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# 4. The Effect of Concurrent Strength and Endurance Training for Badminton Players

**P. Senthil, Dr. S. Arul**

Assistant Professor,
Department of Physical Education and Sports Sciences,
Annamalai University, India.

***Abstract:***

*The purpose of the study was to find out the effect of concurrent strength and endurance training for badminton players on selected variables namely Explosive strength in vertical and Muscular endurance. To achieve this purpose of the study, forty students studying in the department of physical education and sports sciences, Annamalai University, Annamalai Nagar, Tamil Nadu and India were selected as subjects at random. Their age ranged between eighteen to twenty-two years. The selected subjects were divided into two equal groups of twenty each namely concurrent strength and endurance training group and control group.*

*The experimental group has undergone twelve weeks of concurrent strength and endurance training, whereas the control group maintained their daily routine activities and no special training was given. The subjects of the two groups were tested on selected variables namely Explosive strength in vertical and Muscular endurance using standardized tests, namely Vertical jump and bent knee sit-ups at prior and immediately after the training period. The collected data were analyzed statistically through analysis of variance (ANOVA) to find out the significant difference, if any between the groups. The .05 level of confidence was fixed to test the level of significance which was considered as an appropriate. The results of the study showed that there were significant differences exist between concurrent strength and endurance training group and control group. And also, concurrent strength and endurance training group showed significant improvement on Explosive strength in vertical and Muscular endurance compared to control group.*

***Keywords:***

*Concurrent strength and endurance training, Explosive strength in vertical, Muscular endurance, Analysis of variance (ANOVA).*

## 4.1 Introduction:

The sequential exercise regime is referred to as ‘concurrent training’. Concurrent strength and endurance training is undertaken by numerous athletes in various sports in an effort to achieve adaptations specific to both forms of training.

Literature findings to date, investigating the neuromuscular adaptations and performance improvements associated with concurrent strength and endurance training (referred to as concurrent training) have produced inconsistent results.

Some studies have shown that concurrent training inhibits the development of strength and power, but does not affect the development of aerobic fitness when compared to either mode of training alone. Other studies have shown that concurrent training has no inhibitory effect on the development of strength and endurance.

### 4.1.1 Strength and Endurance Adaptions:

Strength and endurance training regimes represent and induce distinctly different adaptive responses when performed individually.

Typically, strength-training programs involve large muscle group activation of high-resistance low-repetition exercises to increase the force output ability of skeletal muscle.

In contrast, endurance-training programs utilize low-resistance, high-repetition exercises such as running or cycling to increase maximum O2 uptake (VO2 max). Accordingly, the adaptive responses in skeletal muscle to strength and endurance training are different and sometimes opposite.

Strength training has been reported to cause muscle fibre hypertrophy, associated with an increase in contractile protein, which contributes to an increase in maximal contractile force (Sale et al 1990). Strength training also reduces mitochondrial density and suppresses oxidative enzymes activity which can cause impede endurance capacity, but has minimal impact on capillary density or in the conversion of muscle fibre types from fast twitch (type II fibres) to slow twitch (type I fibres). In contrast, endurance training usually causes little or no muscle fibre hypertrophy, but it does induce increases in mitochondria content, citric acid enzymes, oxidative capacity and the possibility of muscle fibre conversion from fast twitch to slow twitch.

Many competitive endurance athletes incorporate resistance training into their training in a hope to improve endurance performance. However, as previously mentioned adaptations to exercise are generally considered to be specific to the training type of stimulus.

Although, many adaptations are specific to the type of training, some changes that occur with resistance training could influence endurance performance, which include: muscle fibre transformations and muscle fibre (type I) hypertrophy, which may alter fibre recruitment patterns and help prevent muscle fatigue, as less motor units need to be activated for the same work load (Bishop and Jenkins 1999).

Bishop and Jenkins analyzed endurance performance in 21 female subjects over a 12-week program of strength training.

They found that strength training did not reduce endurance performance and may actually improve endurance capacity in the long term.

Runners and cyclists may improve endurance performance via a resistive weight training program, due to increases in the size of type I fibres, changes in type II subtype ratios, and myofibril contractile properties.

These changes may allow individuals to exercise longer at a given submaximal work rate by reducing the force contribution from each active myofibre or by using fewer myofibres.

In conjunction, the myofibre changes may also allow individuals to delay the endurance capacity benefited only from an "in-water" resistance program specific to their swimming stroke, relative to a standard weights program usually given to these athletes.

The "in-water" resistance program incorporates the use of biokinetic swim benches and reverse current hydrochannel swimming. This may imply that resistance training for swimming needs to be specific to their stroke to achieve any improvements in endurance performance.

### 4.1.2 Statement of the Problem:

The purpose of this study was to investigate the effect of concurrent strength and endurance training for badminton players of Annamalai University, Chidambaram, Cuddalore (Dt). age group between 18 and 22.

## 4.2 Methodology:

The purpose for this study subjects were randomly selected from Annamalai University, Chidambaram. In total 40 subjects were selected at random, and they were divided into two equal groups that is experimental and control group in each group consist of 20 subjects their age ranged from eighteen to twenty-two.

The experimental group has undergone concurrent strength and endurance training such as incline leg press, bench press, jump to box, jump from box, alternate leg squat, alternate leg hops in place, Jogging and cycling three days in a week for the period of 12 weeks and the control group was not undergoing concurrent strength and endurance training.

To find out the Explosive Strength in Vertical and Muscular Endurance the investigator conducted the Vertical Jump and Bent Knee Sit-Ups. Testers' competency, subject reliability and reliability of tests were established by using test and retest method and the reliability coefficient were found to be satisfactory high.

The data were analyzed using analysis of variance (ANOVA) for determine the effect of concurrent strength and endurance training for badminton players have variables of Explosive Strength in Vertical and Muscular Endurance of badminton players of Annamalai University, Chidambaram, Cuddalore (Dt). on the age group between Eighteen to Twenty-two.

### 4.2.1 Selection of Variables and Tests:

The research scholar reviewed the available scientific literature pertaining to available the present study, the following variables were selected.

**Table 4.1: Selection of Variables and Tests**

| Sr. No. | Variables | Test Items |
|---|---|---|
| 1. | Explosive Strength in Vertical | Vertical Jump |
| 2. | Muscular Endurance | Bent Knee Sit-Ups |

### 4.2.2 Statistical Techniques:

The data collected from the experimental group and control group, the selected variables on Explosive Strength in Vertical and Muscular Endurance was statistically examined by using the "F" ratio used to find out the significance difference between experimental group and control group, the level of significance was fixed at 0.05 level of confidence. The mean difference of the criterion measures for the control and experimental groups is presented in tables, mean difference of control and experimental groups for each variable is presented in figure.

**Table 4.2: One way analysis of variance (ANOVA) for pretest scores of Vertical Jump of control and experimental group.**

| Sources of variance | Sum of squares | Degrees of freedom | Mean squares | F |
|---|---|---|---|---|
| Between | 9.025 | 1 | 9.025 | 3.523 |
| Within | 97.35 | 38 | 2.562 | |
| Total | 106.375 | 39 | | |

Table value of (1,38) at 0.05 level is 4.08.

The calculated value of F ratio (3.523) is lesser than the table value of 4.08 at 0.05 level. Hence it is not significant.

Therefore, there is no statistically significance difference between Control and Experimental group scores of Vertical Jump performance.

**Table 4.3: One way analysis of variance (ANOVA) for post test scores of Vertical Jump of control and experimental group.**

| Sources of variance | Sum of squares | Degrees of freedom | Mean squares | F |
|---|---|---|---|---|
| Between | 32.4 | 1 | 32.4 | 7.2809 |
| Within | 169.1 | 38 | 4.45 | |
| Total | 201.5 | 39 | | |

Table value of (1,38) at 0.05 level is 4.08.

The calculated value of F ratio (7.2809) is greater than the table value of 4.08 at 0.05 level. Hence it is significant. Therefore, there is statistical significance difference between Control and Experimental scores of Vertical Jump performance.

**Table 4.4: One way analysis of variance (ANOVA) for pretest scores of Bent-knee sit-ups of control and experimental group.**

| Sources of variance | Sum of squares | Degrees of freedom | Mean squares | F |
|---|---|---|---|---|
| Between | 5.625 | 1 | 5.625 | 3.0911 |
| Within | 69.15 | 38 | 1.18197 | |
| Total | 74.775 | 39 | | |

Table value of (1,38) at 0.05 level is 4.08.

The calculated value of F ratio (3.0911) is lesser than the table value of 4.08 at 0.05 level. Hence it is not significant.

Therefore, there is no statistically significance difference between Control and Experimental group scores of Bent-knee sit-ups.

**Table 4.5: One way analysis of variance (ANOVA) for post test scores of Bent-knee sit-ups of control and experimental group.**

| Sources of variance | Sum of squares | Degrees of freedom | Mean squares | F |
|---|---|---|---|---|
| Between | 10 | 1 | 10 | 5.945 |
| Within | 63.9 | 38 | 1.682 | |
| Total | 73.9 | 39 | | |

Table value of (1,38) at 0.05 level is 4.08.

The calculated value of F ratio (5.945) is greater than the table value of 4.08 at 0.05 level. Hence it is significant. Therefore, there is statistical significance difference between Control and Experimental scores of Bent-knee sit-ups.

## 4.3 Conclusion:

The finding of this study indicated that the effect of concurrent strength and endurance training significantly increase the Explosive Strength in Vertical and Muscular Endurance when compared with pretest as well as control group.

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