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The Effect of Cluster Training with BCAA Supplementation on Protein Metabolism in Volleyball Players

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Abstract
The aim of this research was to identify the significance of the differences between the pre-test and post-test scores on the biochemical variables under study. The researcher used the experimental method to address the research problem, and the conclusions were as follows: All variables showed significant improvement as a result of the efforts made by the trainers. The cluster training method played a prominent role in the development of all variables for the experimental group, as evidenced by the observed differences in the results. The role of the BCAA supplement was also notable in the development of metabolic variables. Cluster training had a significant impact on the development of abilities, which facilitated more effective field application. The overall superiority of the experimental group in the post-test for the research variables indicates the effectiveness of the training modules and their application to the aforementioned group. The recommendations were: to regulate the dosage of BCAA supplements in conjunction with daily training sessions, and to implement cluster training as a core component of training sessions for different age groups; to guide new coaches towards using modern methods, as these have proven effective in achieving rapid development with balanced performance results; to conduct development workshops for coaches on the importance and methodology of cluster training and other modern methods; and to conduct similar studies using the cluster method for other categories and sports.
Keywords: Cluster training, volleyball, nutritional supplements, BCAAs.

Introduction

Introduction and Importance of the Research

Despite the significant advancements in the sports field resulting from scientific research that has contributed to raising the standards of all sports and athletic events, scientific research and specialists in sports training continue to work tirelessly to find the best and most effective methods for keeping pace with scientific advancements. This is achieved through the interconnectedness and integration of numerous theoretical and applied sciences that enrich the sports field and enhance the possibility of achieving optimal performance. Furthermore, the development of sports equipment, tools, and other factors have led to improved performance among athletes in international competitions and the emergence of record-breaking achievements. Therefore, studies and research related to the training process have helped coaches develop their knowledge of methods and techniques that can influence the success of the training process, including cluster training.

One of the most important modern training methods that has emerged globally in the last decade is cluster training, which relies on external resistance training. Its key feature is the provision of rest periods between repetitions, allowing for greater training volumes than other known methods. It is used to develop maximum strength, explosive power, and muscle hypertrophy, thus achieving important goals in sports and activities that demand peak performance, including volleyball.

7Through the researcher's readings and observations, it was found that the increasing level of competition not only focuses on updating training methods but also on developing the use of nutritional supplements that accelerate and enhance the benefits of modern training, thereby improving muscle strength. Among the most prominent supplements that have emerged strongly is branched-chain amino acid (BCAA) supplementation, making it a good option for enhancing strength training. One of the outcomes of strength training is building the muscle mass necessary for the game or activity, or at least maintaining it. It is essential to monitor precise biochemical indicators that reflect the balance in muscle building, the most important of which is protein metabolism. This measure helps determine an individual's protein requirements, as protein is the building block of muscle mass. It can also be described as the balance between the rates of protein breakdown and synthesis in the body. Monitoring the CpK and LDH enzyme levels is another important indicator that can reflect the integrity of muscle tissue and its ability to produce energy and achieve muscular strength in volleyball players. Therefore, the importance of this research lies in the use of cluster training for young volleyball players and its evaluation through specific physical ability values.

Research Problem

One of the most important issues in strength sports, in all its forms, is the relationship between muscle building and muscle breakdown, and the balance between the two. Each of these substances is crucial to the body's physiology. Athletes need to work diligently to find the best training methods to maintain their physical progress, develop their muscles, and maximize their potential.

Nutritional supplements play a vital role in compensating for or increasing the levels of essential components for muscle building and metabolic processes, especially during or near-intensive training sessions. This is because the body mobilizes all its cells for this purpose and therefore requires large quantities of nutrients. Nutritional supplements play this role in addressing these deficiencies.

Based on the above, it is clear that the repetition of varying training loads according to training programs throughout the training season results in some negative physiological effects. These effects necessitate nutritional compensation, in addition to appropriate training, to maintain muscle mass levels, particularly in young athletes. This can lead to changes in their technical and skill levels. 1-3 Research Objectives

To identify the significance of the differences between the pre-test and post-test in the biochemical variables under study.

Research Hypotheses

The researcher hypothesizes that there are significant differences between the pre-test and post-test in the variables under study, favoring the post-test.

Research Scope

- Human Scope: Volleyball players at the Dhi Qar Specialized Center, youth category (16-18 years old)
- Time Scope: December 13, 2024 to November 27, 2025
- Spatial Scope: The Youth and Sports Forum Hall in Al-Shatra District.

Research Methodology and Field Procedures

Research Methodology:

The researcher used the experimental method with a single group approach.

Research Population and Sample

The selection of a research sample is closely linked to the objectives set by the researcher for their study. Often, when studying a phenomenon, it is difficult for the researcher to utilize the entire population. It is often impossible to select, observe, or measure all these individuals under controlled conditions. Therefore, the researcher resorts to selecting a sample representative of the original population. A sample is "that part of the population on which measurements are taken, and it is selected according to scientific rules and methods so that it accurately represents the population" (Ma'youf, 2015, p. 57).

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The research population consisted of 24 young players aged 16-18 years at the specialized volleyball center in Al-Shatra district. The pilot study included 4 players from the youth category, representing 16.66% of the original population. Two players (the liberos) were excluded, resulting in a research sample of 9 players (50%) for the main experiment.

Sample Homogeneity

To ensure sample homogeneity, the researcher implemented several procedures to control variables, despite the sample being of similar age groups. Homogeneity was assessed for the entire sample. Statistical methods, including the arithmetic mean, standard deviation, and coefficient of variation for morphological measurements, were used to determine the presence or absence of differences. Table 1 illustrates these results. The coefficient of variation (CV) was found to be less than 30%, and sources indicate that a VV less than 30% indicates a homogeneous sample.

Table (1) shows the homogeneity of the research sample in terms of training age, height, weight, and morphological measurements using the VV.

Coefficient of variation	Standard deviation	Arithmetic mean	Unit of Measurement	Measurements
٪9.58	1.66	17.31	Year	Chronological Age
٪1.19	1.54	129.33	Month	Training Age
٪3.65	2.71	74.431	Kilogram	Mass
٪1.03	1.87	181.472	Centimeter	Height

Methods, Equipment, and Tools Used

Data Collection Methods:

- Arabic and foreign sources and references.
- Personal interviews.
- Observation and experimentation.
- Tests and measurements.

Tools and Equipment Used in the Research

The researcher used appropriate tools and equipment to fulfill the research requirements.

Field Research Procedures

Identifying Research Variables

The researcher identified the research variables after reviewing scientific sources and previous studies. These variables are:

1. LDH
2. CPK
3. Uric acid
4. Total protein

Describing the Tests Under Study

Physiological Procedures

1. Blood was drawn from the sample immediately after the stress test.
2. Immediately after the test, the player sat on a chair, and blood was drawn.
3. The blood was injected into a special ampoule, and the player's name was written on it by the specialized nurse.
4. 5cc of blood was drawn from each laboratory.
5. The blood was stored in a refrigerated container.
6. After the blood was drawn from the players, it was transported to the laboratory for analysis.
7. The blood was drawn by two specialized laboratory technicians.

Pilot Tests

First Pilot Test

The researcher conducted the pilot test on Friday, the 13th. On December 23, 2024, at 5:00 PM in the indoor sports hall of the Specialized Center in Al-Shatra District, a pilot study was conducted on a sample of four volleyball players from outside the research population. The purpose of this pilot study was to assess the physical capabilities of the participants, identify any weaknesses or challenges they might **encounter, and ensure the following**

1. The availability of appropriate equipment and tools for conducting the tests.
2. The availability of a suitable time and location for conducting the tests.
3. The adequacy of the support staff.
4. Training the support staff on how to administer the tests.
5. The identification of any difficulties or problems the researcher might face in administering the tests before their implementation in the main study.

The Second Pilot Study

The researcher conducted the second pilot study on Monday, December 23, 2024, at 5:00 PM in the indoor sports hall of the Specialized Volleyball Center in Al-Shatra District. This pilot study was conducted on the pilot group to standardize cluster training exercises, determine their load components (intensity, volume, and rest), and establish appropriate dosages.

1. To determine the sample group's ability to perform these exercises.
2. Determining the time required to perform these exercises.
3. Identifying the difficulties and problems the participants encountered in performing these exercises before implementing them in the main experiment.
4. Determining the appropriate dosage of the BCAA supplement used.

Main Experiment

Pre-tests for the Research Sample

The researcher conducted pre-tests and measurements for the experimental group before commencing the training program on Monday, Tuesday, and Wednesday, February 3-5, 2025, at 5:00 PM (in the indoor hall of the Al-Shatra Youth Forum, Dhi Qar, Al-Shatra). All (18) players in the research sample were present. On the first day, the researcher and his team took measurements (height, mass, and age) and then administered physical fitness tests.

Cluster Training Method

After reviewing sports training literature on cluster training and consulting with experts, sports trainers, and specialists in sports training, the training method and approach were determined. A training program was developed based on established scientific principles and the relationship between the components of the training load, tailored to the abilities and potential of volleyball players. The following are some clarifications regarding the completion of the prepared training program.

The researcher adopted the cluster training method in a way that closely addresses the specific needs of the skills, making it a scientifically sound training approach. This approach focuses on developing explosive power and speed-strength, as these are key elements in volleyball skill performance. The method also incorporates a moderate intensity approach within the cluster training framework, focusing on the components involved in skill execution.

Specific Explanations Regarding the Training Program:

Cluster training was implemented during the general preparation period, from Tuesday, February 16, 2025, to Thursday, April 3, 2025, with the experimental group. The group followed the program's components as prepared by the coach.

1. The researcher designed and implemented 18 exercises during the special preparation period. Ten of these exercises utilized weight machines in gyms to develop explosive power using a cluster approach, while the remaining eight exercises, designed by the researcher, were performed on a volleyball court.

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2. The researcher's exercises were divided into four coach-specific training modules, which were integrated with the experimental group's team coach program. Sundays and Wednesdays were dedicated to explosive power exercises, while Mondays and Thursdays focused on speed-strength exercises.
3. The exercises were implemented in 32 training modules over eight weeks of special preparation.

The Jake Boly (2018) model for cluster training was adopted as a working method in regulating the training load for the exercises performed. The researcher, after consulting with the supervisor, decided to choose this model of training load configuration as a basis for training the research sample in developing explosive power while reducing the intensity of the weights to suit the nature of performance in volleyball. The game requires developing speed of performance at the expense of strength, and therefore a level of 30-50% of the maximum weight that can be lifted was chosen instead of 90%. Thus, the proposed configuration is as follows:

Power Training. 3 (1-2-2) •x 5 sets with 15 seconds of rest between each repetition, 30-50% intensity, and 3 minutes of total rest between sets.

The intensity of explosive power exercises was regulated by the weight used, while the intensity of speed-strength exercises was regulated by the speed of execution.

The 2-1 system was adopted for alternating training loads during weekly sessions.

The volume of the training load was reduced while the intensity of the training was increased by decreasing the number of repetitions.

BCAA Dietary Supplement : The researcher worked on adjusting the dosage of the BCAA dietary supplement according to the recommendations of a specialized nutritionist and the instructions included on the supplement's packaging. The supplement powder was mixed with water; the amount stated in the packet was added to half a liter (0.5 liters) of water. The body was given a 5 ml dose before and after each training session, resulting in a total dose of 10 ml of the water-soluble compound. The doses were administered regularly, half an hour before the training session, to allow sufficient time for the body to absorb the compound and for it to begin working. The post-training dose was taken immediately after the cool-down at the end of the training session.

Post-Tests for the Research Sample. The post-test for the research sample was conducted on Saturday and Sunday, April 7-8, 2025 (in the closed hall of the Al-Shatra Youth Forum) after the completion of the eight-week program. The researcher ensured the provision of the necessary conditions and procedures for the pre-test, as outlined in the pre-test classifications, to assess physical abilities.

Statistical Methods

The researcher used statistical methods to analyze the results and test the research hypotheses, employing the Statistical Package for the Social Sciences (SPSS)

Presentation, Analysis, and Discussion of Results

Presentation and Analysis of the Pre- and Post-Test Results for the Second Experimental Group in Physical Skills, Volleyball Skills, and Physiological Performance:

Table (2) shows the means and standard deviations for the pre- and post-tests, the calculated t-value, the Sig value, and the significance level for the experimental group.

Meaning	Sig	value of t Semantic	Post-test		Pre-test		Variables
			Standard deviation	Arithmetic mean	Standard deviation	Arithmetic mean	
Morel	0.00	Semantic	58.45	524.16	41.68	409.16	LDH
Morel	0.00	Semantic	53.31	411.167	44.88	296.32	CPK
Morel	0.00	Semantic	0.20	3.76	0.210	5.90	Uric acid
Morel	0.00	Meaning	0.14	6.61	0.133	7.71	Total protein

Discussion of the Experimental Group Results

By reviewing Table (2), we observe the significance of all results and the validity of the post-tests for the first experimental group. The researcher attributes this to several reasons, including the correct planning and implementation of training units. Paying attention to the correct planning of units and exercises significantly contributes to understanding and standardizing training work and reducing the effort required to achieve the desired results. As Asil Thalj states, "Changes in the training plan prove effective in improving exercise planning and ensuring its consistent application for (12) weeks." (Thalj, 2021, p. 362)

The cluster training exercise on the second experimental group was characterized by the concurrent administration of nutritional supplements. These supplements generally convert protein in the small intestine into amino acids, which are then transported in the bloodstream to the liver. There, the amino acids undergo resynthesis and are then released from the liver into the tissues to be used for protein synthesis. However, some amino acids are not broken down in the liver. All other amino acids are regulated by the intestines and liver before being circulated elsewhere in the body. These are abbreviated as BCAAs (branched-chain amino acids) (Shehata, 2020, p. 33) (Nader, 2020, p. 18)

A sufficient quantity of branched-chain amino acids leads to a significant difference in energy levels and a noticeable increase in the ratios of many physiological variables. This type of amino acid is characterized by... Since it is a branched-chain amino acid that is not broken down in the liver, but rather gives its effect directly when it enters the bloodstream and muscles, taking a branched-chain amino acid (BCAA) supplement leads to an improvement in both physiological variables represented by the pulse rate and biochemical variables (LDH, CK, CPK and the percentage of T.P in the blood during 24 hours as well as uric acid). (Nader, 2020, p. 1)

The training process is a philosophy of the coach's thinking applied practically on the ground. The exercises implemented by the researcher represent his philosophy of cluster training. The training work takes into account the abilities and potential that the players have reached and studies their weaknesses. The researcher, Amir Abdul-Ridha, emphasizes that "it is important to point out that the coach's philosophy is applied to the exercises he chooses, or the training method or program" (Mazhar, 2023, p. 68). The researcher worked to diversify the exercises using the cluster training method. These exercises develop explosive leg and arm power and affect the muscles involved in performance primarily. This was achieved through understanding the technical aspects of the skill. Hussam Al-Momen et al. state that "coherence between exercises and training units is achieved through good distribution and division of exercises" (Salman Daoud Taima, 2024, p. 37)

Speed-strength and strength endurance are among the most important physical abilities, as they are the cornerstone of volleyball players' work. Jumping, hitting, and quick movement on the court require these abilities. Regarding physical fitness, Amjad Kadhim states, "Both speed-strength and strength-endurance are among the most important physical abilities, as they help the athlete maintain their speed for a relatively long period and resist fatigue" (Kadhim, 2023, p. 41)

Abbas Mohsen notes that "creating competition and excitement, on the one hand, and on the other hand, creates the appropriate motivation for athletes to engage in work and training" (Mohsen, 2024, p. 33)

Mohammed Hadi states that "ensuring that training, especially group training, includes the correct training requirements helps the group develop successfully and effectively" (Jasim, 2024, p. 22)

Conclusions and Recommendations

Conclusions

1. All variables showed significant improvement as a result of the efforts made by the trainers.
2. The cluster training method played a prominent role in the development of all variables for the experimental group, as evidenced by the observed difference in results.
3. The BCAA supplement played a significant role in the development of metabolic variables.
4. Cluster training had a significant impact on the development of abilities, which facilitated more effective field application.

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5. The overall superiority of the experimental group in the post-test for the research variables indicates the effectiveness of the training units and their application to the aforementioned group.

Recommendations

1. Work on regulating BCAA supplement dosages alongside daily training units, using cluster training and applying it as a fundamental component in training sessions for different age groups.
2. Guide new trainers to use modern methods, as they have proven their effectiveness in achieving rapid development with balanced performance results. 3. Conduct development workshops to train coaches on the importance and methodology of cluster training and other modern techniques.
3. The necessity of conducting similar studies using the cluster approach for other sports and categories.

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