Experimentation of Serial and Parallel Strength and Endurance Training on Leg Strength Tidal Volume and Body Mass Index

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***Abstract*—The purpose of the study was to find out the effect of serial and parallel strength and endurance training on leg strength, tidal volume and body mass index. Forty five male players of various games aged between 19 and 25 years were selected for the study. They were divided into three equal groups, each group consisting of fifteen subjects in which three experimental groups and one control group, in which the group I (n=15) underwent serial strength and endurance training, group II (n = 15) underwent parallel strength and endurance training for three days (alternative days) per week for twelve weeks and group III, acted as control, which did not participate in any training apart from their regular game practice. The subjects were tested on selected criterion variables as leg strength, tidal volume and body mass index at prior to and immediately after the training period. For testing the leg strength the leg lift with dynamometer was used, for measuring the tidal volume, expirograph was used and BMI was assessed by using Getlet formula. The analysis of covariance (ANCOVA) was used to find out the significant difference if any, between the experimental groups and control group on selected criterion variable separately. Since there were three groups involved in the present study, the Scheffé S test was used as post-hoc test. The selected criterion variables such as leg strength, tidal volume and body mass index were improved significantly for all the training groups when compared with the control group. But there was no significant difference was found between the training groups.**

***Index Terms*—serial and parallel, strength and endurance training, leg strength, tidal volume and body mass index.**

I. INTRODUCTION

Humans have always attempted to exceed each other in terms of speed, height, strength, endurance, and skill. We aspire for perfection in sports performance because humans are inherently competitive. Despite their fascination and rich legacy, new strategies based on insight and information gained through practical experience, observation, and scientific research have supplanted traditional conditioning methods. For a long time, progress towards improved conditioning techniques was gradual, but in recent years, substantial breakthroughs have resulted to some incredible performance boosts (Boucher and Malina, 1993)

Athletic performance has improved dramatically in topical years. Performance levels that were previously inconceivable are becoming the norm, and the number of athletes capable of putting out remarkable efforts is growing. Athletics is a difficult sport, and great drive has led to lengthy and strenuous hours of practice. Coaching has also advanced owing to the efforts of sports specialists and scientists. Sports science has progressed from descriptive to scientific. A broader body of information about athletes is now available, which is reflected in training approaches (Bompa, 1999).

Conditioning is a controlled training and adaptation process that requires consistent incremental effort (Kalf and Arnheim, 1963). The term "training means" refers to a number of physical exercises, as well as other activities, techniques, and procedures, that are used to develop, maintain, and recover performance capability and preparedness.

Sports training is a scientifically based athletic development technique that enables athletes to accomplish remarkable and record-breaking athletic achievements by gradually improving mental and physical efficiency, skill, and drive. Physical training is one of the most significant components of high-

performance training. Physical training seeks to raise an athlete's physiological capacity and improve biomotor skills to the maximum possible level (Harre, 1982).

Sports tutoring is based on a scientifically structured pedagogical process that effects performance ability and preparedness in performance, with the goal of improving and perfecting sports performance while also competing in various sports competitions. A training schedule is designed to improve a sportsperson's ability and energy capacity in preparation for a specific event. Initially, the athlete's capacity to carry out motor actions with varied degrees of strength, speed, resistance, and skill in order to accomplish the individual and group actions the divisions of sports training technique represented the intensity of sports training in any athletic event (Simon, Mihaila and Stanculescu, 2011).

Physical exercise causes anatomical, physiological, metabolic, and psychological changes. A physical activity's efficiency is determined by its time, distance, and repetitions, as well as its load, velocity, and frequency of performance. Consider these factors, known as training variables, when designing training dynamics based on a competition's functional and psychological characteristics. Define which component to focus on and achieve the intended performance target during the training phases leading up to a competition (Zatsiorsky, 1995). According to studies, strength training preserves functional capabilities, has significant affects on the musculoskeletal system, and helps to avoid sarcopenia, lower-back pain, osteoporosis, and other disorders (Winett and Carpinelli, 2001).

The purpose of endurance training is to improve endurance efficiency, which is commonly characterised as exercising the aerobic system. Strength endurance and speed endurance have been demonstrated to predict medium-term endurance efficiency, despite the fact that anaerobic workouts lasting two to eight minutes are required.

II. METHODS

The goal of this study was to determine how serial and parallel strength and endurance training, affected on leg strength, tidal volume and body mass index. 45 male players of different games who were enrolled in the Selvam College of Physical Education, Namakkal, and represented in various inter-collegiate tournaments, for the academic year 2023–2024 were chosen as subjects to fulfil the goal. They were divided into three equal groups of fifteen each and further divided as two experimental groups and one control group, in which the group I (n=15) underwent serial strength and endurance training, group II (n = 15) underwent parallel strength and endurance training for three days (alternative days) per week for twelve weeks, and group III (n=15) acted as control which did not participate in any special training apart from the regular physical and curricular activities.

There will be changes to the playing ability and systems with every training regimen. After consulting with the specialists, the researchers decided to use the following variables as criteria: 1. Leg strength, 2. Tidal volume and 3. Body Mass Index.

III. ANALYSIS OF THE DATA

The differences, if any, between the corrected post test means on several criteria variables were examined independently using analysis of covariance. The Scheffé S test was used as a post-hoc test if the adjusted post test mean's ‘F’ ratio was shown to be significant. To evaluate the ‘F’ ratio discovered using analysis of covariance, the level of significance was set at 0.05 level of confidence.

Table – I

Analysis of Covariance and ‘F’ ratio for leg strength, tidal volume and body mass index of serial and parallel strength and endurance training groups, and control group

Variable Name	Group Name	Serial Training Group	Parallel Training Group	Control Group	‘F’ Ratio
Tidal volume (in liters)	Pre-test Mean ± S.D.	75.27 ± 1.79	76.47 ± 2.87	74.87 ± 2.90	1.57
	Post-test Mean ± S.D.	78.00 ± 1.60	78.67 ± 2.65	74.20 ± 3.51	11.34*
	Adj. Post-test Mean	78.270	77.722	74.875	54.19*

Tidal volume (in Liters)	Pre-test Mean ± S.D.	0.41 ± 0.02	0.401 ± 0.02	0.397 ± 0.02	0.26
	Post-test Mean ± S.D.	0.423 ± 0.02	0.437 ± 0.02	0.396 ± 0.02	18.76*
	Adj. Post-test Mean	0.421	0.426	0.399	67.58*
Body Mass Index (in Kg/m^2)	Pre-test Mean ± S.D.	22.39 ± 0.95	22.23 ± 1.09	22.69 ± 1.38	0.64
	Post-test Mean ± S.D.	21.43 ± 0.98	21.59 ± 1.00	22.70 ± 1.39	5.45*
	Adj. Post-test Mean	21.472	21.795	22.454	24.94*

* Significant at .05 level of confidence. (The table value required for significance at .05 level of confidence with df 2 and 42 and 2 and 41 were 3.21 and 3.23 respectively).

Table – I shows that the leg strength pre-test 'F' ratio value of 1.57 was less than the necessary table value of 3.21 for significant with df 2 and 42 at 0.05 level of confidence. For the post-test mean and adjusted post-test mean 'F' ratio value of 11.34 and 54.19 for the adjusted post-test scores was greater than the necessary table value of 3.24 for significant. According to Table - I, the pre-test averages of tidal volume 'F' ratio value of 0.26 was less than the necessary table value of 3.21 for significant with df 2 and 42 at 0.05 level of confidence. For post-test and adjusted post-test mean 'F' ratio values of tidal volume were 18.76 and 67.58 was greater than the necessary table value of 3.24 for significant. The BMI pre-test mean values 'F' ratio value was 0.64 which was insignificant. For post- adjusted post-test mean 'F' ratio values of BMI was 5.45 and 24.94 was greater than the necessary table value of 3.24 for significant. Further, to find out which training group has significant improvement on selected criterion variables, Scheffe S post-hoc test was applied and presented in table – II.

Table - II

Scheffẽ S Test for the difference between the adjusted post-test mean of leg strength, tidal volume and body mass index

Serial Training Group	Parallel Training Group	Control Group	Mean Difference	Confidence Interval at 0.05 level
Adjusted Post-test Mean for Leg Strength				
78.270		74.875	3.395*	0.88
78.270	77.722		0.548	0.88
	77.722	74.875	2.847*	0.88
Adjusted Post-test Mean for Tidal Volume				
0.421		0.399	0.022*	0.008
0.421	0.426		0.005	0.008
	0.426	0.399	0.037*	0.008
Adjusted Post-test Mean for BMI				
21.472		22.454	0.982*	0.359
21.472	21.795		0.323	0.359
	21.795	22.454	0.659*	0.359

* Significant at 0.05 level of confidence.

IV. RESULTS

The adjusted post-test mean difference in leg strength between serial training group and control group and parallel training group and control group was 3.395, and 2.847, respectively, and these differences were significant at the 0.05 level of confidence, according to Table II. The table II also indicate that there was no significant difference was occurred between the training groups (0. 548). Based on the study's findings, it can be said that serial training practice group and parallel training group considerably boost the leg strength ability.

The adjusted post-test mean difference in tidal volume between serial training group and control

group, parallel training group and control group was 0.022, and 0.037, respectively, and these differences were significant at the 0.05 level of confidence, according to Table - II. The table II also indicate that there was no significant difference was occurred between the training groups (0. 005). Based on the study's findings, it can be said that serial training practice group and parallel training group considerably boost the tidal volume ability.

The adjusted post-test mean difference in BMI between serial training group and control group, and parallel training group and control group was 0.982, and 0.659, respectively, and these differences were significant at the 0.05 level of confidence, according to Table - II. The table II also indicate that there was no significant difference was occurred between the training groups (0. 323). Based on the study's findings, it can be said that serial training practice group and parallel training group considerably boost the BMI.

V. CONCLUSIONS

The study's findings show that after the appropriate training regimen, leg strength significantly increased. Male volleyball players' leg strength significantly improved following the plyometric training program, according to Magray and Jain (2020). Following the weight training regimen, Rawte & Yadav (2020), and Mohammad (2016) reported a considerable improvement in leg strength. According to Blakey and Southard (1987), leg strength has grown as a result of a combination plyometric and weight training program.

Tidal volume was improved for both the training group, whereas there was no significant difference between the training groups. Moradians, et al., (2016) found that there was a significant improvement in tidal volume for aerobic and interval training groups.

The result of the study indicates that there was a significant reduction in BMI after the serial and parallel training groups. Genç, and Dağlıoğlui, (2021) found that there was a significant reduction in BMI after eight-week plyometric training programme. Azeem and Ameer, (2013) found that there was an insignificant reduction after the strength training programme on BMI

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