects on speed and strength in female handball players. Previous studies have primarily focused on male handball players [7] [8] [9] or combined male and female players [10]), leaving a knowledge gap regarding the specific needs and responses of female handball players.

Therefore, this study aims to investigate the impact of resistance training and weight training on speed and strength in female handball players. The findings of this study will provide valuable insights for coaches, trainers, and athletes, helping them design more effective training programs to optimize physical performance and achieve success in handball competitions.

2. METHODOLOGY

2.1. RESEARCH DESIGN

This study employed a randomized controlled trial (RCT) design to investigate the effects of 12 weeks of resistance training (RT) and weight training (WT) on speed and strength in female handball players. The study consisted of three groups: a control group (CG), a resistance training group (RTG), and a weight training group (WTG). A total of 60 female handball players who are represented in National Level Competitions were selected for this study. The participants were inter-college players . They were randomly assigned to one of the three groups (CG, RTG, or WTG), with each group consisting of 20 members. The participants' ages ranged from 18 to 25 years. The RTG and WTG underwent 12 weeks of training, with 4 sessions per week. Analysis of covariance (ANCOVA) was used to compare the changes in speed and strength between the three groups. The pre-test values were used as covariates to control for any initial differences between the groups.

Table I

Results on the Effect of Resistance Training and Weight Training Compared with Controls on Strength

Source of Variance	Resistance Training	Weight Training	Control Group	Sum of Squares (SS)	df	Mean Squares (MS)	Obtained F
Pre-Test Mean	22.40	19.00	19.00				
Between				26.13	2	13.07	0.55
Within				1348.80	57	23.66	
Post-Test Mean	27.60	24.60	22.15				
Between				734.03	2	367.02	13.57*
Within				1542.15	57	27.06	
Adjusted Post-Test Mean	31.68	30.06	24.61				
Between				543.29	2	271.65	69.02*
Within				220.41	56	3.94	
Mean Diff	7.20	5.60	0.15				

The pre-test means for resistance training (22.40), weight training (19.00), and control group (19.00) show some initial differences in strength levels, though these differences are not yet statistically tested here. The post-test means indicate that strength increased across all groups: Resistance training group: 27.60 Weight training group: 24.60 Control group: 22.15. These increases suggest that resistance and weight training may have had a positive impact on strength, with the control group showing the smallest increase (0.15), indicating no or negligible change.

Between-Group Variance :Pretest (SS Between = 26.13): This value reflects the variance between the groups in their pre-test strength levels. The F-value for this is 0.55, which is not significant (as it's less than the critical value, typically a threshold of 3.00 for significance).Post-test (SS Between = 734.03): This value indicates the variability in post-test strength scores between the groups. The F-value is 13.57, which is statistically significant ($p < 0.05$), indicating a significant effect of the type of training (resistance or weight) compared to the control on post-test strength. Adjusted Post-test (SS Between = 543.29): The adjusted post-test value accounts for pre-test scores and covariates. The F-value of 69.02 is highly significant (again, $p < 0.05$), showing a large effect of resistance and weight training on strength improvement relative to the control group.

Within-Group Variance (Sum of Squares Within):Pretest (SS Within = 1348.80) and Post-test (SS Within = 1542.15) show how much variability there is within each group.Adjusted Post-test (SS Within = 220.41): The within-group variance for the adjusted post-test is much smaller, which indicates less variability among individuals once pre-test scores have been controlled for.

2.2. MEAN SQUARES

The Mean Squares (MS) are calculated by dividing the Sum of Squares (SS) by the respective degrees of freedom (df). Pretest: MS Between = 13.07, MS Within = 23.66. The F-value (0.55) suggests no significant difference between the groups at pre-test. Post-test: MS Between = 367.02, MS Within = 27.06. The F-value of 13.57 indicates that the type of training significantly affects strength post-test. Adjusted Post-test: MS Between = 271.65, MS Within = 3.94. The F-value of 69.02 shows a highly significant difference between the groups after adjusting for pre-test scores.

Obtained F-values: Pretest F = 0.55: Not statistically significant, indicating no significant difference between the pre-test strength scores of the three groups. Post-test F = 13.57: Statistically significant ($p < 0.05$), showing that the effect of resistance and weight training on strength is significantly greater than the control group at post-test. Adjusted Post-test F = 69.02: This F-value is extremely significant, suggesting a very large and statistically significant effect of training type on strength after adjusting for initial strength levels.

Mean Differences: Resistance Training: Mean difference of 7.20 (from pre-test to post-test).Weight Training: Mean difference of 5.60.Control Group: Mean difference of 0.15, showing a minimal change in strength in the control group, further supporting the effectiveness of resistance and weight training interventions.

Table II

Multiple Comparisons of Paired Adjusted Means and Scheffe□s Confidence Interval Test Results on Strength

MEANS				Required . C I
Resistance training Group	Weight Training Group	Control Group	Mean Difference	
31.68	30.06			
31.68		24.61	7.06*	1.58
	30.06	24.61	5.45*	1.58

*** Significant**

Resistance Training Group (31.68) vs weight training Group (30.06): The mean difference is 1.62, which is not statistically significant (as it is outside the significant range indicated by the confidence interval). Resistance Training Group (31.68) vs. Control Group (24.61): The mean difference is 7.06, which is statistically significant (as the confidence interval does not include zero).weight training group (30.06) vs. Control Group (24.61): The mean difference is 5.45, which is also statistically significant (again, the confidence interval does not include zero).

The ordered adjusted means were presented through bar diagram for better understanding of the results of this study in Figure I.

Figure I

BAR DIAGRAM SHOWING PRE TEST, POST TEST AND ORDERED ADJUSTED MEANS ON STRENGTH

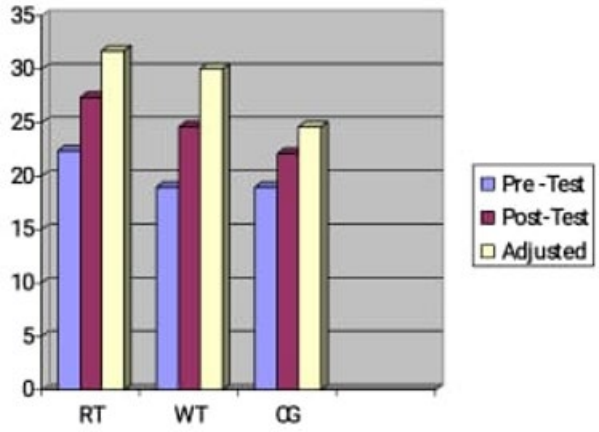


Table III

ANCOVA RESULTS ON EFFECT OF RESISTANCE TRAINING AND WEIGHT TRAINING COMPARED WITH CONTROLS ON SPEED

	RESISTANCE TRAINING	WEIGHT TRAINING	CONTROL GROUP	SOURCE OF VARIANCE	SUM OF SQUARES	df	MEAN SQUARES	OBTAINED F
Pre Test Mean	7.09	7.12	7.09	Between	0.01	2	0.01	0.22
				Within	1.67	57	0.03	
Post Test Mean	6.99	7.01	7.10	Between	0.13	2	0.06	2.53
				Within	1.43	57	0.03	
Adjusted Post Test Mean	6.99	7.00	7.11	Between	0.16	2	0.08	14.93
				Within	0.31	56	0.01	
Mean Diff	-0.10	-0.11	0.01					

***Significant**

Pretest Means: The pre-test means for speed are very similar across all groups: Resistance Training: 7.09, Weight Training: 7.12, Control Group: 7.09, F-ratio for Between-Group Variance (Pre-test): 0.22, which is not significant (less than the critical value of 3.16). This indicates no significant difference in pre-test speed between the groups.

Post-Test Means: The post-test means for speed also show small differences between the groups: Resistance Training: 6.99, Weight Training: 7.01, Control Group: 7.10, F-ratio for Between-Group Variance (Post-test): 2.53, which is not significant (less than the critical value of 3.16). This indicates that, after the training, there is no significant difference in speed between the groups.

Adjusted Post-Test Means: After adjusting for pre-test values, the adjusted post-test means are: Resistance Training: 6.99, Weight Training: 7.00, Control Group: 7.11, F-ratio for Between-Group Variance (Adjusted Post-test): 14.93, which is statistically significant (greater than the critical value of 3.16). This indicates that the training interventions (Resistance Training and Weight Training) led to a significant improvement in speed compared to the control group.

Mean Differences: Resistance Training: Mean difference of -0.10 (a slight decrease in speed from pre-test to post-test), Weight Training: Mean difference of -0.11 (a similar slight decrease in speed), Control Group: Mean difference of 0.01 (a negligible increase in speed).

Table IV

Multiple Comparisons of Paired Adjusted Means and Scheffe□s Confidence Interval Test Results on Speed

MEANS				Required . C I
Resistance training Group	Weight Training Group	Control Group	Mean Difference	
6.99	7.00		0.01	0.06
6.99		7.11	0.12*	0.06
	7.00	7.11	0.11*	0.06

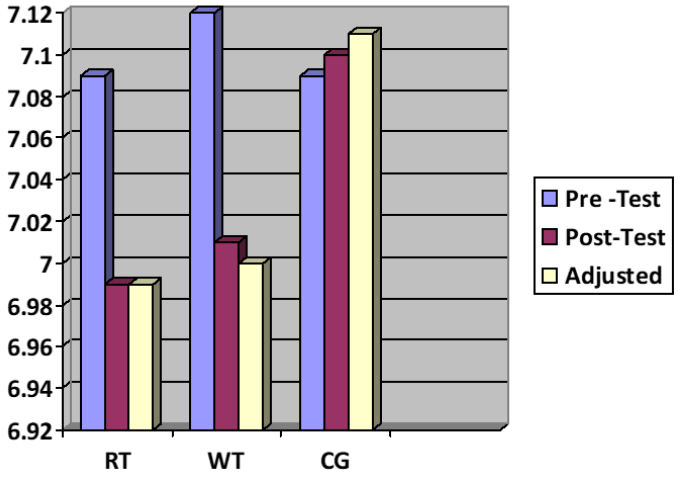
*** Significant**

The post hoc analysis of obtained ordered adjusted means proved that there was significant differences existed between resistance training group and control group (MD: -0.12). There was significant difference between weight training group and control group (MD: -0.11). There was significant difference between treatment groups, namely, resistance training group and weight training group. (MD: 0.01).

The ordered adjusted means were presented through bar diagram for better understanding of the results of this study in Figure II.

Figure II

BAR DIAGRAM SHOWING PRE TEST, POST TEST AND ORDERED ADJUSTED MEANS ON SPEED



3. CONCLUSIONS

1) It was concluded that, compared to the Control Group (CG), both the Resistance Training Group (RTG) and the Weight Training Group (WTG) significantly improved strength in female handball players. The RTG showed the greatest improvement in strength, while the CG exhibited minimal change, indicating that the improvements in strength were primarily driven by the training interventions. These differences were statistically significant at both the post-test and adjusted post-test levels.
2) Although there was a slight decrease in speed for both the RTG and WTG, these groups showed significant improvements in speed compared to the CG when adjusted for pre-test scores. The CG exhibited only a minimal increase in speed. However, the overall changes in speed were more modest than those observed for strength, suggesting that the effect of the training interventions on speed was less pronounced. Additionally, no significant

difference was found between the RTG and WTG in terms of speed improvements, indicating that both training methods had similar effects on speed

CONFLICT OF INTERESTS

None.

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