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Original Article

An Experimental Study on the Effect of Strength Training on Resting Pulse Rate and Vital Capacity among Football Players

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Abstract

Finding out how strength training affected resting pulse rate and vital capacity was the goal of this investigation. Thirty male footballers from the Govt. Degree College in Ganderbal, J&K, India, participated in this research. The individuals' ages varied from 18 to 24 years old. Two distinct sets of subjects, Group I and Group II, each with fifteen subjects, emerged for this research. Group 1 represented as the test group while Group 2 was designated as a control group, receiving no extra exercise outside of the required physical education classes and workouts, participating in a 12-week ST regimen three times weekly. Both categories' participants underwent tests on the chosen criteria factors, including vital capacity and resting pulse rate, applying a spirometer for measuring ultimate air exhalation following ultimate inhalation of participants prior to and following the instructional session, and radial pulse rate to measure resting pulse rate. If there are any noteworthy variances among groups, they are evaluated using a statistical analysis of covariance (ANCOVA). The 'F' ratio is tested at an acceptable threshold of 0.05 that was thought to be adequate for the investigation and determined using ANCOVA. Engaging in a 12-week, thrice-weekly strength training regimen significantly improved resting pulse rate and vital capacity among football players compared to a control group. This underscores the pivotal role of commitment to strength training in enhancing athletes' overall physical well-being.

Keywords: Strength Training (ST), Football, Resting Pulse Rate, Vital Capacity

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Introduction

The core aim of incorporating strength and power training into the realm of highly competitive sports is to elevate athletes' prowess in specific and relevant athletic endeavors. This entails a symphony of diverse training techniques, encompassing unique movement patterns, varied temporal organization of loads, different resistance levels, a wide spectrum of movement velocities, specific biomechanical nuances, and training across various surfaces. The grand crescendo of these efforts is envisioned to orchestrate a remarkable enhancement in players' performance, particularly in pivotal motor tasks like jumping, sprinting, and nimble directional changes. (BR. Ronnestad *et al.*, 2011) and (M. Jovanovic *et al* 2011).

Attaining success in sports events is intricately tied to a fusion of motor fitness components, game-related skills, and physiological factors. Therefore, the training regimen ought to be meticulously tailored to enhance speed, agility, explosive power, coordination, flexibility, and cardiovascular

fitness. This includes refining aspects such as respiratory rate, VO2 max, anaerobic power, and honing specific game skills. The tapestry of athletic achievement is woven through the artful cultivation of these multifaceted elements (Hardayal, 1991).

In the realm of sports training, the art of coaching extends beyond mere physical fitness routines; it encompasses a holistic approach to elevate an athlete's performance. Rooted in systematic principles, this approach centers on refining motor skills and fortifying the musculo-skeletal system, with the overarching goal of enhancing the player's overall game. The crux of any training process lies in the adept refinement of techniques and the cultivation of tactical efficiency, crafting a narrative of skill development and strategic prowess (Singh, 1991).

The surge in popularity of strength training has elevated it to a pivotal recommendation within well-rounded fitness programs. Its applicability extends beyond general fitness, encompassing various contexts. This article serves as an exploration into the rapidly expanding arena of strength training, highlighting fundamental scientific principles, diverse training methods, clinical applications, and the nuanced prescription of exercises tailored for strength training.

As the investigator delves into this study, it becomes evident that there is a crucial need to unveil the physiological consequences specific to football players. Thus, the study unfolds as a response to this imperative, seeking to unravel the intricate physiological outcomes in the realm of football athleticism.

Table-2 training schedule for weight training group

Weeks	Phase	Days/ Week	Focus/Exercises	Sets x Reps	Intensity (1-rep max or RPE)	Additional Notes
I - IV	Foundation	Mon. Wed. Fri.	Warming up. Compound Exercises (Barbell Squats, Dead lifts, Bench Press) Cardio- Vascular Exercises (Jogging and Stationary Bike)	3x10-12 3x/week (15-20 min) 2x/week (15-20 min)	50-60%	---------
IV - VIII	Intensification	Mon. Wed. Fri.	Warming up. HIIT and Progressive Resistance (Sprint Intervals) Warming up. Compound Exercises (Barbell Squats, Dead lifts, Bench Press) .	15-20 min 3x10-12	RPE 5-6 during sprints 60-70%	Increased weights (5-10% from foundation phase for compound exercises)
VIII-XII	Specialization	Mon. Wed. Fri.	Warming up. Sports Specific Drills (Cone drills) Interval Training (shuttle runs) . Breathing Exercise (Diaphragmatic Breathing).	3x10 4x15 5 min/day	Agility and Quick directional changes Max effort short rest intervals Focus on slow controlled breaths	-------

Materials and Methods

This research utilizes an experimental approach, employing a strength training (ST) group and a control group, supplemented by both pre-tests and post-tests. To achieve the study's aims, thirty college-level football

players from the Govt. Degree College Ganderbal Jammu and Kashmir UT were selected at random. Each group received 15 participants, with Group A serving as the experimental group (n= 15) and Group B serving as the control group (n= 15). The average age of those included was 18 to 24. The ST program comprised 45-minute sessions which took place twice a week. Before and after the 12-week session, all subjects underwent testing. To every subject, the test technique was orally discussed and genuinely stated. The participants' uncertainties were cleared up. The distribution of a handout and timetable helped to gather details regarding the students' daily workout regimen as well as intensity.

Selection of subjects

Thirty College level footballers from from the Govt. Degree College Ganderbal Jammu and Kashmir UT were chosen randomly as research participants to fulfill the study's objectives. The individuals' ages varied from 18 to 24 years old.

Selection of Variables

The selection of "Resting Pulse Rate" and "Vital Capacity" as variables for the experimental study on the impact of strength training among football players is rooted in their paramount significance to athletes' overall physical fitness and on-field performance. Resting pulse rate serves as a crucial indicator of cardiovascular health, offering insights into the adaptations resulting from strength training, particularly in terms of endurance and quick recovery. Meanwhile, vital capacity, measuring lung function, is pivotal for sustaining energy levels during the prolonged aerobic demands of football, potentially contributing to increased stamina. By focusing on these variables, the study aims to provide a holistic understanding of how strength training can positively influence cardiovascular and respiratory aspects, ultimately enhancing the comprehensive athletic performance of football players. The selection of the remaining factors was determined by taking into consideration the practical requirements, availability of equipment, and the relevance of these variables to the research project.

Independent Variables

Two separate groups were chosen for this experiment, one of which served as the experimental group and the second served as the control group, allowing for comparison of the results.

- Strength Training

Dependent Variables

- ***Physiological Parameters***
  - Vital Capacity
  - Resting Pulse Rate

Selection of test items

The primary objective of this research was to examine the effects of strength training on resting pulse rate and vital capacity among football players. The best evaluations for the study were chosen by the investigator after consulting with experts and physical education specialists and reviewing relevant literature, as stated in the table below.

Table 1 The particulars regarding the physiological factors, assessments, and units of measurement.

Sr. No	Criterion Variables	Test Items	Unit of Measurement
1	Resting Pulse Rate	Radial Pulse Test	Numbers/min
2	Vital Capacity	Spirometer	Liters

Statistical Analysis

The data underwent analysis employing appropriate statistical methods, utilizing the statistical software SPSS-22. The determination of significance was carried out through ANCOVA, and the level of statistical significance was set at a confidence level of 0.05. Detailed results are elaborated upon below.

Analysis of Data

Resting Pulse Rate

The analysis of covariance was performed on the pre-test and post-test scores of resting pulse rate for both the strength training group and the control group, and the results are shown in Table 1.

TABLE 3 ANCOVA for pre-test and post-test scores of resting pulse rate for ST and CT

TEST	Strength Training	Control Group	Source of Variance	Sum of Squares	Df	Mean Squares	Obtained 'F' ratio
Pretest Mean S.D	73.23 2.95	73.41 2.96	Between Within	0.26 244.11	1 28	0.26 8.72	0.03
Posttest Mean S.D	70.54 2.89	73.59 2.80	Between Within	69.55 227.01	1 28	69.55 8.11	8.58*
Adjusted Posttest Mean	70.62	73.52	Between Within	62.94 75.92	1 27	62.94 2.81	22.38*

*Significant at 0.05 level of confidence.

(The critical values in the table for a significance level of 0.05 with degrees of freedom 1, 28 and 1, 27 are 4.20 and 4.21 respectively).

Table-3 displays the pre-test mean values for both the strength training and control groups, registering at 73.23 and 73.41, respectively. The computed pre-test 'F' ratio was 0.03, indicating an absence of a significant difference in pre-test scores between the groups. This calculated value falls below the critical 'F' ratio of 4.20, considering degrees of freedom (df) as 1 and 28.

Nevertheless, in the post-test, the strength training group exhibited a mean value of 70.54, while the control group showed 73.59, resulting in an 'F' ratio of 8.58. This ratio surpassed the table F ratio value of 4.20 (with degrees of freedom 1 and 28), indicating a substantial difference in post-test scores between the two groups.

Following adjustments for covariates, the post-test mean values for resting pulse rate were 70.62 for the strength training group and 73.52 for the

control group. The 'F' ratio was 22.38, surpassing the table F ratio value of 4.21 (with degrees of freedom 1 and 27), affirming a noteworthy difference in resting pulse rate between these groups.

In summary, the study's outcomes highlight a substantial contrast in resting pulse rate between the strength training group and the control group.

To offer a more elucidating interpretation of these findings, Figure-1 visually represents the adjusted post-test means in the form of a bar chart.

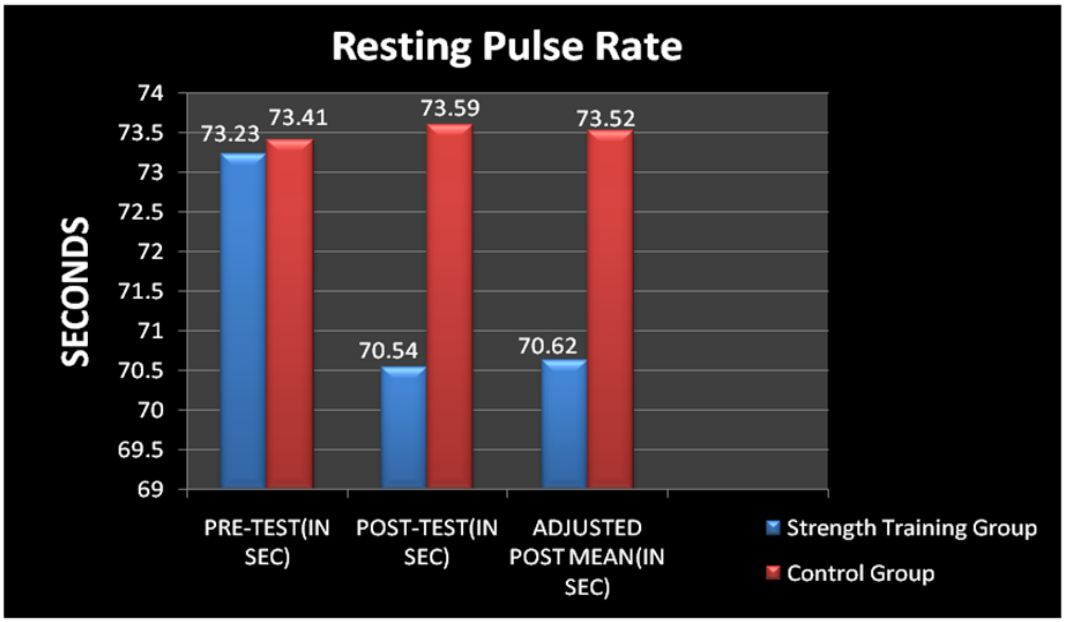

Figure 1 bar chart illustrating adjusted post mean values on resting-pulse rate

Vital Capacity

The analysis of covariance was performed on the pre-test and post-test scores of vital capacity for both the strength training group and the control group, and the results are shown in Table-4.

Table 4 ANCOVA for pre-test and post-test scores of vital capacity for ST and CT

TEST	Strength Training	Control Group	Source of Variance	Sum of Squares	df	Mean Squares	Obtained 'F' ratio
Pretest							
Mean	3.37	3.42	Between	0.014	1	0.014	0.02
S.D	0.83	0.82	Within	19.082	28	0.682	
Posttest							
Mean	3.90	3.42	Between	1.68	1	1.68	6.04*
S.D	0.59	0.46	Within	7.81	28	0.28	
Adjusted Posttest Mean	3.91	3.41	Between Within	1.83 3.39	1 27	1.83 0.12	14.63*

*Significant at 0.05 level of confidence.

(The critical values in the table for a significance level of 0.05 with degrees of freedom 1, 28 and 1, 27 are 4.20 and 4.21 respectively).

Table-4 displays the pre-test mean values for both the strength training and control groups, registering at 3.37 and 3.42, respectively. The computed pre-test 'F' ratio was 0.02, indicating an absence of a significant difference in pre-test scores between the groups. This calculated value falls below the

critical 'F' ratio of 4.20, considering degrees of freedom (df) as 1 and 28.

Nevertheless, in the post-test, the strength training group exhibited a mean value of 3.90, while the control group showed 3.42, resulting in an 'F' ratio of 6.04. This ratio surpassed the table F ratio value of 4.20 (with degrees of freedom 1 and 28), indicating a substantial difference in post-test scores between the two groups.

Following adjustments for covariates, the post-test mean values for vital capacity were 3.91 for the strength training group and 3.41 for the control group. The 'F' ratio was 14.63, surpassing the table F ratio value of 4.21 (with degrees of freedom 1 and 27), affirming a noteworthy difference in vital capacity between these groups.

In summary, the study's outcomes highlight a substantial contrast in vital capacity between the strength training group and the control group.

To offer a more elucidating interpretation of these findings, Figure-2 visually represents the adjusted post-test means in the form of a bar chart.

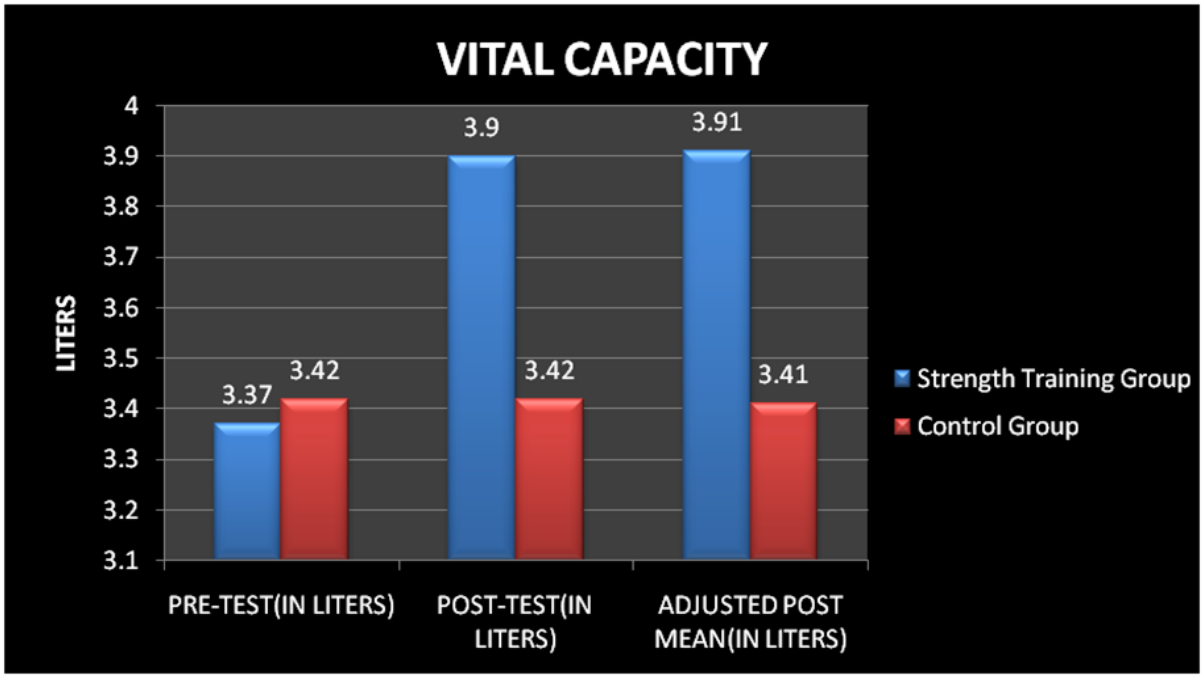

Figure 2 bar chart illustrating adjusted post mean values on vital capacity

Discussion & Conclusion

The study conducted by Waseem Ahmad Bhat and Sevi aimed to investigate the impact of strength training on resting pulse rate and vital capacity among a group of football players. The research involved 30 participants, randomly divided into an experimental group (Group I) that underwent 12 weeks of strength training and a control group (Group II) that did not receive any specialized training apart their regular physical education classes.

The results of this study are consistent with previous research on resistance training and its effects on respiratory parameters. Strength training, which involves adding resistance during exercises, has been shown to enhance strength and endurance. This increased muscular strength may have contributed to improved resting pulse rate and vital capacity among the strength training group.

Several studies have investigated the effects of resistance training on respiratory and physiological parameters. For instance, a study by J. Karthikeyan (2017) attempted to evaluate the effectiveness of weight training and game specific exercises on selected resting pulse rate, vital capacity variables of men football players. The study’s results affirmed that weight

training and game specific exercises had remarkable improvement in physiological vital capacity and a remarkable reduction in resting pulse rate compared to control group. Additionaly, a research by G. Sethu, C. Alexandar (2015) concluded that physical training significantly increased vital capacity and reduces resting pulse rate. These results also are in corroboration with the studies of K. Ghosh *et al.,* (2023), B. Neranoch *et al.,* (2023).

Furthermore, the findings of this study align with the principles of progressive overload, where gradually increasing resistance leads to enhanced physical performance. Strength training, by introducing resistance, may have led to adaptations in physiological variables over the 12-week period.

It's important to note that while this study provides valuable insights into the potential benefits of strength training, further research with larger sample sizes and longer durations could offer more comprehensive insights into the effects on resting pulse rate and vital capacity. Additionally, considering potential confounding factors such as diet, sleep, and other lifestyle factors could provide a more nuanced understanding of the observed improvements.

In conclusion, the research by suggests that a 12-week strength training program significantly improved resting pulse rate and vital capacity among football players. The study provides valuable insights into the benefits of strength training for enhancing resting pulse rate and vital capacity among men football players. The significant differences observed in post-test scores support the notion that this training method is an effective way to improve physiological and respiratory function. Incorporating strength training into the training regimen of athletes and individuals seeking to enhance their physiological and respiratory capacity could be beneficial.

However, it is essential to note that this study had some limitations, such as a relatively small sample size and a specific focus on men football players. Future research with larger and more diverse participant groups could further validate these findings and explore the broader applications of strength training in physiological and respiratory function enhancement.

Conflict of Interest: No Conflict of Interest among authors.

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