The effect of glycogenic training on some physical variables and cortisol and testosterone levels in soccer players

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Introduction and Research Problem:

Improving the scientific and educational aspects of the training process cannot be achieved without an understanding of the different sciences related to the training process including physiology and chemistry. These sciences show us the extent of responses, adaptations, and changes that result from the different types of training (physical, skills, tactical, psychological) to the physical systems of the athlete and the extent of the athlete's response to these exercises. A successful trainer is someone who obtains information that enable him to understand what happens to the athletes' physical systems when the athletes perform aerobic and anaerobic exercises.

Soccer is the most popular sport in the world, therefore it has acquired a growing international interest, and specialists have always worked on developing it by elevating the players' level with respect to the different preparation aspects especially physical and physiological qualities, which are considered the link between the skill performance and motor qualities of a soccer player (23: 56).

Reilly (2000) and Ryder (2004) agree that soccer has a positive effect on all physiological, physical, skills, tactical, and psychological variables. It improves blood circulation and biochemical variables, activates the player's internal systems, and is closely connected with the individual's characteristics and capacities (33: 101)(35:44).

Salama (2000), Abdel Fattah and Shaalan (2002), and Arnason (2004) point out that the nature of soccer players' performance during the game is characterized by the difference in performance methods, in terms of frequency and diversity of moves

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including fast running with and without the ball, high jumps, changing directions while running, kicking the ball, getting the ball, and other performance moves that change according to the changing playing conditions (8: 270-271) (1: 129) (24: 278).

Arturas et al. (2001) also note that the soccer player's performance level depends mostly on his physical and physiological capacities, as performance in soccer is not constant. Therefore, special endurance is one of the most important elements of the soccer player's physical preparation, as it is a basis for improving skills, technical, tactical, and psychological performance of the player (25: 29).

Soccer is one of the activities characterized by both aerobic and anaerobic work, as the player needs aerobic capacity because of the long duration of the game as well as anaerobic capacity in the performance of some attack skills such as counter attacks. Physiological capacities play a role in accomplishing attacks and in the performance at the end of the game when muscular fatigue occurs (12: 87).

Saad Eddin (2000) and Bastawissy (2000) point out that blood is highly affected by the different types of sports activities as it plays a vital role in oxygen transfer from the respiratory system to other cells, as well as transferring food from the digestive system and removing wastes resulting from the processes of burning and oxidation from body tissues. These functions become more important during strenuous physical effort, as certain changes in its components take place in response to the type of exerted physical effort, so that the body can effectively perform its functions (19: 115) (7: 111).

Anne (2006) adds that the endocrine system works on integrating the effects of food and exercising on reshaping the body, and the outcome of physical performance. Moreover, exercising imposes physical demands in two directions: first, a mechanical load (pressure, tension, revolving) on working muscles, and secondly, the working muscle needs metabolic energy to obtain the required energy to overcome the mechanical load (22: 453).

Astrand and Rod Hal (2003) add that cortisol and testosterone levels, blood volume, and red blood cells increase in trained persons compared to non-trained persons. It is also noted that height training leads to and increase in blood volume and hemoglobin volume as an outcome of the increase in plasma volume and blood cells. Additionally, hemoglobin concentration and red blood cell count increase (23: 443).

The corisol level can increase or decrease compared to the pre-exercising level by more or less than 60% of the maximum vital capacity of oxygen consumption (VO2max). Testosterone increases muscular protein without affecting the protein degradation process, or any effect on the transfer of amino acids inside the muscle (26: 864-871).

The researcher has reviewed a number of previous studies including Abdel Hamid, A. A. (2013): "The effect of using anaerobic (glycogenic) physical effort on some physiological variables and the level of accuracy in aiming in basketball players"; Abbas, L.M. (2013): "The effect of competition effort on the level of cortisol and insulin and lactic acid in youth basketball players"; Ahmad, W.Y (2013): "Testosterone levels and their effect on some liver enzymes in bodybuilders"; Ali, A.S. (2008): "The effect of the anaerobic threshold load intensity on some physiological variables and the cortisol, masculine, and growth hormones concentration levels"; Mohamed, N.S (2005): "The effect of a proposed training program of morning biorhythm on cortisol and anxiety and the level of performance on the balance beam"; Strobel (2003): "The effect of running on the treadmill on the concentration of Noradrenaline in male athletes". These studies found that high intensity training improves the level of cortisol and testosterone hormones as well as physical capacities, which improves skills performance.

The researcher observed some deficiencies in training programs through his work in soccer training in several Egyptian clubs, as they neglected the development of anaerobic endurance, especially the ones based on energy generation systems that have and efficient impact in raising the functional capacity of the vital systems. This is evident from the continental levels compared to the international levels. The player needs the energy provided by the glycogenic system, especially the anaerobic one. Therefore, the players' high performance throughout the game is linked to the improvement of glycogenic anaerobic capacities of the players. Thus, it is important to use glycogenic anaerobic efforts during the training process. This motivated the researcher to conduct the present study in order to identify the effect of glycogenic training on some physical variables, and cortisol and testosterone levels in soccer players.

Research Objective:

This research aims at identifying the effect of the glycogenic training on some physical variables as well as the levels of cortisol and testosterone in soccer players.

Research Hypotheses:

- There are statistically significant differences between the pre-test and post-test measurements of some physical variables and the level of cortisol and testosterone in the soccer players of the experimental group.
- There are statistically significant differences between the pre-test and post-test measurements of some physical variables and the level of cortisol and testosterone in the soccer players of the control group.
- There are statistically significant differences between the post-test measurements of some physical variables and the level of cortisol and testosterone in the soccer players of the experimental and control groups.

Research terms:

- Endocrine glands: ductless glands that secrete their substances directly into the blood stream without any ducts between the gland and the blood stream (30: 210)
- Cortisol: A hormone that is secreted by the Adrenal Cortex and it works on increase protein synthesis and reducing glucose in tissues.
- Testosterone: is the male hormone which is produced by the testicles. It serves in increasing protein synthesis

and the production of sperms (30: 115)

Research Procedures:

Research Methodology:

The researcher used the experimental method with two groups: an experimental group and a control group. He used the pre- test/ post- test measurement experimental design as it was deemed the most appropriate for the nature of this research.

Research Population:

The research population consisted of male soccer players under 18 years of age registered at 6th October club, Guiza Governorate, in the sport season 2013/2014.

Research Sample:

The research sample was selected by complete census method from all the soccer players below 18 years of age at 6th October club. The research sample consisted of 32 soccer players below 18 years of age. The goalkeepers (two) were excluded. The core sample consisted of 22 players divided into two groups: an experimental group and a control group. Each group consisted of 11 players.

Table (1)

Means, Medians, Standard Deviations, and Skewness Of Growth Rates, Physical Variables, Cortisol and Testosterone Levels in the Experimental Group and the Control Group (N = 22)

Variables		Measurement Unit	Experimental Group				Control Group			
			Mean	Median	SD	Skewness	Mean	Median	SD	Skewness
Growth rates	Age	Year	17.1	17	0.95	1.01	17.6	17.5	1.95	1.12
	Height	Cm	160.2	160	1.12	0.95	163.2	163	1.25	1.52
	Weight	Kgm	55.6	55.2	2.11	0.96	56.1	56	2.21	1.65
	Training period	year	4.6	4.2	2.61	1.12	4.1	4.0	0.94	1.20
Physical tests	Speed of composite motor performance	Second	4.42	4.2	2.30	1.23	4.45	4.2	2.25	1.23

Follow Table (1)

Means, Medians, Standard Deviations, and Skewness Of Growth Rates, Physical Variables, Cortisol and Testosterone Levels in the Experimental Group and the Control Group (N = 22)

Variables		Measurement Unit	Experimental Group				Control Group			
			Mean	Median	SD	Skewness	Mean	Median	SD	Skewness
	Running 30m × 5	Second	28.3	28	1.25	1.65	28.1	27.6	1.62	2.51
	Performance endurance	Second	55.1	55	1.65	1.85	54.8	54.5	2.11	1.65
	Zigzag run (Barrow)	Second	8.3	8.2	2.12	1.98	7.9	7.5	2.20	1.87
Biochemical	Cortisol	Milligram/ deciliter	13.22	13.20	0.51	0.021	13.28	13.22	0.27	0.058
	Testosterone	Milligram/ deciliter	519.21	519.0	2.98	0.0028	515.62	515	2.19	0.0027

Table (1) demonstrates that the skewness coefficients of growth rates, physical variables, and cortisol and testosterone levels examined in both the experimental and control groups are in the range of ±3, which indicates the moderate distribution of the sample with respect to these variables.

Data collection tools:

A. Used measuring tools and devices:

1. A restameter for measuring height, measurement unit is the centimeter.
2. A scale for measuring weight, measurement unit is the kilogram.
3. A set of digital stopwatches of the same type that work to the nearest 1/100, measurement unit is the second.
4. Soccer s, medicine balls, Swedish benches, graduated ruler, clubs, lime, cones, sticks.
5. A set of glass tubes for blood samples and anticoagulants (Heparin).
6. Sterilized plastic 5-cm syringes.
7. Ice box to put the blood tubes until they are transferred to the laboratory.
8. ELISA Colorimeter device to measure the biochemical variables of the research.

The proposed training program (attachment 4):

− Purpose of the program:

The training program aims at improving some biochemical (cortisol and testosterone), and physical variables in soccer players under 18 years of age according to the glycogenic training method. Doing this, the researcher seeks to make the players achieve the best possible technical level.

− Steps of designing the training program:

The researcher used the opinions of 8 experts in the field of sports training and soccer training (attachment 1) through an opinion poll form about the themes and duration of the proposed training program (attachment 3). The acceptance rate reached 75% as follows:

− The number of training modules during the special preparation period (6 weeks):

− The number of training modules per week = 4 training modules

− 4 modules × 6 weeks = 24 training modules

− Duration of the daily training modules 90-120 minutes

− Average module duration = 90 + 120 = 210 ÷ 2 = 105 minutes

− Average module duration = 105 minutes

− Duration of the training modules of the program = 24 modules × 105 minutes = 2520 minutes

− The total duration of the program was divided to the load degrees according to the limited load cycle (1 : 2).

Results and Discussion:

A. Results:

Table (2)

Significance of the statistical differences between the Means of the pre-test and post-test measurements in physical and biochemical variables of the experimental group (N = 11)

Variables		Measure-ment unit	Pre-test		Post-test		Difference between Means	Improve-ment rate	Calculated t value
			M	SD	M	SD			
Physical tests	Speed of composite motor performance	Second	4.45	2.25	3.90	2.11	0.55	14.1%	3.80*
	Running 30m × 5	Second	28.1	1.62	22.4	1.45	5.7	25.4%	4.25*
	Performance endurance	Second	54.8	2.11	49.1	2.60	5.7	11.6%	3.99*
	Zigzag run (Barrow)	Second	7.9	2.20	6.5	2.14	1.4	21.5%	3.98*
Biochemical capacities	Cortisol	Milligram/ deciliter	13.22	0.51	19.22	0.98	6.00	45.38%	2.65*
	Testosterone	Milligram/ deciliter	519.21	2.98	625.25	8.98	106.04	20.42%	3.98*

* Value of tabular t at level 0.005 = 2.08

Table 2 shows statistically significant differences between the pre-test and post-test measurements of the experimental group with respect to the physical and biochemical variables in favor of the post-test measurement. Moreover, the improvement rate ranges between 11.6% and 45.38%.

Table (3)

Significance of the statistical differences between the Means of the pre-test and post-test measurements in physical and biochemical variables of the control group (N = 11)

Variables		Measure-ment unit	Pre-test		Post-test		Difference between Means	Improve-ment rate	Calculated t value
			M	SD	M	SD			
Physical tests	Speed of composite motor performance	Second	4.24	2.30	4.20	2.11	0.22	5.2%	3.22*
	Running 30m × 5	Second	28.3	1.25	26.5	2.12	1.8	6.7%	3.24*
	Performance endurance	Second	55.1	1.65	53.6	2.65	1.5	2.7%	3.90*
	Zigzag run (Barrow)	Second	8.3	2.12	7.6	1.17	0.7	9.2%	3.70*
Biochemical capacities	Cortisol	Milligram/ deciliter	13.28	0.27	13.35	0.21	0.07	0.52%	1.17
	Testosterone	Milligram/ deciliter	515.62	2.91	521.15	0.98	5.53	1.07%	1.25

* Value of tabular t at level 0.005 = 2.08

Table 3 shows statistically significant differences between the pre-test and post-test measurements of the control group with respect to the physical variables and in favor of the post-test measurement. The improvement rate ranges between 2.70% and 9.02%. However, there are no significant differences in the biochemical levels of cortisol and testosterone hormones, as the value of t ranges between 1.17 and 1.25 which is less than its tabular value at significance level of 0.05.

Table (4)
Significance of the statistical differences between the Means of the post-test measurements in physical and biochemical variables of the experimental and control groups (N = 22)

Variables		Measure-ment unit	Experimental group		Control group		Calculated t value
			M	SD	M	SD	
Physical tests	Speed of composite motor performance	Second	3.90	2.11	4.20	2.11	3.12*
	Running 30m × 5	Second	22.4	1.45	26.5	2.12	4.8*
	Performance endurance	Second	49.1	2.60	53.6	2.65	3.10*
	Zigzag run (Barrow)	Second	6.5	2.14	7.6	1.17	3.70*
	Seated forward bend	cm	4.20	1.24	3.75	2.24	2.99*
Biochemical capacities	Cortisol	Milligram/ deciliter	19.22	0.98	13.35	0.21	2.12*
	Testosterone	Milligram/ deciliter	625.25	8.98	521.15	0.98	3.90*

* Value of tabular t at level 0.005 = 1.77

Table 4 indicates significant differences between the post-test measurements of both the experimental group and the control group with respect to physical and biochemical variables in favor of the post-test measurement of the experimental group.

B. Discussion:

From table 2, it is shown that there are statistically significant differences between pre-test and post-test measurements in physical and biochemical variables of the experimental group in favor of the post-test measurement. Additionally, the improvement rate ranged between 11.6% and 45.38%. The researcher attributes this improvement to the proposed program that uses glycogenic physical effort.

This is consistent with the findings of Abdel Mawla (2008) that using multiple-effect training doses at the beginning of the training season helps in the development of various physical qualities in a balanced manner, equal effect of fatigue and rest intervals also helps in developing the functional qualities including anaerobic work. He also warned from using single effect training doses at the beginning of the training season as it is preferable to use multiple direction doses. He also pointed out that using single effect doses leads to the improvement of results, special physical qualities, and functional capacities of body systems. However, they may subject the athlete to extreme fatigue (exhaustion) during the training program (3: 79).

Abdel Fattah and Shaalan (2002) also agree that continuing the training increases lactic anaerobic (glycogenic) work. However, the concentration of lactic acid in the blood reduces with the performance of a structured physical load as a result of cutting back on effort, the increase in the capacity of getting rid of lactic acid, and improving the player's functional condition (1: 34-35). Moreover, McMillan (2005) emphasizes that the cortisol hormone increases glucose production in the liver, leading to the decomposition of the hormone as well as the increase in liver glycogen due to the activation of glycogen synthase and the reduction of immune response. Additionally, cortisol maintains blood pressure and cardiac outcome in their normal level (31: 503).

On the other hand, Astrand Eral (2003) notes that glycogenic anaerobic training leads to the increase in cortisol concentration. This increase in cortisol concentration resulting from the increase in physical load reflects the central nervous system's control of this hormone (23: 62).

Thus, the first hypothesis which reads: "There are statistically significant differences between the pre-test and post-test measurements of some physical variables and the level of cortisol and testosterone in the soccer players of the experimental group" is supported.

Table (3) demonstrates statistically significant differences between the pre-test and post-test measurements in physical variables in favor of the post-test measurement. The improvement rate ranges between 2.70% and 9.02%. However, there are no significant differences in the biochemical levels of cortisol and testosterone, as the value of t ranges between 1.17 and 1.25, which is less than its tabular value at significance level of 0.05. The researcher attributes these results to the fact that the traditional training program includes general physical activities that improve physical qualities, but not the high, structured physical effort that may improve the levels of cortisol and testosterone. Thus, this explains that no improvement in these variable has been found.

This is consistent with Abdel Halim and Ibrahim (2001) observation that the intensity of exercises should be regulated in order for the individual to improve. A training load that is less than the player's minimum level only maintains the player's vitality, a moderate load helps in the development and improvement of the player but only to a certain limit, after this an increase in the load (high load) should take place in order to ensure the player's development and improvement (14: 66).

Ahmad (2001) also emphasizes that it is important to determine the athlete's physical capacities as it helps in the scientific planning of the physical preparation program. This should be simultaneous with the athletes' performance of these programs so as to benefit as much as possible from them and elicit their hidden potential (5: 97).

Thus, the second hypothesis is partially supports, as the physical variables of the soccer players in the control group have improved but the levels of cortisol and testosterone have not.

Table (4) shows statistically significant differences between the post-test measurements of both the experimental and control groups in physical and biochemical variables in favor of the experimental group. The researcher attributes this improvement of the proposed glycogenic training program.

In this respect. Davies and Few (2003) indicate that testosterone affect the tissues through a change in the chemical properties of the cell and its reaction with the nucleus. The researcher adds that testosterone is responsible for the development of primary sexual characteristics. It also serves a building role through protein synthesis and muscular growth.

The researcher believes that the increase in testosterone in soccer players of the present study may contribute to the muscular growth process of the players. The researcher attributes these findings to the intense effort of the skills performance, which results in the production of a large number of calories and sweat, which helps in the concentration of both testosterone and cortisol in the blood and the excretion of a large amount of it with sweat immediately after the exertion of effort. This leads to the decline in the player's physical and functional capacities as lactic acid accumulates in the blood and muscles, which affect the skills level of players.

Fernando et al. (2008) note that testosterone is secreted then transmitted to the targeted tissues using a special transmitter called globulin. Globulin enters the cell through special cellular receptors, then it reaches the nucleus to perform its main job, namely growth and increasing protein synthesis. The important function of the hormone secretion is the intense physical load and duration of performance. Additionally, physical effort increases the secretion of cortisol. The increase in this hormone is part of the major process of rebuilding inside the muscle tissues. In case muscle rupture occurs to a certain extent, the increase in cortisol is an indicator of rebuilding the muscle itself (26 : 41).

The findings of this study are consistent with the findings of Mohamed (2013)(4), Shaban (2008)(17), Salama (2005)(20), and Yousuf (2013)(21) in improving the levels of testosterone and cortisol using high-intensity exercises.

Thus, the third hypothesis that reads: "There are statistically significant differences between the post-test measurements of some physical variables and the level of cortisol and testosterone in the soccer players of the experimental and control groups" is supported.

Conclusions:

The following conclusions can be deduced from the research results and discussion:

- The glycogenic training program helped improve the following biochemical capacities (cortisol and testosterone) in soccer players below 18 years of age.

- The glycogenic training program improved some physical capacities (speed of composite motor performance, running 30m × 5, performance endurance, Barrow zigzag run, and seated forward bend) in soccer players below 18 years of age.
- The training program of the soccer players below 18 years of age in the control group did not affect the levels of cortisol and testosterone in soccer players.

Recommendations:

In light of what has been deduced from the research findings, the researcher makes the following recommendations:
- Using glycogenic exercises as an effective training means to develop soccer players' physiological capacities.
- Gradual progression of using glycogenic exercises when applying them to the different intervals.
- Replicating this study with other youth samples of different age, sex, and sport activity.

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