

The Effect of Playing Exercises on the Concentration of cortisol Hormone for Futsal Players

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Abstract: The importance of research in employing playing exercises in building a training program based on the fact that integrated performance in this game depends on the interaction and entry of cortisol hormone and what are the functional changes to bring the training program (used in the research) to the safe side. The researcher uses the experimental method by designing two equal groups, control and experimental, to make it suitable. The research problem is that the experimental method is “an intentional and controlled change to the specific conditions of the phenomenon and to observe the results of the change in the phenomenon that is the subject of the study. The research community is determined in an intentional way, represented by the Kirkuk Educational Futsal Team players for the academic year (2023-2024). The number of players is (20) and the research sample was chosen intentionally and consisted of (18) players representing (80%) of the research community. Thus, they were divided into two experimental and control groups by drawing a lottery with (8) players for each group, after the researcher excluded (4) players, namely goalkeepers and injured players. To achieve the objectives of the study, the researcher assumed the significance of the differences in the results of the pre- and post-tests for the two

research groups (control and experimental) in the concentration of the cortisol hormone for futsal players. The significance of the differences in the results of the post-test for the two research groups (control and experimental) in the concentration of the cortisol hormone for futsal players. The researcher reaches a set of conclusions, the most important of which are: The use of playing exercises carried out by the experimental group significantly outperformed the control group in the concentration of the cortisol hormone, as we notice its return to its normal level after 24 minutes of rest during the evening period. So, this indicates that the training program prepared by the researcher is in accordance with the correct scientific foundations.

Keywords: Cortisol Hormone, Futsal Players, Training Program

Introduction

The scientific progress in various fields worldwide, including sports, requires specialists to reconsider and find the best and most accurate scientific methods to prepare training programs that aim to achieve outstanding athletic levels (Bekris, 2022; Farhani, 2022). This must be done according to the specificity of each activity and the goals intended to be achieved. Sports training is not an easy field or a random job that anyone can simply engage in. It is a science with its own specialists who understand its secrets, are experienced in its nuances, and recognize the interconnection between it and other sciences. Thus, successful sports training relies on choosing the appropriate training method for the goal of the training program and executing it well (Amani-Shalamzari, 2020; Ribeiro, 2022).

For physical and skill performance to be well-measured, we need a genuine understanding of energy production systems and the functional changes that occur in the body due to physical activity. These changes affect various body systems, and the body's response to physical load is managed through multiple systems and mechanisms. One of the most important systems involved is the endocrine system, which consists of glands that secrete hormones directly into the blood. Among these hormones is cortisol, which plays a crucial role in metabolism and contributes to the stability and balance of various bodily functions (Arruda, 2016; Nogueira, 2020; Tessitore, 2008).

Undoubtedly, changes in the human body, including variations in cortisol levels, lead to body imbalance and alterations in functional systems. These changes can lead to chronic adaptations, affecting athletes both positively and negatively. Furthermore, the increase or decrease of cortisol levels in the blood can result in immediate changes that may hinder the progress of futsal players in achieving their goals.

Hence, the importance of this research lies in employing play-based exercises to develop a training program. This approach starts from the understanding that integrated performance in this sport depends on the interconnection and interrelation between physical, skill, and functional aspects, as well as tactical aspects. Considering that performance endurance is a blend of physical attributes and motor skills, reflecting players' levels and capabilities during competitions, developing the physical aspect in isolation from the skill aspect is a waste of time and effort. This can only be achieved by understanding the functional changes to ensure that the training program (used in the research) reaches its intended goals.

Futsal is characterized by the intermingling of its skills and physical abilities, making it essential for players to possess an integrated combination of physical and skill aspects. This integration is reflected in performance endurance during competitions. Additionally, futsal primarily relies on the anaerobic system, requiring scientific knowledge and the amalgamation of various aspects in play-based exercises similar to what occurs during competitions. There is a training principle that states, "training is a reflection of competition."

More importantly, it is crucial to understand the changes in the hormonal system and its responses due to the physical exertion experienced by players in this sport. This can be assessed by examining cortisol levels during the recovery period. An increase in this hormone after recovery indicates a negative outcome as it leads to a weakened immune

system and muscle breakdown, adversely affecting the performance of the players. This is supported by Risan Khuraibit (2016)(1), who stated, "The increase in cortisol gives adverse health results, affecting the mood and athletic performance, causing continuous muscle breakdown, weakening the immune system of athletes, and leading to illness and injury due to muscle weakness. This can be observed by coaches through the fluctuating mood of the player, loss of motivation for training, and loss of appetite."

As a player and observer of this sport, the researcher has noticed a weakness among the Physical Education team players in Kirkuk Governorate in physical aspects, which undoubtedly negatively impacts skill aspects, especially in the last quarter of matches. This is attributed to poor performance endurance, leading to weak execution of basic skills and a lack of focus by coaches on changes in the endocrine system. The significance of differences in the results of the pre-test and post-test for the control and experimental groups in cortisol concentration among futsal players. The significance of differences in the post-test results between the control and experimental groups in cortisol concentration among futsal players.

Methodology

Research Hypothesis:

- There are significant differences between the pre-test and post-test results for the control and experimental groups in cortisol concentration among futsal players, in favor of the post-test.
- There are significant differences in the post-test results between the control and experimental groups in cortisol concentration among futsal players.

Research areas:

- Human Domain: Futsal players of the Kirkuk Education team for the academic year 2023/2024.
- Time Domain: From 8/12/2023 to 9/3/2024.
- Place Domain: The indoor hall of the Sports Activity Department in Kirkuk.

Population and Sample:

The research population was deliberately selected, consisting of futsal players from the Kirkuk Education team for the academic year 2023-2024, totaling 20 players. The research sample was also selected deliberately, consisting of 18 players, representing 80% of the research population. They were divided into two groups, experimental and control, through a lottery, with each group comprising 8 players. The researcher excluded 4 players, including goalkeepers and injured players. Table (1) illustrates this.

Table 1. Research population, sample, excluded players, and percentage

Research population	Number	Percentage
Research sample	16	80%
Excluded players	2	10%
Exclude goalkeepers	2	10%

Homogeneity of the Research Groups:

Homogeneity was ensured for the research sample in the variables of (weight, height, chronological age, and training age). Table (2) illustrates this.

Table 2. The means, standard deviations, modes, and skewness values for the variables (mass, height, chronological age, training age) are shown.

	Variables	measruing unit	Sample	Mode	Skewness
1	Weight	Kg	(64.07±1.80)	62	0.430
2	Height	cm	(165.62±2.27)	166.00	0.028
3	Chronological age	year	(16.00±0.73)	16.00	0.000
4	Training age	year	(3.12±0.71)	3.00	-0.192

The skewness values range between (± 1), indicating a normal distribution for the research sample. This means that the sample is homogeneous within the aforementioned variables.

Equivalence of the Research Groups: The researcher established the equivalence between the research groups in the variables under study, as shown in Table (3).

Table 3. Researcher established the equivalence between the research groups in the variables under study.

Variables		measruing unit	Control group	Experimental Group	Rate(T) Calculated	Valuable (Sig)	Meaning of differences
Cortisol hormone	Before exertion	2.68-10.5 μ g	(7.30±0.20)	(7.50±0.29)	1.595	0.133	N.S
Cortisol hormone	24 minutes after exertion	2.68-10.5 μ g	(15.06±0.72)	(15.19±0.64)	0.39	0.700	N.S

The significance levels are greater than 0.05, indicating that there are no statistically significant differences between the experimental and control research groups. This shows their equivalence in the aforementioned variables.

Research Methodology:

The researcher used the experimental method with the design of two equivalent groups, the control and the experimental, as it is suitable for the research problem. The experimental method involves "a deliberate and controlled change of the specific conditions of the phenomenon and observing the results of the change in the phenomenon under study" (Abbas et al., 2012)

Tools Used:

- Personal interviews: The researcher conducted personal interviews (Appendix 9) with several experts in the fields of training physiology, measurement and evaluation, sports training, and football to understand how to measure cortisol hormone.
- Testing and measurement.

- Observation.
- References and scientific sources (Arabic and foreign).
- A compression band for the upper arm.
- Transparent plastic tubes with a capacity of 5 c.c.
- Medical syringes for drawing blood (5 c.c).
- Medical cotton.
- Cool box for preserving blood samples during transport to the laboratory.
- Disinfectant (alcohol).
- Centimeter measuring tape.

Instruments Used:

- Medical scale for measuring weight (Made in China) - 1 unit.
- Centrifuge with a speed of 3000-5000 rpm for separating blood serum.
- Micro Centrifuge (Made in China) with a speed of 3000-5000 rpm for determining hemoglobin levels.
- Cobase411 (Made in Germany) for measuring cortisol hormone levels.

Measurement of Cortisol Hormone:

The researcher, with the help of the assistant team, conducted the cortisol hormone measurement before exertion at exactly 4:00 PM, after the participants arrived at the field. All subjects sat quietly in the field to achieve complete rest. A venous blood sample of 5 c.c. was drawn by the medical assistant team. This procedure was done before the warm-up, and the blood was placed in E.D.T.A. tubes, which contain an anticoagulant. Each tube was labeled with the player's name, then placed in a cool box and transported directly to the laboratory for separation and analysis of cortisol concentration. After this, the participants engaged in the exertion of the match. Following the match, they were given a 24-minute rest period, after which another venous blood sample was taken, and the same procedures as before exertion were repeated. It should be noted that this procedure was carried out for both the pre-test and post-test for the control and experimental groups.

scientific Basis for the Tests:

A standardized test is "a test that, when tried on samples similar to the one to be tested, has shown a high degree of validity in terms of reliability, stability, and objectivity under the same conditions and available capabilities" (Naji & Ahmed, 1987)

Regarding the tests used in the current research, they are all commonly used scientific tests suitable and valid for the research sample. They have been applied in all studies related to futsal for both youth and advanced categories, such as the studies by (Mahmoud Younes *et al.*, 2017, and Mohammed Sharqi Hadi Al-Husseini, 2021).

Variables in Research and How to Control Them

Experimental research is characterized by the presence of dependent and independent variables. It is essential to identify these variables due to their significant importance. In this research, they are as follows:

Independent Variables in the Research:

- Play exercises.

Dependent Variables in the Research:

- Anaerobic performance endurance.
- Skill-related variables.
- Cortisol hormone concentration.

Field Procedures Used in the Research

Pilot Experiments:

1. First Pilot Experiment: Conducted on Monday, December 11, 2023, to approve the exercises after understanding their application and identifying potential errors, as well as determining the duration of each exercise.
2. Second Pilot Experiment: Conducted on Wednesday, December 13, 2023, to verify the feasibility of the selected tests and familiarize the assisting team with the work process and registration method. Tests were then distributed over three days.
3. Third Pilot Experiment: Conducted on Thursday, December 14, 2023, aimed at identifying the maximum values for the exercises used.
4. Fourth Pilot Experiment: Conducted on Friday, December 15, 2023, aimed at determining the rest periods between repetitions and sets, and the appropriate repetitions for each exercise according to the used intensities.

Designing the Play Exercises Used in the Research

After analyzing the content of sources and scientific studies, the play exercises specific to the research (Appendix 6) were designed in a questionnaire form. They were distributed to specialists in sports training science, football, and futsal to assess their suitability.

Pre-test of Cortisol Hormone Concentration

Pre-tests were conducted on December 17, 2023, to measure cortisol hormone concentration as previously explained.

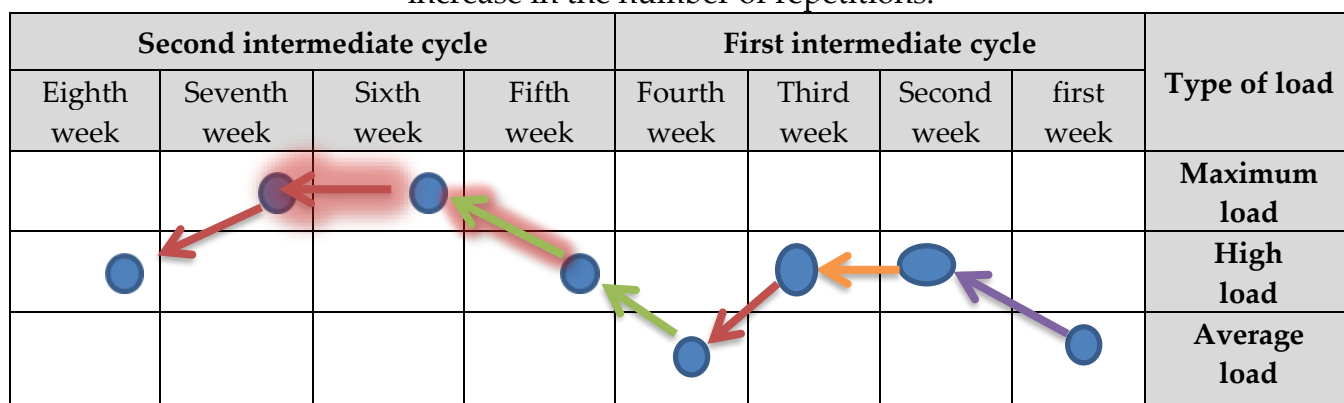
Implementation of Play Exercises Used in the Research

After completing all the pre-tests, the play exercises prepared by the researcher were implemented on the experimental group from December 21, 2023, to March 1, 2024. Meanwhile, the control group followed a program prepared by the team's coach (Appendix 10). The following points were considered during the implementation of the play exercises:

- All training units started with general warm-up followed by specific warm-up for the muscles involved in each exercise within a single training unit.
- Three training units per week were executed for eight weeks, resulting in a total of 24 training units for the training program.
- The experimental group's training program included two mesocycles, each consisting of four microcycles with a wave-like load progression in each mesocycle (1:3).
- The training units for the experimental and control groups were conducted on Thursdays, Sundays, and Tuesdays.
- Exercise duration ranged from 50 to 180 seconds.
- High-intensity interval training was used.

- Rest duration between repetitions was determined through the third pilot experiment, ensuring heart rate returned to 120-130 beats per minute.
- Rest periods between exercises were determined through the third pilot experiment.
- Training load for similar exercises was controlled by varying training volumes and rest periods while maintaining intensity.
- The intensity used was competitive performance intensity.
- The training program was implemented during the specific preparation phase.
- All exercises in the experimental group's program were applied at the beginning of the main section.
- The duration of the training unit ranged from 28 to 60 minutes.
- Load progression in the training program was based on increasing the total training volume for each microcycle, as shown in Figure 1.

Figure 1. shows the fluctuation of the training load movement in the weekly cycles based on the increase in the number of repetitions.



Post-tests:

After completing the training programs for both the control and experimental groups, the researcher conducted the post-tests on 2-4 / 3 / 2024 under the same conditions as the pre-test.

Statistical Methods:

- Percentage
- Mean
- Mode
- Standard Deviation
- Skewness Coefficient
- Paired Sample t-test
- Independent Sample t-test

The data were statistically analyzed using the SPSS software.

Result and Discussion

Differences Between the Pre-test and Post-test Results for the Control Group in Cortisol Hormone Levels for Futsal Players:

It is evident from Table (4) there are significant differences between the pre-test and post-test results for the control group in some of the investigated variables (cortisol hormone concentration after exertion) for futsal players. The t-value for these variables was 18.33, while the sig-value for these variables and cortisol concentration after exertion was 0.000, which is less than 0.05 and there are no significant differences between the pre-test and post-test results for the control group in moderate and long anaerobic performance endurance and cortisol hormone concentration before exertion for futsal players. The t-value was 0.78, and the sig-value for these variables was 0.460, which is greater than 0.05.

Table 4. Cortisol Hormone Levels for Futsal Players in the Control Group in Pre-test and Post-test.

Variables		measruing unit	Pre-test	Post-test	Rate(T) Calculated	Valuable (Sig)	Meaning of differences
Cortisol hormone	Before exertion	2.68-10.5 µg	(7.30±0.20)	(7.17 ± 0.51)	0.78	0.460	N.S
Cortisol hormone	24 minutes after exertion	2.68-10.5 µg	(15.06±0.72)	(10.93 ± 0.30)	18.33	0.000	Significant

The researcher attributes the development in the control group to the use of exercises prepared by the coach and applied in the training program, following the coach's specific method. Although the significance of the results was clear in the tests shown in the tables above, the differences between the tests varied. The observed improvement in this group was due to the training methodology followed by the coach, which was effective in enhancing this group in the aforementioned variables. Additionally, the coach's role in motivating the control group members to perform at their best during training, tests, and competition contributed to their improvement. However, they did not reach the level of the experimental group, which benefited from a more specialized training program and exercises designed to stress the energy systems relevant to the game. These exercises closely resembled match conditions. As Mofta Ibrahim (1999) emphasized, "To achieve a good level in a match, it is essential to focus on the careful selection of purposeful exercises and place the player in training conditions that closely resemble match conditions (Hamad, 1999).

Differences between the pre-test and post-test results for the experimental group and the post-test results for both the control and experimental groups in cortisol hormone concentration for futsal players.

It is evident from Table (5) There are significant differences between the pre-test and post-test results for the control group in some of the investigated variables (cortisol hormone concentration after exertion) for futsal players. The t-value for these variables was 24.17, while the sig-value for these variables and cortisol concentration after exertion was 0.000, which is less than 0.05 and there are no significant differences between the pre-test and post-test results for the experimental group in cortisol hormone concentration before exertion for futsal players. The t-value for this variable was 1.51, and the sig-value was 0.174, which is greater than 0.05.

Table 5. Cortisol Hormone Levels for Futsal Players in the experimental group in Pre-test and Post-test.

Variables		measruing unit	Pre-test	Post-test	Rate(T) Calculated	Valuable (Sig)	Meaning of differences
Cortisol hormone	Before exertion	2.68-10.5 µg	(7.50±0.29)	(7.38 ± 0.17)	1.51	0.174	N.S
Cortisol hormone	24 minutes after exertion	2.68-10.5 µg	(15.19±0.64)	(10.04 ± 0.40)	24.17	0.000	Significant

It is evident from Table (9) There are significant differences between the post-test results of the control and experimental groups in some of the investigated variables (cortisol hormone concentration after exertion) for futsal players. The t-value for these variables was 5.000, while the sig-value for these variables and cortisol concentration after exertion was 0.000, which is less than 0.05 and there are no significant differences between the post-test results of the control and experimental groups in cortisol hormone concentration before exertion for futsal players. The t-value for this variable was 1.112, and the sig-value was 0.285, which is greater than 0.05.

Table 6. Cortisol Hormone Levels for Futsal Players in the control and experimental groups in Post-test.

Variables		measruing unit	Control group	Experimental Group	Rate(T) Calculated	Valuable (Sig)	Meaning of differences
Cortisol hormone	Before exertion	2.68-10.5 µg	(7.17±0.51)	(7.38 ± 0.17)	1.112	0.285	N.S
Cortisol hormone	24 minutes after exertion	2.68-10.5 µg	(10.39±0.30)	(10.04 ± 0.40)	5.000	0.000	Significant

Differences between the pre-test and post-test results for the experimental group and the post-test results for both the control and experimental groups in anaerobic performance endurance, cortisol hormone concentration, and some basic skills for futsal players.

The researcher attributes the observed changes in cortisol levels to the effectiveness of the similar exercises and the scientifically-based regular training program. This program involved physical loads with appropriate intensity, volume, and rest, tailored to the capabilities of the group members. This approach enhanced the functional and vital systems through the changes resulting from their responses to the applied exercises, particularly the hormonal system, which is crucial for managing physical exertion and regulating metabolic processes to provide necessary energy for sustained performance.

The significant results indicate an adaptation of cortisol levels in the sample, consistent with George and Thomas (1984), who noted that "hormones respond to athletic training to meet metabolic demands, and the duration of hormonal response depends on the intensity and duration of the exercise." It is evident that cortisol levels before exertion were within normal limits in the evening, confirming the validity of the test procedures and isolating extraneous variables from the research sample. Additionally, cortisol concentration at 24 minutes post-exertion was within normal limits, attributed to the hormone's secretion dependence on exercise intensity and duration. Bahaa Eldin Salama (1994) stated that "hormonal responses depend on exercise intensity and duration, with rapid responses being more sensitive to exercise intensity compared to delayed responses." Ahmad Nasr Eldin Said (2003) emphasized that "under the influence of physical exertion, cortisol secretion increases, aiding metabolic processes, especially concerning carbohydrates by accelerating glycogen conversion to glucose, thus raising blood glucose levels." Abu Ala Ahmad Abdel Fattah (2003) added that "levels of growth hormone, cortisol, and insulin change during physical activity, with insulin decreasing and glucagon increasing with exercise intensity, while growth hormone and cortisol levels rise to support growth hormone function by mobilizing free fatty acids and reducing amino acid absorption, aiding in glycogen rebuilding.

The lack of increased cortisol levels at 24 minutes post-exertion can be attributed to two reasons: first, the half-life of cortisol is around 24 minutes post-exertion, as noted by Ahmad Nasr Eldin Said (2003). Second, the researcher attributes this to the effectiveness of

the training program designed by the coach, which appropriately regulates training loads based on players' physical, functional, and health capacities. Ahmad Hashmet and Nader Hussein (2001) stated that "an increase in cortisol concentration during rest is a sign of overtraining," and Risan Khreibet and Abu Ala Abdel Fattah (2016) noted that "intense training associated with stress and strain is the main factor in elevated cortisol levels, which remain high for up to two hours post-training, potentially leading to health risks, including immune system suppression and muscle weakness if training doses are repeated without adequate rest.

The importance of the coach's role in regulating the training load cannot be overstated. Monitoring cortisol levels is crucial, as prolonged elevated cortisol can negatively affect mood, athletic performance, and lead to muscle breakdown, which impairs the immune system and increases the risk of illness and injury. Coaches should be vigilant in addressing any signs of excessive cortisol to prevent continued muscle degradation and maintain optimal athletic performance.

Conclusion

There were significant differences in cortisol hormone concentration after physical exertion in the control group, indicating the body's adaptation to the given training. The experimental group showed a significant decrease in cortisol hormone concentration after physical exertion, indicating the effectiveness of the scientifically designed play-based training program. The experimental group demonstrated better results than the control group in terms of reducing cortisol hormone concentration after physical exertion.

The specially designed play-based training program proved to be more effective in managing cortisol hormone concentration compared to the standard training program. These exercises helped in better hormonal adaptation, supporting metabolic stability, and providing sufficient energy for sustained performance.

Cortisol plays a crucial role in metabolism and the body's response to physical activity. The increase in cortisol after training indicates appropriate training load and good body adaptation, while the significant decrease in the experimental group shows well-regulated training loads.

The researcher recommends adopting similar play-based exercises for training futsal players and using cortisol hormone concentration measurements during recovery as an indicator for adjusting training programs. In conclusion, well-designed play-based exercises can enhance futsal players' performance by effectively managing cortisol hormone concentration, highlighting the importance of a scientific approach in designing sports training programs.

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