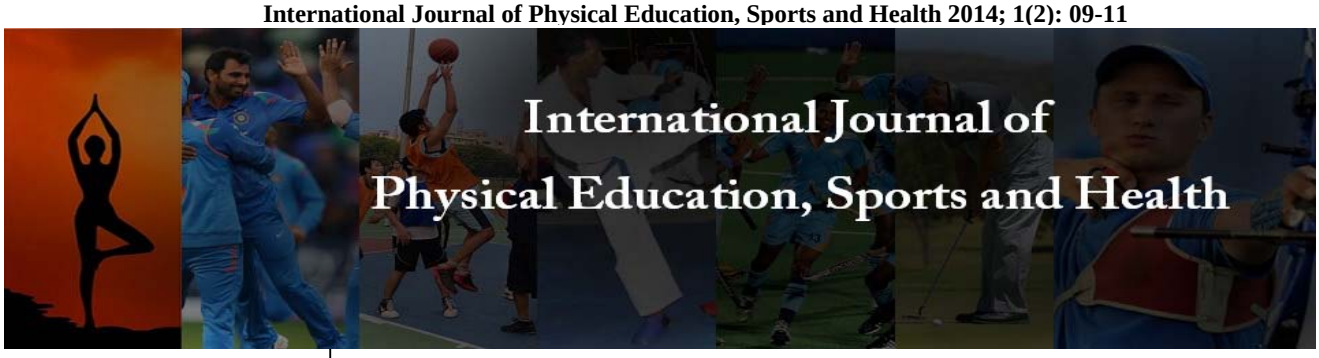

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Effect of Different Intensities of Resistance Training on Selected Strength Parameters among Men Handball Players

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Abstract
The purpose of the study was to find out the effect of different intensities of resistance training on selected strength parameters among men handball players. To achieve this purpose, 45 male students studying in the various departments of Annamalai University, Chidambaram, Tamil Nadu (India) were selected. They were divided into three equal groups and each group consisted of 15 subjects. Group-I performed high intensity resistance training, group-II performed moderate intensity resistance training and group-III acted as a control group. The training period for both the experimental groups was twelve weeks and a control group who did not participate any special training apart from the regular curricular activities. The criterion variables tested were muscle strength and strength endurance. The collected data from these three groups prior and after the training period was statistically examined for significant difference if any, by applying Analysis of Covariance (ANCOVA). Since three groups were involved, the Scheffe S test was used as a post - hoc test to find out any difference between the groups. The result of the study shows that there was significant improvement for both the training groups of different intensities men handball players on selected criterion variables.

Keywords: Resistance training, Strength Parameters, Muscular strength and Strength Endurance.

1. Introduction
Resistance training, also called weight training or strength training, is pitting muscles against a resistance such as a weight or other type of resistance, to build the strength, anaerobic endurance, and or size of skeletal muscles. A well-rounded program of physical activity includes strength training, to improve bone, joint function, bone density, muscle, tendon and ligament strength, as well as improving heart and lung fitness. These activities should work all the major muscle groups of our body (*legs, hips, back, chest, abdomen, shoulders*, and *arms*). Full range of motion is important in resistance training because muscle overload occurs only at the specific joint angles where the muscle is worked (Ormsbee *et al*., 2007) [1]. Research on the effect of resistance training on health and fitness determinants revealed that weight training, like other types of exercise, positively affects physical performance and body composition and a number of health parameters (Miller, *et al*., 1984; Stone, 1991; Toth, *et al*., 1995) [2, 3, 4].
The fundamental principles of resistance training are that exercise should be brief, infrequent, and intense. Exercises are performed with a high level of effort, or intensity, where it is thought that it will stimulate the body to produce an increase in muscular strength and size. Advocates of progressive resistance training believe that this method is superior for strength and size building than most other methods. As strength increases, progressive resistance training techniques will have the weight/resistance increased progressively where it is thought that it will provide the muscles with adequate overload to stimulate further improvements. There is an inverse relationship between how intensely and how long one can exercise. As a result, high intensity workouts are generally kept brief. After a progressive resistance training workout, as with any workout, the body requires time to recover and produce the responses stimulated during the workout, so there is more emphasis on rest and recovery in the progressive resistance training philosophy than in most other weight training methods. In any workout, not just progressive resistance training, training schedules should allow adequate time between workouts for recovery to adaptation (Komi, 1992) [5].

2. Methodology

The purpose of the study was to find out the effect of different intensities of resistance training on selected strength parameters among men handball players. To achieve this purpose, 45 male students studying in the various departments of Annamalai University, Chidambaram, Tamilnadu, were selected as subjects. They were divided into three equal groups and each group consisted of 15 subjects.

3. Training Program

The experimental group-I performed high intensity resistance training, group-II performed moderate intensity resistance training and group-III acted as a control group who did not participate any special training apart from the regular curricular activities. The subjects of experimental group-I performed high intensity resistance training with the training intensity of 80-95% of their 1RM and the subjects of experimental group-II performed moderate intensity resistance training with the training intensity of 65-80% of their 1RM. After assessing the 1 RM of experimental group subjects, the training load was fixed accordingly. Then the experimental group underwent a resistance training program for 3 days per week for 12 weeks. The experimental group underwent their strength training under the instruction and supervision of the investigator.

4. Statistical Technique

The data were collected on selected criterion variables such as muscular strength, and strength endurance were measured by using Push-ups and sit-ups at before and after the eight weeks of strength training as pre and post test. Analysis of covariance (ANCOVA) was applied to find out the significant difference if any between the experimental and control group.

5. Analysis of the Data

The influence of resistance training on each of the selected criterion variables was analyzed and presented below.

Table 1: Analysis of Covariance and 'F' ratio for Muscular Strength and Strength Endurance of Experimental Groups and Control Group

Variables Name	Group Name	High Intensity Resistance Training	Moderate Intensity Resistance Training	Control Group	'F' Ratio
Muscular Strength	Pre-test Mean ± S.D	9.90 ± 0.035	9.20 ± 0.321	9.13 ± 0.542	1.96
	Post-test Mean ± S.D	10.8 ± 0.91	12.7 ± 0.83	9.10 ± 0.03	16.45*
	Adj.Post-test Mean ± S.D	12.16	12.55	9.44	35.14*
Strength Endurance	Pre-test Mean ± S.D	12.3 ± 1.3	12.3 ± 1.4	12.2 ± 1.31	0.328
	Post-test Mean ± S.D	13.5 ± 1.2	13.9 ± 1.58	12.0 ± 1.7	5.08*
	Adj.Post-test Mean ± S.D	13.38	13.8	12.1	10.40*

Table 1 showed that there was a significant difference between experimental and control group on muscular strength and strength endurance.

Table 2: Scheffẽs Test for the difference between the Adjusted Post-Test Mean of Muscular Strength

Adjusted Post-test Mean				
Muscular Strength				
High intensity resistance training group	**Moderate intensity resistance training group**	***Control group***	**Mean Difference**	**Confidence interval at .05 level**
12.16	12.55		0.39	2.09
12.16		9.44	2.72*	2.09
	12.55	9.44	3.11*	2.09

Table 2 shows that the adjusted post-test mean difference in muscular strength between high intensity and control groups (2.72) and moderate intensity and control groups (3.11) were significant at .05 level of confidence. But there was no significant difference between high and moderate intensity groups (0.39) on muscular strength after the training programme.

Table 3: Scheffẽs Test for the difference between the Adjusted Post-Test Mean of Strength Endurance

Adjusted Post-test Mean				
Strength Endurance				
High intensity resistance training group	**Moderate intensity resistance training group**	***Control group***	**Mean Difference**	**Confidence interval at .05 level**
13.38	13.8		0.42	1.11
13.38		12.1	1.28*	1.11
	13.8	12.1	1.70*	1.11

Table 3 shows that the adjusted post-test mean difference in muscular endurance between high intensity and control groups (1.28) and moderate intensity and control group (1.70) were significant at .05 level of confidence. But there was no

significant difference between high intensity and moderate intensity groups (0.42) on muscular endurance after the training program.

6. Discussion on findings

Research on the effect of weight training on health and fitness determinants revealed that weight training, like other types of exercise, improves physical performance and a number of health parameters (Miller, *et al*., 1984; Poehlman, 1992; Stone, 1991; Toth, *et al*., 1995) [2, 6, 3, 4]. Almost every study revealed an increase in muscular strength, power muscular endurance, flexibility and jumping ability due to weight training compared with other training.

Resistance training is an effective intervention to improve muscle power without adverse effects on joint laxity (Bieler & Sobol, 2014) [7], mobility and muscle strength (Krist, Dimeo and Keil, 2013) [8]. Supervised strength training represents an efficacious intervention for improving strength with residual benefits lasting longer than previously expected (Sherk *et al*., 2012) [9], strength and power-related measurements (Ronnestad *et al*., 2008) [10] Hanson *et al*., (2009) [11] suggested that changes in strength, power, and fat free mass are predictors of strength training induced improvements in functional tasks.

Similarly, LeMura *et al.,* (2002) [12] observed 16 weeks of various modes of resistance training and found that the resistance training group increased upper and lower body strength. Starkey (1996) [13] studied the effects of different volumes of high-intensity resistance training on isometric torque and muscle thickness and found that both groups improved muscular strength torque similarly at most angles. Dorgo *et al.,* (2009) [14] found significant improvements in muscular strength and muscular endurance of the manual resistance training and weight resistance training groups.

7. Conclusions

The results of the study shown that there was a significant improvement on selected strength parameters among men handball players due to the effect of high and moderate intensities of resistance training however, no significant differences were found between the experimental groups.

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