# COMPARATIVE EFFECTS OF CIRCUIT WEIGHT TRAINING AND INTERVAL WEIGHT TRAINING PROGRAMMES ON THE SKILL-RELATED PHYSICAL FITNESS COMPONENTS OF JUMPERS

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## Abstract

*The purpose of this study was to compare the effects of circuit weight training and interval weight training on jumpers' skill-related physical fitness components. The jumpers' ranged between 18- 21 years, with a mean of 19.6 years. A ten-week circuit weight and interval weight training were conducted on jumpers, randomly selected into two experimental and control groups. The Analysis of Co-variance (ANCOVA) formed the inferential statistical tool, while Tukey Pairwise-Comparisons Test served as the posthoc analysis for this study. The two training programmes elicited significant changes, and their effects did not differ significantly on all the skill-related physical fitness components of jumpers. Both training programmes should be adapted, by coaches and trainers responsible for the training of jumpers, by enhancing the skill-related physical fitness components for effective performance for now and future purposes.*

**Keywords:** Comparative Effect, Circuit Weight Training, Skill-Related, Physical Fitness & Jumpers.

## Introduction

Weight training is a common type of strength training for developing the strength and size of skeletal muscles. It uses the force of gravity in the form of weight bars, dumbbells or weight stacks to oppose the force generated by muscles through a concentric or eccentric contraction. Weight training uses a variety of specialized equipment to target specific muscle groups and types of movement (Luke, 2019).

Sports in which weight training is used include bodybuilding, weightlifting, strongman, hammer throw, shot put, discus and other related strength events in athletics as well as other sports that require muscle buildup (Keogh, Justin, & Winwood, 2017). Weight training as a training method is not a new phenomenon to practitioners of different power sports. It is readily apparent that weight training produces an increased muscle mass and a high degree of strength and contributes beneficially to performance in many sports.

During the past three decades, the effectiveness of a carefully planned weight training programme as a method of improving body development and sports performance has been accepted based on well-controlled studies. Although being muscle-bound, having reduced localized muscle endurance, and losing speed and agility were previously thought to result from weight training. According to recent studies, such claims contradict (Fleck & Kraemer, 2014).

Much may be gained through the systematic and intelligent application of modern weight training principles and techniques to training applications in the sports world. The use of the principles of overload coupled with progressive resistance through dynamic weight training programmes appears to be the most efficient and effective means of acquiring dynamic strength. The closer the weight training movement stimulates the actions in sports, the greater the transfer of strength to motor performance. Muscle enlargement (hypertrophy) does not reduce muscle endurance, for an increase in capillarization usually accompanies the cross-sectional increase of muscle fibres (Simon, 2019).

The relative use of weight lifting equipment in developing the muscles of the body in track and field events is not new to coaches and athletes. Track and field events, like any other power sports, need to develop and condition athletes' physical fitness components. It is a fact that well-toughened, strengthened muscles resist and endure fatigue-related stress, thereby performing better (Smith, 2018). Strength training can strengthen athletes and practitioners with just a few weekly sessions. One can do strength training with free weights such as barbells and dumbbells, weight machines or with no equipment at all (Simon, 2019).

However, in jumping events, it has been observed that hypertrophied muscles increase in size and functional capacities. From a practical viewpoint, most jumping activities require sufficient energy reserves for short bursts or runs (Smith, 2018). To effectively grasp the concept of this paper, the components of physical fitness were narrowed to the skill-related components, including agility, balance, coordinator, muscular power, reaction time and speed. Circuit weight and interval weight training are two important weight training methods used in training jumpers (DeMet & Wahl-Alexander, 2019).

Circuit weight training is the performance of several repetitions using a moderate amount of weight continuously, moving from one station to another with minimal rest between stations. Interval weight training requires the trainee to perform one set in every station with one-minute rest after each station/exercise before proceeding to the next circuit/round for three circuits (three non-consecutive sets per station for three circuits/rounds. Circuit training is a form of body conditioning that involves high-intensity aerobics and exercises performed in a circuit form (Tom, 2018).

The need to examine the effects of these two circuit training programmes was borne out of the fact which of them is most suitable for developing the skill-related physical fitness components of jumpers for optimal performance. This is to put to rest the discrepancies and arguments among coaches, trainers and jumpers about which circuit programme to singularly adept in training.

Based on these indecisions, this study seeks to compare the effects of circuit weight and interval weight training on jumpers' skill-related physical fitness components.

**Research Questions**

- Is there a difference between the effects of circuit weight and interval weight training programmes on jumpers' lateral explosive power?
- Is there a difference between the effect of circuit weight and interval weight training programmes on jumpers' vertical explosive power?
- Is there a difference between the effect of circuit weight and interval training programmes on jumpers' agility?
- Is there a difference between the effects of circuit weight and interval weight training programmes on jumpers' reaction time?
- Is there a difference between the effects of circuit weight and interval weight training programmes on jumpers' speed of movement?
- Is there a difference between the effects of circuit weight and interval weight training programmes on jumpers' balance?

- Is there a difference between the effect of circuit weight and interval weight training programmes on jumpers' coordination?

**Hypotheses**

The following hypotheses were postulated to address the problem of the study adequately:

1. There would be no significant difference between the effects of circuit weight and interval weight training programmes on jumpers' lateral explosive power.
2. There would be no significant difference between the effects of circuit weight and interval weight training programmes on jumpers' vertical explosive power.
3. There would be no significant difference between the effects of circuit weight and interval weight training programmes on jumpers' agility.
4. There would be no significant difference between the effects of circuit weight and interval weight training programmes on jumpers' reaction time.
5. There would be no significant difference between the effects of circuit weight and interval weight training programmes on jumpers' speed of movement.
6. There would be no significant difference between the effects of circuit weight and interval weight training programmes on jumpers' balance.
7. There would be no significant difference between the effects of circuit weight and interval weight training programmes on jumpers' coordination.

**Methodology**

**Research Design**

The randomized control group pretest-posttest experimental design was adopted for this study, and it describes what will be if certain variables are carefully controlled or manipulated.

**Population of the Study**

The population for this study were all male jumpers (long, high, and triple) attached to Delta State Sports Commission, comprising 15, 16, and 14 jumpers from each category, a totally of 45 jumpers.

**The Sample and Sampling Techniques**

The systematic sampling techniques were adopted for this study. The sample size was thirty-six (36) male athletes who were 12 high jumpers, long jumpers and triple jumpers training with the Delta State Sports Council. Their ages ranged from 18 to 21 years, with a mean of 20 years and a standard deviation of 0.7 years. The overall height of the jumpers ranged from 1.70 – 1.85m, with a mean of 1.76m. Their weight ranged from 59kg – 72kg, with a mean of 65.5kg. Twelve (12) jumpers in experimental group 1 were assigned to circuit weight training, while twelve (12) others for experimental group 2 were assigned to interval weight training. Twelve (12) jumpers, who were assigned to the control group, were not assigned to either circuit weight training or interval weight training programmes. Four (4) high, long and triple jumpers were in the two (2) experimental and control groups.

**Research Instrument**

The following research instruments were utilized for the study:

- Broad Jump
- Sargent Vertical jump
- Dodge Run

- 50 meters Dash
- Skipping
- Bass Test

**Validity of the Research Instrument**

The testing instruments have been validated elsewhere to authenticate their standardizations and universal usage.

**Reliability of the Research Instrument**

A pilot study was conducted for the study. The sample size consists of 12 male jumpers of 4 each in a high jumper, long jumper, and triple jumper. They were randomly assigned to 2 experimental and a control group. The Pearson Moment Coefficient of correlation statistics was used to measure the results acquired from the test-retest pilot study.

**Training Programme**

The training programme consisted of ten weeks of circuit weight, and interval weight training programmes performed three times a week. The training programs were mainly for lower extremities (legs) and only one for the arms. Experimental group 1. performed the circuit weight training programme, which consisted of three (3) consecutive sets of six (6) station circuits, with 3 minutes rest between the sets before proceeding to the next station. Experimental group II performed the interval circuit weight training programme, which consists of three (3) non-consecutive sets with one (1) minute rest observed after each exercise/station with the same six (6) station circuit. The stations are:

1. Bench press
2. Hamstring curl
3. Half-squat
4. Alternate jump
5. High step-up
6. Heel raise/lift

**Order of Data Collection:** The data collected for this study was carried out in two phases:

**Phase 1**: Measurement of physical characteristics, which include measurement of (a) height, (b) weights, (c) skin fold and body diameters.

**Phase II**: Field measurement tests were carried out, and they included the following **research instruments:**

- Broad jump for vertical explosive power
- Sergeant's jump for vertical explosive power
- Dodge run for agility
- Stick drop for reaction time
- 50-meter dash for speed
- Skipping for coordination
- Bass test for dynamic balance

The above field tests have been validated, and their reliability co-efficient is high (Oboh, 2006; Morehouse, 2010).

**Method of Data Analysis**

Inferential Statistics of Analysis of Covariance (ANCOVA) was adopted in analyzing the data. Post-hoc analysis was applied using Tukey Pairwise - Comparison Test to determine the specific treatment/group that contributed to the obtained difference.

**Findings and Discussions**

**Hypothesis 1:** There would be no significant difference between the effects of circuit weight training and interval weight training programmes on jumpers' lateral explosives.

**Table 1: Analysis of Co-Variance (ANCOVA) for Jumpers' Lateral Explosive Power**

| Source | Sum of Squares | DF | Mean squares | F |
|---|---|---|---|---|
| **Adjusted Treatment (AT)** | 0.27 | 2 | 0.135 | **9*** |
| **Error (Resw)** | 0.52 | 33 | 0.015 | |
| **Total Residual (Rest)** | 0.79 | 35 | | |

Thirty-six cases were proceeded: 24 exp, i.e. 12, for circuit weight training, 12 for interval training and 12 for the control group.

The calculated F-ratio of 9 at the 0.05 level of significance is greater than the F-critical value of 3.30. This was found statistically significant, indicating a significant difference between the effects of circuit weight training and interval weight training on jumpers' lateral explosive power. The null hypothesis of no significance was therefore rejected. Tukey Pairwise-Comparison test was used as a post-doc analysis to determine the sources of the significance further.

**Table 2: Summary of Tukey Pair-Comparisons Test Results for Jumpers' Lateral Explosive Power.**

| Means Compared | Mean Difference | r |
|---|---|---|
| **$\overline{X}1 - \overline{X}2$ = 25 – 2.52 =** | 0.01 < | **0.123** |
| **$\overline{X}1 - \overline{X}3$ = 2.51 – 2.35 =** | 0.16 > | **0.123** |
| **$\overline{X}2 - \overline{X}3$ = 2.52 – 2.35 =** | 0.17 | **0.123*** |

*** Significant at 0.05 level: r = 0.123**

The results in table 2 show that the paired means representing groups 1 & 3 and 3 & 3 were significant at a 0.05 level. The implication is that both circuit weight and interval weight training had substantial training effects on jumpers' lateral explosive power.

**Table 3: Analysis of Co-Variance (ANCOVA) for Jumpers' Vertical Explosive Power**

| Source | Sum of Squares | DF | Mean | F |
|---|---|---|---|---|
| **Adjusted Treatment (AT)** | 76 | 2 | 38 | **11.5*** |
| **Error (Resw)** | 107.4 | 33 | 3.4 | |
| **Total Residual (Rest)** | 183.4 | 35 | | |

Thirty-six cases were processed: 24 exp, i.e. 12 for circuit weight training, 12 for interval training and 12 for the control group.

* Significant at 0.05 level

The calculated F-ratio of 11.5 at the 0.05 level of significance is greater than the F-critical value of 3.30. This was found statistically significant, indicating a significant difference between the effects of circuit weight training and interval weight training on jumpers' lateral explosive power. The null hypothesis of no significance was therefore rejected. Turkey

Pairwise-Comparison Test was used as a post-doc analysis to determine the significance source further.

**Table 4: Summary of Turkey Pair-Comparisons Test Results for Jumpers' Vertical Explosive Power.**

| Means compared | Mean Differences | ɼ |
|---|---|---|
| $\overline{X}1 - X2$ = 946 – 946.3 = | 0.3 < | 1.8 |
| $\overline{X}1 - X3$ = 946- 944 = | 2 > | **1.8*** |
| $\overline{X}2 - X3$ = 946.3 – 943 = | 2.3 > | **1.8*** |

*** Significant at 0.05 level: ɼ = 1.8**

The results in table 4 showed that the paired means representing circuit weight training and interval weight training were responsible for the significant difference. This indicates their effectiveness in developing jumpers' vertical explosive power.

**Table 5: Analysis of Co-Variance (ANCOVA) for Jumpers' Agility**

| Source | Sum of Squares | DF Squares | Mean | F |
|---|---|---|---|---|
| **Adjusted Treatment (AT)** | 1.25 | 2 | 0.625 | **4.8*** |
| **Error (Resw)** | 4.31 | 33 | 0.13 | |
| **Total Residual (Rest)** | 5.56 | 35 | | |
| 36 cases were processed: 24 exp, i.e. 12 for circuit weight training, 12 for interval training and 12 for the control group. | | | | |

*** Significant 0.05 level**

The calculated F-ratio of 4.8 at the 0.05 level of significance, as shown in Table 5, is greater than the F-critical of 3.30. This was found to be significantly significant, indicating substantial effects of weight training techniques on jumpers' agility. The summary result for post-hoc analysis is presented in table 6.

**Table 6: Summary of Turkey-Comparisons Test Results for Jumpers' Agility**

| Means compared | Mean Differences | ɼ |
|---|---|---|
| **$\overline{X}1 - X2$ = 64.21 – 64.25 =** | 0.4 < | **0.52** |
| **$\overline{X}1 - X3$ = 64.21 – 63.21 =** | 1.00 > | **0.52*** |
| **$\overline{X}2 - X3$ = 64.24 – 63.21 =** | 1.03 > | **0,52*** |

*** Significant at 0.05 level: ɼ = 0.52**

As indicated in table 6, the paired means representing both experimented groups were responsible for the significant difference, which showed their efficacy as useful tools for enhancing jumpers' agility.

**Table 7: Analysis of Co-Variance (ANCOVA) for Jumpers' Reaction Time**

| Source | Sum of Squares | DF Squares | Mean | F |
|---|---|---|---|---|
| **Adjusted Treatment (AT)** | 12.26 | 2 | 6.13 | **8.7*** |
| **Error (Resw)** | 23.24 | 33 | 0.7 | |
| **Total Residual (Rest)** | 35.50 | 35 | | |
| 36 cases were processed: 24 exp, i.e. 12 for circuit weight training, 12 for interval weight training and 12 for the control group. | | | | |

*** Significant at 0.05 level.**

The calculated F-ratio of 8.7 is greater than the F-critical value of 3.30 at the 0.05 level of significance. The null hypothesis was therefore rejected, indicating a significant difference between the effects of circuit weight training and interval weight training programme on jumpers' reaction time. The summary result for the posthoc analysis is presented in table 8.

**Table 8: Summary of Turkey Pairwise-Comparisons Test Results for Jumpers' Reaction Time**

| **Means compared** | | **Mean Differences** | | **ɼ** |
|---|---|---|---|---|
| **$\overline{X}$1 – X2 = 6.61 – 6.62** | **=** | 0.01 | < | 0.05 |
| **$\overline{X}$1 – X3 = 6.61 – 6.69** | **=** | 0.08 | > | **0.05*** |
| **$\overline{X}$2 – X3 = 6.62 – 6.69** | **=** | j 0.07 | > | **0,05*** |

***Significant at 0.05 level: ɼ= 0.05**

As indicated in table 8, circuit weight training and interval weight training significantly impacted jumpers' reaction time based on the compared means.

**Table 9: Analysis of Co-Variance (ANCOVA) for jumpers' Speed of Movement**

| **Source** | **Sum of Squares** | **DF** | **Mean** | **F** |
|---|---|---|---|---|
| **Adjusted Treatment (AT)** | 0.621 | 2 | 0.313 | **31*** |
| **Error (Resw)** | 0.326 | 33 | 0.01 | |
| **Total Residual (Rest)** | **0.947** | **35** | | |
| 36 cases were processed: 24 exp, i.e. 12 for circuit weight training, 12 for interval weight training and 12 for the control group. | | | | |

The calculated F-ratio of 31 at the 0.05 level of significance is greater than the F-critical value of 3.30. There was an indication of a significant difference between the effects of circuit weight training and interval weight training on jumpers' speed of movement. The result of the post-hoc analysis is reflected in table 10.

**Table 10: Summary of Turkey Pairwise- Comparisons Test Results for Jumpers' Speed of Movement**

| **Means compared** | | **Mean Differences** | | **ɼ** |
|---|---|---|---|---|
| **$\overline{X}$1 – X 2 = 6.45 – 6.44** | **=** | 0.01 | < | 0.05 |
| **$\overline{X}$1 – X3 = 6.45 – 6.60** | **=** | 0.15 | > | **0.06*** |
| **$\overline{X}$2 – X3 = 6.44 – 6.60** | = | 0.16 | > | **0,06*** |

***Significant at 0.05 level: ɼ = 0.06**

The above result reveals that circuit weight training and interval weight training programmes significantly improved the speed of movement of jumpers, hence the obtained significant difference.

**Table 11: Analysis of Co-Variance (ANCOVA) for Jumpers' Balance**

| Source | Sum of Squares | DF | Mean | F |
|---|---|---|---|---|
| **Adjusted Treatment (AT)** | 4628 | 2 | 2314 | **11.3*** |
| **Error (Resw)** | 6721 | 33 | 204 | |
| **Total Residual (Rest)** | 11349 | 35 | | |
| 36 cases were processed: 24 exp, i.e. 12 for circuit weight training, 12 for interval weight training and 12 for the control group. | | | | |

***Significant at 0.05 level.**

In table 11, the calculated F-ratio of 11.3 at the 0.05 level of significance is greater than the F-critical value of 3.30. The null hypothesis of no significance was therefore rejected, which indicates that there is a significant difference between the effects of both training programmes on jumpers' balance. The summary result for the posthoc analysis is presented in table 12.

**Table 12: Summary of Turkey Pairwise-Comparison Test Results for Jumpers' Balance**

| Means compared | | Mean Differences | | ɼ |
|---|---|---|---|---|
| **$\bar{X}1 - X2$ = 76 - 73** | = | 3 | < | 6.2 |
| **$\bar{X}1 - X3$ = 76 - 64** | = | 12 | > | **6.2*** |
| **$\bar{X}2 - X3$ = 73 – 64** | = | 9 | > | **6.2*** |

***Significant at 0.05 level: ɼ = 6.2**

Indication from table 12 stipulates that both weight training programs were observed to be the source of the significance. Both training programmes are effective protocols for enhancing jumpers' balance.

**Table 13: Analysis of Co-Variance (ANCOVA) for Jumpers' Coordination**

| Source | Sum of Squares | DF | Mean | F |
|---|---|---|---|---|
| **Adjusted Treatment (AT)** | 9110 | 2 | 4555 | 9.9* |
| **Error (Resw**) | 15221 | 33 | 461 | |
| **Total Residual (Rest**) | 24331 | 35 | | |
| 36 cases were processed: 24 exp, i.e. 12 for circuit weight training, 12 for interval weight training and 12 for the control group. | | | | |

***Significant at 0.05 level.**

The calculated F-ratio of 9.9 at the 0.05 level of significance is greater than the F-critical of 3.30. This was found significant, indicating a difference between the effects of both training programmes on jumpers' coordination. The result of the post-hoc analysis is presented in table 14.

**Table 14: Summary of Turkey Pairwise-Comparison Test Results for Jumpers' coordination**

| Means compared | | Mean Differences | | ɼ |
|---|---|---|---|---|
| **$\overline{X}1 - X\ 2$ = 128 - 131** | = | 2 | < | 21.01 |
| **$\overline{X}1 - X3$ = 128 - 105** | **=** | 23 | > | **21.01*** |
| **$\overline{X}2 - X3$ = 131 - 105** | = | 26 | > | **21.01*** |

***Significant at 0.05 level ɼ = 21-01**

The results in table 14 reflect both training programmes as useful methods for developing jumpers' coordination

**Discussion of Findings**

**Lateral explosive power:** The experimental groups improved superiority over the control group. The null hypothesis was rejected, and comparatively, there were no differential effects between the training programmes. This may be due to the efficacy of both training programmes, which Nobel (2017) earlier observed as effective training for training jumpers.

**Vertical explosive power:** The result indicated a significant difference between the effects of circuit weight and interval weight training programmes. Further analysis revealed that the attained significant level was elicited by both training programmes, which did not comparatively differ. The findings of this study conformed with those of Adamson (2017) and Sorani (2018).

**Agility:** The result of ANCOVA revealed a significant difference between the effects of circuit weight and interval weight training programmes on jumpers' agility. The attained significant level resulted from the efficacy of both training methods, and they did not significantly differ comparatively from one another. The findings of this study were in consonant with the findings of Jenson (2016).

**Reaction Time:** A null hypothesis of no significant difference was reported between the two training programmes on jumpers' reaction time. However, the effects were comparatively different, as indicated by further analysis. Both training programmes were very effective in developing jumpers' reaction time. Even Bracko (2014) earlier reported similar findings in a related study.

**Speed of movement:** Results led to the rejection of the null hypothesis, and a significant difference between the effects of circuit weight and interval weight training on jumpers' speed of movement was reported. Comparatively, there were no differential effects between both training programmes. The findings of this study were in agreement with those of Hunter and Marshall (2017).

**Balance:** The null hypothesis of no significant difference was rejected; hence, there was a significant difference between the effects of both training programmes on jumpers' balance though comparatively, there were no differential effects between both training programmes. The findings of this study conformed with those of Wilmore (2017) and Shepard (2016).

**Coordination:** There was a significant difference between the effects of both training programmes on jumpers' coordination. There were no differential effects between both training programmes, and they equally served as useful tools for enhancing jumpers' coordination. The findings of Miller (2016) and Mayo (2016) agreed with this study's findings.

**Recommendations**

The following recommendations were made as a result of the findings from this study:

1) Circuit weight training and interval weight training should be interchangeably used for developing jumpers' skill-related physical fitness components for maximum performance.
2) The required adequate facilities and equipment for effective weight training sessions for jumpers' effective proficiency should be provided.
3) Further study is recommended using other sports.
4) This study recommends using female jumpers for further studies
5) The health-related physical fitness components should be further examined to determine if they are proficient in training jumpers.

**Conclusion**

All the null hypotheses of no significant difference were rejected. There were no significant differences between the effects of lateral explosive power, vertical explosive power, agility, and reaction time. So also as the speed of movement, balance and coordination.

It will be out of place to train and condition jumpers towards attaining maximum performance without developing their physical fitness components. This study only looked at the skill-related physical fitness components without the health-related physical fitness components because it will require a wider scope beyond the content of this study. Conclusively, circuit weight and interval weight training are very useful tools in developing, training and conditioning jumpers' skill-related physical fitness components for optimum performance.

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