

The Effect of 8 Weeks of Gymnastic Exercises on Basic and Cognitive Skills in Children with Attention Deficit / Hyperactivity Disorder

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Abstract— Physical activity is used as a method in the treatment of children with motor and cognitive disorders. The aim of this study was to investigate the effect of 8 weeks of gymnastics training on basic and cognitive skills of children with attention deficit / hyperactivity disorder. The present single subject study is a research design in the form of post-test and pre-test. Case of study was a 5-year-old girl living in Karaj who suffered from attention deficit / hyperactivity disorder. The Ulrich test was used to measure motor skills and the London Tower test was used to measure cognitive skills. Exercise interventions include 8 weeks of gymnastic training. After performing the training protocol, the subject participated in the post-test. The results of the exercise showed that gymnastic exercises have improved the level of performance of the child in basic and cognitive skills. Planning according to the needs of the child improves the performance of children with attention deficit / hyperactivity disorder.

Keywords— *Ulrich test, London Tower test, basic skills, attention deficit*

Childhood is one of the most important stages of life in which a person's personality is formed and formed. Children in this period have differences in cognitive, behavioral, social and emotional skills. The presence of these differences, if not addressed in a timely manner, may lead to disorders in children. One of these disorders is a common disorder called Attention Deficit Hyperactivity Disorder (ADHD). The prevalence of this disorder in school-age children is reported to be 3 to 7% worldwide (1). According to Meyer et al. (2015), neural differences in the structure and function of the prefrontal cortex lead to impaired behavior control and inattention (2). These children have behavioral and cognitive characteristics such as inability to control motor skills, attention deficit, learning disability, aggression, academic problems, arousal, and motor restlessness (3, 4). Motor skills are especially important in school-age children; Because it is a prerequisite for the implementation of specific sports skills and affects the participation of individual social activities such as games and group sports (5). In

I. INTRODUCTION

general, research on children with ADHD shows that these children are at a lower level than their peers in the implementation of basic skills and fine and gross motor skills (6-9). Because this disorder leads to developmental delays in motor and cognitive areas, failure to progress to the implementation of basic skills will have direct and indirect consequences on the ability of individuals to perform skills related to specialized movements; so parents and families are looking for a way to treat this disorder. What is important about this disorder is that, a unique method in the treatment of this disorder has not been introduced and most of the therapeutic interventions performed due to concerns about the side effects of drugs have been cognitive-behavioral interventions (1). One of the effective methods of intervention has been physical and cognitive exercises on children with ADHD. The results of studies in this field have shown that physical exercise can improve the functional and cognitive deficits of children with attention deficit / hyperactivity disorder (10-12). In this regard, Klil-Drori and Hechtman (2020) in their research pointed to the positive effects of aerobic exercise on people with attention deficit / hyperactivity disorder (12). Ghorbanpour et al. (2013) believe that physical exercises are of special importance due to their two characteristics of movement and rhythm (13). In addition to being an effective way to improve basic motor skills, physical exercise also affects cognitive processes, attention, perception and the development of personal relationships and social skills (14). Akbari et al. (2009) evaluated the effect of 24 sessions of physical activity (local and indigenous play) on the development of positive basic skills (15). Draper et al. (2012) also concluded in their study that physical activity as a group affects the development of gross skills and cognitive skills in preschool children (16). One of the best ways to get rid of acne scars is to do gymnastics. Because gymnastics provides opportunities for physical awareness and individual abilities and body control, it can help improve weaknesses in children with ADHD.

Therefore, this study investigated the effect of 8 weeks of gymnastic exercises on basic and

cognitive skills of children with attention deficit / hyperactivity disorder.

II. METHODOLOGY

The present study is a single-subject design. These plans include detailed, in-depth and individual study of subjects in different situations and environments. In these designs, the changes resulting from experimental interventions in relation to the individual are evaluated. In other words, in such schemes, the individual himself plays the role of both experimental subject and control subject. The purpose of such schemes is to determine the effectiveness of interventions in relation to a particular case. In some cases, such schemes are used that often not many people can be found in educational conditions (17). However, the statistical population of the present study includes all children aged 5 to 10 years in Alborz province who have attention deficit / hyperactivity disorder. According to the purpose of the study, a 5-year-old child with ADHD with an average intelligence score (95) living in Karaj was selected as the main subject using purposive sampling method. The degree of attention deficit in the child was determined after filling out the Connors 60 parent questionnaire. The validity of this questionnaire is 85% and its reliability is 91%. This questionnaire has 26 items and its total score varies from 26 to 104. If a child scores above 34, it indicates attention deficit disorder. The higher the score the greater disorder in the child (18).

In the post-test stage, the Coarse Motor Development Test (TGMD-3) was used to assess basic skills. This test assesses 13 motor skills, which are divided into two subtests, movement skills and ball skills (manipulation). Moving skills measured include: running, trotting, rocking, stepping, horizontal jumping and sliding, and ball skills include: hitting a stationary ball with both hands, one-handed forehand, on site dribble, Receive, hit with the foot, throw from above the head and throw from below with the hand. The scoring method is such that if the child meets that criterion or not, a score of one and zero is considered, respectively.

The final score of the basic skill is obtained by combining the standard scores of the sub-test of movement and control of the object (ball). Ulrich and Webster reported the mean reliability coefficient of the displacement skill test as 0.97, the reliability coefficient of the ball skill test as 0.95, and the overall reliability coefficient of the gross motor skills test as 0.97 (19). Also, at this stage, the London Tower test was used to assess cognitive skills. The test was performed using the London Tower Test software of the Sima Cognitive Behavioral Sciences Research Institute. In this test, you have to make the sample shape by moving the colored beads (green, blue and red) and placing them in the right place with the least necessary movements. The subject was told that you would be given 12 problems and that you would have to correct the sample shape with the least amount of movement. The scoring method in this test is such that the person will be given a score based on his / her efforts in solving the problem. Thus, when a problem is solved in the first attempt, it scores 3, when it solves in the second attempt, it scores 2, when it solves in the third attempt, it scores 1, and when three attempts fail, it scores zero. It becomes. The maximum score in this test is 36. Also delay time or design time (includes the number of moments that are calculated for a person from presenting a pattern of an issue to the beginning of the first move in an attempt), test time (total moments from the beginning of the first move in an attempt to completing moves in the same attempt) The total test time (total delay time and test time) and the total result (total score) are accurately calculated by the computer.

After the pre-test, the child practiced gymnastic skills for 8 weeks and 3 sessions per week. Each training session was dedicated to three parts of warm-up (10-15 minutes), main exercise (35-40 minutes) and cooling (10 minutes). The exercises were initially selected from simple gymnastic movements and were mostly aimed at familiarizing the child with the principles of gymnastics. As time passes and the child progresses in the initial exercises and corrects the movements, the intensity and complexity of the exercises increase. The progress of the exercises was from stationary movements to

jumping and jumping movements. There was also a 30-second rest period between each exercise and the next. After the exercises, in the post-test phase, the subject was re-evaluated in basic skills (displacement and manipulation) and cognitive skills.

Table1. Exercises used in the 8-week training course

Exercise session	Activity
First session	Skills of standing, walking and running correctly, strengthening hand muscles
second session	Consecutive pair jumping skills and long jump
third session	Flexibility skills, rabbit jumping and angle sitting
Fourth and fifth sessions	Proper standing skills, cradle and candle introduction
Sixth Session	Body and slide or fern integration skills
Seventh session	Swimming skills, throwing legs back and forth and jumping fish
Eighth session	Angel skills on the knee, open leg gesture and hand bending swimming
Ninth and tenth sessions	Arched waist skills with open legs, balance preparations and scapular flexibility
Eleventh and twelfth sessions	Candle skills, rocking cradle and strengthening abdominal and back muscles
Thirteenth session	Arched waist skills with open legs, balance and flexibility
Fourteenth and fifteenth sessions	Straight leg cradle skills, back arch and squat
Sixteenth and seventeenth sessions	Body rotation skills: back, leg open and sitting angle
Eighteenth and nineteenth sessions	Front rolling, bridge and wall balancing skills
Twentieth, twenty-first and twenty-second sessions	Skills of balancing, throwing legs and carousel
Twenty-third and twenty-fourth sessions	Tripod and angel balance skills

In order to analyze the data, the method of eye analysis, effect size was used. The effect size was also obtained from Cohen's d method. This effect size is based on mean and standard deviation in pre-test and post-test.

III. RESULTS

The displacement subscale in motor skills increased after 8 weeks of gymnastics training. The child's raw scores on movement skills in the pre-test stage were 24 and after performing gymnastic exercises in the post-test stage, it reached 38, which indicates the effect of gymnastics exercises on movement skills.

Examination of the child's scores in the pre-test and post-test stages shows that in all variables related to the displacement subscale, except for the hiccup variable, positive changes have taken place after eight weeks of gymnastic training.

Also, the study of scores shows that the child's raw scores in the ball skill subscale have changed positively in motor skills after gymnastic exercises. The child's raw scores on manipulation skills at the pre-test stage were 22, and after gymnastics this number changed to 32.

Examining the child's scores on ball skills shows that gymnastic exercises have been able to improve the other subscales except for the two subscales of throwing from below and dribbling. However, this performance improvement is less than that of mobility skills.

The results of repeated measurements of mean changes in mean scores in the pre-test and post-test stages (Table 1) indicate the magnitude of the high effect of gymnastic exercises on motor function of a child with attention deficit / hyperactivity disorder.

Gymnastics also improves test execution time and reduces test error in children with ADHD.

Table1. Results of repeated measurements of the subject's motor abilities based on raw scores

Variable	pre-test	post-test	Cohen's d	effect size (Interpret)
Movement skills	4 ± 1.2	6.3 ± 5.48	1.069	very high
	3.16	4.33		
	± 2.16	± 1.49		
Ball skills	± 2.16	± 1.49	0.78	high

The aim of this study was to investigate the effect of 8 weeks of gymnastics training on basic and cognitive skills of children with attention deficit / hyperactivity disorder. The important point in this study is that the study of physical exercise on people with ADHD has received less attention individually. As mentioned in the research results section, eight weeks of gymnastic exercise has a beneficial effect on motor skills of children with attention deficit / hyperactivity disorder. These findings are consistent with the results of Amouzadeh et al. (2015), Eslami et al. (1398), Etnier (2010) and Verret et al. (2016), all of which emphasize the positive effect of physical activity on the development of motor skills (23-20). These results contradict the theory of maturity, which states that the growth process is controlled by genetic factors (24) and emphasize the views of scientists who believe that physical activity leads to child development (25). Also, the findings of the present study are in contradiction with the findings of Williams (2005) (26). Williams found in his research that basic skills develop only on the basis of age and maturity, and that participation in physical activity has no effect on the development of basic skills. Contradictory results of research in this field can have different reasons. One of these reasons is the type of exercise program. Sometimes exercise programs are not designed and implemented to suit the child's needs, which reduces the effectiveness of exercise programs on the child's basic skills. In the present study, by designing exercises based on the needs of a child with ADHD, performance improvement in basic skills is observed after eight weeks of gymnastic training.

On the other hand, due to the lack of space and the high cost of sports classes, most children do not have enough time to engage in physical activity, which can lead to new movement problems or exacerbate existing problems in children. Based on the results of the present study, it can be said that participating in a gymnastics training program that is tailored to the needs of the child leads to experiencing opportunities to increase body awareness and individual abilities and more control over body

IV. DISCUSSION

organs, which ultimately leads to improved performance in basic skills (27).

Examination of the average scores obtained in the subscales of manipulation (ball skill) and post-test displacement shows that gymnastic exercises had a greater effect on displacement skills. These results are consistent with Akbari (2013) research (27). One of the reasons for the effectiveness of gymnastic exercises is the greater use of movement skills during these exercises. In the other words, when practicing gymnastic skills, more movement skills are used which has led to the further development of this skill.

On the other hand, the study of the average performance of post-test manipulation skills showed that this subscale was less advanced than the displacement skills. Manipulation skills are one of the most important body movements, because people perform thousands of movements related to manipulation skills every day. To justify the poorer performance of manipulation skills compared to movement skills, it can be pointed out that manipulation requires coordination between all parts of the body and the interaction of organs, such as eye-hand coordination or eye-foot coordination. These skills are closely related to mental activity, and due to anterior cortical injuries in children with ADHD, manipulation skills are less advanced compared to movement skills. Also, in fine motor skills, fine muscle control is used more, and because this child was weak in fine muscle control, as a result, he could not show good performance of moving skills.

In the study of cognitive skills data, the results showed that physical exercise improved the child's performance in the post-test phase. This result is consistent with the results of Amouzadeh et al. (2015), Shoushtari (2011) and Verret et al. (2012) (20, 23, 28). These results are consistent with perceptual-action theory, which states that the concepts of motion and performance are not separate and that perception cannot be studied independently of motion. It also seems that the subject consumes a significant amount of energy after participating in gymnastics training sessions, which creates a

favorable feeling in the child, which leads to increased accuracy and attention in the implementation of cognitive skills (20).

V. Conclusion

In general, the results of the present study show that perceptual-motor training and experience is a positive factor in the development of motor skills, including displacement and manipulation skills. Based on the results of the exercise, it can be said that the more skilled a person is in performing coordinated movements, the greater the ability to control the nerve and organize between the elements and systems involved in that movement. Therefore, for a more coordinated execution of a movement, the degrees of freedom are reduced and in fact less systems, joints and muscles are involved to perform the movement, which causes less energy consumption and energy optimization to perform the same movement (29). These findings are contrary to the initial developmental view, including the view of maturity in motor development.

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The power triangle strategy in the Middle East after the Arab Spring
Based on the Offensive and Defensive Realism

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Abstract—Following the Arab Spring in the Middle East and North Africa plus Afghanistan, we saw a change in the structure of power. In fact, with the Egyptian revolution in 2011, the change of government in Libya, Tunisia, Syrian crisis and Afghanistan have changed the course of many issues. Some countries that have benefited from a better position in the Arab Spring have actually decided to change their behavior and focus on strategies and policies to falsify the right position. Three of these countries have stable states in the Middle East. With the development of the region, Iran, Turkey and Saudi Arabia have taken power. Iran has been linked by Iraq and Syria, Turkey in Syria and northern Iraq against P.K. K¹, Finally, Saudi Arabia in Syria, Yemen and Bahrain. The key points of the central analysis of these events are to help assess the foreign policy of Iran, Turkey and Saudi Arabia in the Middle East. Why are these countries seeking influence in the region? What approach do regional players take in the Middle East? This study defines the foreign policy of these countries, provides explanations about the competition of these powers, and generalizes their policy through the theory of realism, especially defensive and Offensive realism

Keywords— *Foreign Policy, Realism, Middle East, Defensive and Offensive realism*

I. INTRODUCTION

Since World War II, the Middle East and the Persian Gulf have undergone several significant changes, which are turning points in the region's development history. Some of these are: the Islamic Revolution in Iran (1979), the collapse of the Soviet Union (1991), the Second Persian Gulf War (2003), September

11, 2001, the major developments in the Arab Spring (2011). The Arab Spring and subsequent changes in the political system in some countries like Afghanistan, in addition to regional and supra-regional actors, have a profound effect on regional security and political interactions in shaping the evolution of relative power and other scales. The incident marked a turning point in the development of the new structure in the Middle East. On the one hand, the change in the role, influence and interests of regional and international actors, On the other hand, the emergence of new coalitions in the region.

Developments have prompted Persian Gulf States, especially Saudi Arabia, to view the event as a threat to its security and to its policy of active intervention, before a wave of change in its borders and the region's unbalanced power. However, the country was initially affected by the Syrian crisis and the Bahraini protests in the Arab world, which was called the Arab Spring. Very quickly, the scene of confrontation between regional and supra-regional powers, including Iran and Saudi Arabia, turned the states against each other. Turkey itself is interfering in the active politics of regional power and is not going to be considered an isolated actor. The nature of this approach of the government is contradictory for regional developments, and it sees the contradictory goals pursued by its leaders, thus adding to the unrest in Syria. Iran immediately supported the adoption of a political solution to the crisis but by supporting Assad's government. Turkey supports Assad's opponents; Saudi Arabia used military forces in Yemen and Bahrain to suppress the opposition but supported it in Syria.

Given the impact of Iran's strategic relations with Syria on the flow of resistance in the region, the Syrian crisis is very important for Iran. Saudi Arabia's policy on the Syrian crisis can be defined in the context of defense realism, while Turkey and Iran's policy in the region can be interpreted as Offensive and Defensive realism.

The main question is: what is the approach of Iran, Turkey and Saudi Arabia to regional developments? The author argues that Iran's foreign policy in the region (Middle East), with the support of Shiites in the region, pursues ideological elements, which are defensive, and that the policies of Turkey and Saudi Arabia are in some way opposed to that approach. The position of the two countries, the purchase of their weapons, and the expansionist efforts to achieve their goals are also consistent with the theory of offensive and defensive realism. (See Table 3, page 19). However, in the case of Syria, their strategies are different. In the first part of this study, we will define the theory of defensive and offensive realism, before examining the foreign policy approach of Iran, Turkey, and Saudi Arabia as a discussion of developments in the Middle East.

II. THEORETICAL FRAMEWORK

Understanding government behavior in anarchic conditions or providing a good theory for foreign policy is the most important goal of international relations awareness. Realism theory is the leading model in international relations in the process of analyzing and explaining changes in the international system. The debates in this algorithm have led to the emergence of a new hypothesis from within. The main approaches are Hans Jay Morgenthau's Classical Realism, neorealism (structural realism) by Kenneth Waltz, neoclassical realism by Gideon Rose and offensive and defensive realism arising from neorealism. All of these theories have based on "Realism," but with minor differences in their ideas on a number of fundamental issues in international relations, such as security, anarchy, and so on.

TABLE 1. ASSUMPTION OF REALISM

Human Nature	→	Selfish
Most Important Actors	→	State
Causes of State Behavior	→	Rational pursuit of self-interest
Nature of International System	→	Anarchy

The realistic approach to international politics divided into two types: offensive and defensive:

III. OFFENSIVE REALISM

Zakaria and Mearsheimer are among the most important Offensive theorists. This kind of power of political inclination is the starting point for discussion of insulting discourses, revisionist powers, especially the great powers, in the international system, and by emphasizing the chaos in the

international environment, they believe that anarchy is competition between the main powers. Controlling power will be permanent. For them, the Hobbesian chaos is a condition that security is very rare. Wealthy nations seek to create large armies; the secret of their borders is to increase their international influence (Zakaria, 1998, p. 3). Mearsheimer's main reason for dedicating himself to the government in three cases: the anarchic structure of the international system, all countries have the ability to offend. In addition, have expressed distrust of the enemies' goals. These three hypothetical opportunities to balance and maintain the balance of power that countries are involved in provide not only power but also a powerful incentive to maximize power.

In offensive realism, power is the main means of achieving the goal and gaining hegemonic status in the international system, their emphasis is mainly on military and economic power because it is the military power of a country that increases the security factor. (Mearsheimer, 2001, p.52, Waltz, 1979, p.66) This kind of realism that insists on the centrality of the big states where big powers are trying to The disturbing realities of the changing maintaining existing afford to achieve its goals in the region. Realists offensive based on the following arguments have achieved such a result:

- Realists believe, offensive international chaos is very important. In this world, the wisdom governments that are looking for security tend to take measures that might lead to conflict with others.
- Because state power means the loss of another state power, relative power of governments to apply a zero-sum game that a result of ending the game, is conflict and struggle.
- Distrust the motives of the actors, permanent feature of the international system of anarchy and is divided into two categories: One of distrust of the current incentives and other actors if there is trust, there is no guarantee a stable situation. In the context concerns, the crop coming from an actor can cooperate in the current situation is also precarious.
- The issue of fraud and greedy government's phenomenon is continuing anarchy in the system. Greedy governments, the governments that are not for security, but also for wealth, ambition, power, and personal desire to regulate relations. Yet the government has always may be based on your relationship with your security setting, but the opportunity will be a fraud in their work.
- The aim of all governments' revisionist access to the hegemonic status in the international system. Therefore, this category of Government strongly seeking power, and if conditions are right, demanding to change the distribution of power in their favor. (Snyder, 2002, p. 151)

IV. DEFENSIVE REALISM

The most important defense theorists are Robert Jarvis, Stephen Walt, Jack Snyder, Stephen Van Oura, and Charles

Glaser. In addition, a realist of Kenneth Waltz can be considered as a defensive realist.

Defensive realism believes that the government seeks to maintain its existence in the system of international anarchy. Proponents of the theory of the relationship between anarchy and the implications for the international system on the one hand and behavior of states, on the other hand, are concerned, but they complicate the relationship. Only on condition that other countries feel threatened by the self-react and their reactions usually in balance and prevent threatening the country. (Layne, 2003, p. 321)

Waltz attached great importance to the theory of balance of power. War and military force to maintain the status quo is beneficial not to change the system. Stephen Walt, unlike the balance of power, introduced the Balance of threat theory, which has proposed by trying to improve and increase the efficiency of the theory of balance of power. The balance of power does not explain why the balances are often incapable of Formative. (Walt, 1988, p. 281) Walt believes that the government only the power to do not balance, but an accomplice to balance the threat of attack. According to shortcomings of the theory of balance of power, Stephen Walt contends that the balance of threat theory can offer a better explanation Walt described the threat level with respect to the fourth factor:

- I. Ability (population, economic strength, the vastness of the country and other factors, geopolitical power)
- II. Geographical proximity
- III. Military Capabilities
- IV. Aggressive intentions. (Ibid, p. 295)

Defensive realists argue that a defensive action by invoking the concept of security has often wrongly interpreted as a belligerence behavior. Governments that threaten the ability of others, will Respond with military measures. Unlike offensive and defensive realism, assumption is that international anarchy is usually benign. This means that security is not rare. As a result, governments have aggressive behavior, and only if they feel threatened, they react to it. In addition, this reaction often at the level of balance or prevent serious security threat, and only if the problem is clear, the reactions will occur harder conflict. (Snyder, 2002, p. 163)

Offensive and defensive approaches are two major differences: The first is that government security offensive in reducing the deliberate search of security in other countries, while the government does not act defensively. Second, the government attacking each other's security to be intentional uses threatening, while the defensive deliberate each other's security do not threaten. (Shiping, 2008, p.96)

Defensive neorealism asserts that aggressive expansion as promoted by offensive Neorealist upsets the tendency of states to conform to the balance of power theory, thereby decreasing the primary objective of the state, which they argue is ensuring its security. (Layne, 2003, p. 306) While defensive realism does not deny the reality of interstate conflict, nor that

incentives for state expansion do exist, it contends that these incentives are sporadic rather than endemic. Defensive neorealism points towards "structural modifiers" such as the security dilemma and geography, and elite beliefs and perceptions to explain the outbreak of conflict. (Taliaferro, 2001, p. 125)

Defensive structural realists break with the other main branch of structural realism, offensive realism, over whether or not states must always be maximizing relative power ahead of all other objectives. While the offensive realist believes this to be the case, some defensive realists believe that the offense-defense balance can favor the defender, creating the possibility that a state may achieve security. A second-strike capable nuclear arsenal has often understood to indicate the supremacy of the defense in the offense-defense balance, essentially guaranteeing security for the state that possesses it. Yet in a multi-polar world, a second-strike capability does not provide the same guarantees that it did during the bi-polar Cold War period. Some defensive realists also differ from their offensive counterparts in their belief that states may signal their intentions to one another. If a state can communicate that its intentions are benign to another state, then the security dilemma may be overcome. (Glaser, 1994, p.50) Finally, many defensive realists believe that domestic politics can influence a state's foreign policy; offensive realists tend to treat states as black boxes. (Walt, 1998, p.29) In modern times, several economic and political groups are known to benefit from the effects Defensive Realism, in terms of both the economic activity generated in delivering the resources or technology needed to increase a particular state's own security, as well as the positive feedback effect caused by the perceived destabilization to an opponent's own security by comparative observation.

TABLE 2: DEFENSIVE & OFFENSIVE CRITERIA

SOURCE: INTERNATIONAL SECURITY, VOL. 25, NO. 3 (WINTER 2000/01), P.

Defensive Realism	Offensive Realism
system which encourages states to maintain moderate and reserved policies in order to attain security	System in which state seek to maximize power and influence in order to achieve security through domination and hegemony
Basic principle: 'Security Maximization'	Basic principle: 'Power Maximization'
In simple words protecting own power	In simple words projecting own power

Category of Contemporary Realism- Assumption about Anarchy

✓ The International system provides incentives for expansion only under certain conditions	✓ The International system always provides incentives for expansion
✓ Balance-of-power theory (Kenneth Waltz)	✓ Hegemony theory of war (Robert Gilpin)
✓ Dynamic Differentials theory (Dale Copeland)	✓ Power transition theory (A.F.K.Organski and Jacek Kugler)
✓ Great power cooperation theories (Robert Jervis, Charles Glaser, Benjamin Miller.	✓ Balance of interest theory (Randall schweler) Theory of great power politics (John Mearsheimer)
✓ Balance of threat theory (Stephen Walt)	✓ State centered realism (Fareed Zakaria)
✓ Domestic Mobilization theory (Thomas Christensen)	✓ Theory of war aims (Erik Labs)
✓ Offense- Defense theory (Stephen van Evra, Thomas Christensen, Jack Snyder, Charls Glaser and Chaim Kaufmann.	✓ Hegemonic theory of foreign policy. (William Wohlforth)

emphasis offensive realism puts on hegemony as states end aim stands in sharp contrast to defensive realism's belief that state survival can be guaranteed at some point well short of hegemony. In a defensive realist mindset, security increments by power accumulation end up experiencing diminishing marginal returns where costs eventually outweigh benefits. (Mearsheimer, 2001, pp. 271 & 345) Defensive realism posits that under anarchy there is a strong propensity for states to engage in balancing—states shouldering direct responsibility to maintain the existing balance of power—against threatening power-seeking states, which may, in turn, succeed in "jeopardize (ing) the very survival of the maximizing state. (Tuft, 2005, p. 390). This argument also applies to state behavior towards the most powerful state in the international system as defensive realists note that an excessive concentration of power is self-defeating, triggering balancing countermoves. (Wang, 2004, p.177)

Yet, Mearsheimer challenges these claims by making the argument that it is rather difficult to estimate when states have reached a satisfactory amount of power short of hegemony and costly to rely extensively on balancing as an efficient power-checking method due to collective action issues. (Snyder, 2002, p.155) According to him, when a great power finds itself in a defensive posture trying to prevent rivals from gaining power at its expense, it can choose to engage in balancing or intervene by favoring buck-passing—transferring the responsibility to act onto other states while remaining on the sidelines. In order to determine the circumstances in which great powers behave according to one or the other, Mearsheimer builds on Waltz defensive realism by including a second variable (geography) alongside the distribution of power. On one hand, the choice between balancing and buck-passing depends on whether the anarchic international system is of a bipolar, balanced, or unbalanced multipolar architecture. On another hand, state geographic location in terms of border sharing and stopping power of water also influences great powers' strategy preference. Combined together, these two variables allow him to establish that great powers tend to favor—to the contrary of defensive realism predictions—buck-passing over balancing in all instances of multipolarity except for those that include a potential hegemon. (Mearsheimer, 2001, p.31. Wang, 2004, p.57. Feng, 2006, p. 69). Responding to defensive realists' posture on state behavior towards the most powerful state in the international system, Mearsheimer believes that threatened states will reluctantly engage in balancing against potential hegemon but that balancing coalitions are unlikely to form against a great power that has achieved regional hegemony. (Mearsheimer, 2001, p. 271) This lack of balancing is best explained by the regional hegemon's newly acquired status quo stance, which follows from the geographical constraints on its power projection capability. (Mearsheimer, 2001, p.240, Snyder, 2002, p. 156) offensive realism includes explanations of both international outcomes pertaining to the systemic level of analysis and individual state behavior. Additionally, the inclusion of new variables such as geography alongside the distribution of power enhances offensive realism's potential to make specific assumptions about states pursue aggressive

actions and resort to balancing and buck-passing strategies. (Tuft, 2005, p. 401)

V. IRAN, TURKEY'S AND SAUDI ARABIA'S POSITIONS ON THE REGION

Syria's geographical location is of strategic importance because is primarily located in the Middle East and on the east coast of the Mediterranean Sea. Despite its neighbors such as The Zionist regime, Palestine, Lebanon, Jordan, Turkey and Iraq, Syria's strategic importance is enormous. Another reason is the ability to transfer energy from Iraq and Iran through the ports of Baniyas and Tartus on the Mediterranean coast to Europe. Syria, located in western Asia, is a link between the three continents of Asia, Europe and Africa. It is an important part of the geopolitical and geostrategic part of West Asia. It also affects Lebanese political equations.

Iran, Turkey and Saudi Arabia, as the three players in the region, were directly involved in the Syrian crisis, and each of them has pursuing its own goals. Saudi-Syrian relations have traditionally been close due to ideological approach which comes from Sunni-Islam. Saudi Arabia is not satisfied with Iran's high influence in Syria and Lebanon. While, the most authoritarian political system of human rights, women's rights, democracy, and freedom of expression in Saudi Arabia has been completely neglected. For this reason, one of the countries involved in this crisis is the result of the Arab Spring in the Middle East, and efforts are being made to prevent all kinds of crises from entering the country. In other words, Saudi Arabia has traditionally been a conservative actor in the region, seeking to address threats to the Arab world and protect its security. (Barzegar, 2012, p. 3) Saudi leaders are concerned about maintaining political stability and regional security. Saudi estimates security and stability in the Arab world and developments in the Persian Gulf in the following ways:

- a) Supporting regional political activists who have the same strategic goals as Saudi Arabia and its allies.
- b) Vulnerability to the protection of the Persian Gulf in the Arabian Peninsula, in particular, and in general, against internal and external threats without the support of the US military.
- c) Iran's counter-influence in Iraq, Lebanon and Syria, and its closest neighbor, Bahrain and other Persian Gulf states
- d) The reduction of deficits and interventions in the Arab world. (Kamrava, 2013, p. 26)
- e) The confrontation with Shiite influence in the Arab world. In other words, supporting extremist and Wahhabi Sunni groups against the Shiites.

VI. THEORIZING THE SUBJECT

The Saudis have not had a positive view of Syria since the death of Hafez al-Assad and the coming to power of Bashar al-Assad, because Bashar al-Assad acted independently of regional politics. For example, in the '90s triangle, Saudi Arabia, Egypt, and Syria to provide a common overall diplomacy of the Arab

world crises can be defined within the framework of this triangle. However, since the rise to power of Bashar al-Assad, the triangle was weakened and from 2005 was completely collapse and divided into two axes that are an axis of Syria and Iran in particular. (Ibid, p. 33) King Salman may triangle Union countries; Egypt, Saudi Arabia, and Turkey, the countries of the Middle East for avoiding Iran's growing influences in the region are effective. (Pienaar and Shokri, 2015, BBC) With the purchase of heavy weapons by Saudis and attacking on Yemeni and its military presence in Bahrain to suppress the opposition and support the Syrian rebels and terrorists, trying to keep their interests at any cost and provide for their own security. Therefore, according to this behavior, it can be argued that Saudi Arabia, for its security and influence in other areas tries to use offensive realism. Nevertheless, Iran's support of safety for all and support political solutions tries to maintain its role as a neutral element to acquire their interests. In this case, we can recognize Iran as a supporter of defensive realism, throughout.

Saudi Arabia is deeply concerned by Iran's regional influence, especially among Shiites. (Al-tamimi, 2012, p. 8) Moreover, tries to reduce Iran's influence. Saudi Arabia is trying to make some kind of conflict between Shiite and Sunnis in Syria. In fact, the Saudi leaders state that they have a duty to support Bashar's opponents. The Syrian government is also seen as a symbol of the Shiites due to its proximity to Iran. The Saudis justify this by considering the Sunni statistics against the Syrian government, which makes up 70% of the population. Saudis try to give a religious war and immune themselves to the wave of protests. Perhaps the Saudis in the region are pursuing part of the US policy on developments in the Arab world. When the Mohammad Reza Shah's regime in Iran collapse in 1979, Saudi Arabia became the closest ally of the United States in various fields including: Counter Iran's threats, maintaining the status quo in the region, increase the reasonable control of Sunni groups in Lebanon and pressure on OPEC2 to keep oil prices low. As a result, Saudi foreign policy in general is pragmatic and based on the security of the state and the monarchy. (Kamrava, 2013, p. 29)

For Iran, Syria was one of the first countries to recognize the Islamic Republic of Iran after the 1979 revolution, and it was one of the few Arab countries that did not support Saddam Hussein (in Iraq 1980-1987 invasion war) against Iran. In other words, since the establishment of the Islamic Republic of Iran, the Syrian government has had close relations with Iran. Then Syria's importance to Iran, its counter-policies against Israelis, which has strategically located by the Syrian government with Iran, Hezbollah and the Hamas movement in Palestine, created part of the resistance because it creates the Shiite crescent as well. Syria has been a strategic ally of Iran in the region for the past 40 years, before the crisis in its country. Iranian officials have said that the Syrian crisis can only be resolved through political solutions. They also support Bashar al-Assad's government in the face of terrorist opposition by Shiite military advisers and militias. Iranian's officials argue that Syrian opposition victory and the overthrow of Bashar al-Assad causes to weaken Iran which is one of its most important allies in the

region. Due to that, will weaken the resistance to Israelis as well. In other words, withdrawal of the Syrian Baath party from the political scene will have a direct impact on developments in the region; if the position of Hezbollah and Hamas get compromised, Iranian influence in the region will ease and security issues will be more and more complicated. Of course, analysis of how Iranian assist to Hezbollah and Hamas, is very difficult regardless of the Syria. Iranian strategies are to not loss of at least part of the ability to influence the Arab-Israeli conflict, the Palestinian militants and his Shiite allies in Lebanon, particularly Hezbollah group. (Nerguizian, 2012, p. 84)

In the current developments in Syria, Iran initially said the political solution is the best way for ending the conflicts, as well as the Assad government to implement political reforms. However, the developments in Syria have become an international issue and the competitive playing field is cross-regional and regional countries. After the acts of violence terrorist group (ISIS or ISIL) in Syria and Iraq, and begin the process of migrating to Western countries, and ISIS threat to the West plus bombing operations in those countries, world powers decided to make a new line to contrast against of violence. In this time, Iranian got the opportunity, and with protectionist measures and sending military advisors to Syria, its defense policy in the form of assistance extended to Syria and fight against ISIS. With the arrival of other countries such as Russia and Turkey in Syria as well as America, France, and Britain from the West, the war against terrorism was also associated with strategic contradictions. Because Iranians thought, sustaining the Bashar government is better than ISIS or other groups for its goals. Russia made a new strategy with Iran and Turkey recently as well, and got the alliance group against ISIS, especially for getting the main roles in the Middle East against US strategies. (Ibid, p. 86)

Although Turkey was generally not a global expansionist power, neighboring Kurds in the region sought to influence politics and sought to establish Kurdistan around the northern territory of the "fertile crescent" (Iraq, Syria, and Lebanon). Finally, with this progress, Turkey seeks to lead the Islamic world and prove the superiority of Turkish Islam. Ever since the Justice and Development Party came to power (AKP), Turkey has adopted a more convincing foreign policy and has seeking to become an important player in the international arena. (Rezaei, 2014) In fact, the party defined by Ahmad Davutoglu that the neo-Ottoman policy was called to create the power of the Turks of the Ottoman Empire. To this end, Turkey has demonstrated its goal of creating a regional sphere of influence, resolving the Kurdish issue, and becoming a major energy hub. Due to its geographical location, Turkey creates a sphere of influence that extends from North Africa to the Black Sea and the Caspian Sea. This country with the creation of this network by linking to partners and allies in the international arena will strengthen and can achieve its goals. This is one of the reasons for the introduction of "solving problems with neighbors' policy" that was defined by Davutoğlu. Although Turkey's

aspirations "of foreign policy no problem" and based on soft power was challenged, but it remains a hard power tool.

Following this process, but the most powerful armies in the world, which is the Turkish army, the confidence of economic and military power, the leaders of this country to believe that they can even a geopolitical map of the Middle East would change. Turkey also a procedurally similar issue in three years with its neighbors Iraq and Syria have taken. In fact, Turkey's policy since 2009 has taken an offensive look because, during this period, practically no threat to the security of the country on behalf of its southern neighbors has occurred. in the Syrian crisis, Turkey's aim, reform or not the overthrow of the dictatorial regime, but to direct control by screwing Bashar al-Assad of Syria and its future and in the meantime, has been trying in every way possible, to overthrow the current regime in Damascus. Which unlike many NATO members and a key allies of the United States (Great Britain and France) in America's war against Syria, isolated themselves, Turks officials clearly declared its readiness in this battle and insisted that the military option should be possible through Turkey. (Ibid, 2014, p. 25)

Thus, in recent years, Turkey's foreign policy toward Syria, Iraq, and even Libya, Egypt, Palestine, and Lebanon seems to be approaching an offensive realism. Turkey seeks to optimize the use of its power position and increase freedom of action in the Middle East and upset the balance of power in their favor

invasion and opposition. In contrast, the Saudi government is trying to gain influence in the Arab region and support the opponents in Syria with its strategy. However, in the case of Bahrain, Iran and Turkey are in favor of appropriate political solutions and seeking the defensive policy. While Saudi Arabia has a different strategy in this country and has tried to suppress the protests with aggression. In Yemen, Iran's strategy is supporting Houthi militias, but it opposes announcing its support clearly. Because the Houthi group's opinion is close to the Iranian ideology. (Jahener, 2012, p. 36) Saudi Arabia, on the other hand, opposes the Houthis and seeks to counter Iran's influence in its privacy regarding Shiite and Sunnite confrontation idea. In addition, the fugitive Yemeni president Hadi, has asked them for help, and he is trying to protect his interests by launching a military attack on Yemen for more than 5 years now. In fact, it wants to maintain its security. This means that in Yemen and Syria, we can see competition between Iran and Saudi Arabia. They are trying to influence areas that are not sustainable. By spreading their military actions on the region for System in which state seeks to maximize power and influence in order to achieve security through domination and hegemony that is part of offensive realism in its policy. In 2015, Turkey implicitly disclosed its expansionist policies in support of Saudi Arabia's Offensive against Yemen (Mizanonline.ir, 2015). Turkey is trying to control Kurds in the border and afraid of strengthen of Kurds in the region. Nevertheless, Kurds in Turkey, Iraq, and Syria are a Potential threat to turkey national security because turkey will not lose the territory and its control about Kurds in the region. Therefore, the Turks have continued this offensive method to consolidate their hegemony, and they are considering the conditions for the presence of the Kurds in the borderlands between the three countries in a protected manner. Realistic offensive policies show governments seek to increase their power in other countries. Such a system has built inside and alliances with foreign players, trying to disrupt the power structure in its areas. In fact, these factors in international relations literature threaten other actors. Given the performance of the three countries described in this article, it is clear what strategy they are currently pursuing. However, this article may not cover all the factors, as well as the issues related to the military aids.

TABLE 3. THE ROLE OF REGIONAL ACTORS IN TARGET COUNTRIES, EVALUATED BY AUTHOR

players	Syria	Bahrain	Yemen
Iran's strategy	Active role	Inactive role	Active role
	Defensive R	Defensive R	Defensive R
Saudi's strategy	Active role	Active role	Active role/war
	Defensive R	Offensive R	Offensive R
Turkey's strategy	Active role	Inactive role	Inactive role
	Offensive R	Defensive R	Defensive R

VII. CONCLUSION

In the Middle East, given the geopolitical and geostrategic situation and religious concepts, all activities are complex and very sensitive.

In this paper, we examine three important regional powers by examining Shiite ideology and Turkish nationalism and radical Sunni ideology, which will jeopardize other interests by expanding and influencing each of these perspectives. Iran and Saudi Arabia, as well as Turkey's foreign policy orientation, would base on two elements, ideological and geopolitical. They seek to play in their regional security and increase their influence as much as others. Iran's strategies goals are more defensive and practical, and most importantly, it seeks to fill security challenges. In foreign defense policy, governments seek to increase relative security. When they feel threatened, will try to increase their power. Due to its defensive nature, Iran's foreign

All players have different actions in their behaviors. For example, Iran seeks the support of the Syrian government, but with all its might (military advisers, humanitarian aid, medicine, food, etc.). As the Turkish government did, but at different levels. On the other hand, the Syrian government opposed the

policy has forced to change its attitude towards Syria and seek to increase its power. Saudi Arabia is trying to pursue an offensive policy, preventing the expansion of its internal borders as a wave of revolution in the region (after Arab Spring). Analyzing Saudi Arabia's policy after the regional revolutions show their conditions for maintaining regional order, not only monitoring developments to maintain regional structures but also try to provide comprehensive and decisive effects on the protesters. Saudi conservative foreign policy, on the one hand, is offensive because of its desire to maintain the status quo, but at the same time as trying to use political, economic, and security management tools to win the region's developments. In order to advance its goals in Syria and to support the new al-Qaeda-backed armed groups in Syria, Saudi Arabia cannot either reform the electoral system in Syria because free elections have never taken place in that country which aligns with its interests in the region and prevents Iran's influence in the region. After the emergence of the Justice and Development Party, Turkey's policy have created by "strategic depth and zero tensions with its neighbors." As unrest erupted in Syria, they took an interventionist stance, demanding Assad's removal from power. This strategic change was the first step for Turkey. After the military-backed of oppositions in Syria and invaded the country, its strategy changed to offensive realism. Turkey has joined Russia and Iran in defending Bashar al-Assad's government against ISIS and the power transmission after the current situation during last years.

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Acute and Continuous Effects of Caffeine Consumption with Anaerobic Training on Anaerobic Performance, Body Composition and Serum Lactate Levels in Active Men

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Abstract— the purpose of this study was to compare acute and continuous effects of caffeine consumption with a four-week anaerobic training on anaerobic performance, serum lactate levels and body composition values in active men. The study design was a quasi-experimental one. Experimental and control groups were compared in the phases of pre-test and two post-tests. Thirty-two active male students performed a 400m-run and blood samples were collected 2 minutes later. Next day, Wingate test was conducted to assess anaerobic power. Then, all subjects were randomly divided into 2 groups: caffeine consumption (Experimental group) and placebo (Control group), performing a 4-week anaerobic exercise. Finally, blood samples have been collected like before; then, each group was divided into 2 subgroups (caffeine or placebo consumption for one day) and blood samples have been collected after a 400m-run again. Subjects also consumed either caffeine or placebo at a dose of 5 mg/kg of body weight. T-tests were used to analyze

data, at a significance level of $P < 0.05$. Four weeks Anaerobic training with and without caffeine consumption decreased the time of 400m-run and elevated serum lactate levels ($p = 0.001$) (higher differences were observed in caffeine group), but had no significant effect on Wingate test results. Weight value only increased in Experimental group. Acute consumption of caffeine in placebo group also decreased the time of 400m-run and elevated lactate levels ($p = 0.001$). Acute and continuous consumption of caffeine along with anaerobic exercise improved anaerobic performance; while increased serum lactate levels in active men.

Keywords— Anaerobic training, Caffeine, Anaerobic performance, Lactate

I. INTRODUCTION

The study of issues affecting sport performance is one of the most important tasks and concerns of researchers in the field of sports sciences. The issue of sport supplements is one of the most important concerns that demands attention in our country more than the past due to their effect on performance, widespread use by athletes and increased awareness among instructors. Caffeine is a quasi-crystalline, white and bitter tasted substance chemically called 1,3,7-trimethyl xanthine with the formula $C_8H_{10}N_4O_2$, which is one of the supplements that is used today in sports activities prevalently, and is found in a variety of beverages especially coffee, tea and chocolate with cacao [1]. In the past, consumption of caffeine before the tournament was considered to be doping; however, the World Anti-Doping Agency recently eliminated caffeine from the list of banned substances. So far, some of the studies that have been carried out on this supplement abroad have pointed to the positive effects of caffeine consumption on long-term activities, but its impact on anaerobic performance and sprint training led to contradictory findings [2, 3]. The mechanism of caffeine effectiveness is that it initially stimulates adrenaline secretion, which causes a) the release of fatty acids, b) Storage of muscle glycogen, c) Stimulation of the central nervous system and increase in mental arousal, d) Increase in the formation of cross bridges [4]. Also, caffeine leads to placement of calcium through the plasma and the endoplasmic membrane in the endoplasmic network of the heart muscle cells and skeletal muscle which reduces the potential of the threshold to stimulate and extension of the contraction time [5]. However, numerous articles have been presented by various researchers, including Davis (2009), Turley (2015) and Andre (2015) that caffeine consumption can affect anaerobic performance in the short-term and high intensity activities, including repetitive Wingate tests, handgrip test, as well as sports such as soccer, hockey and rugby that are largely reliant on anaerobic system [6-8], and acts as an ergogenic substance. For instance, taking 5 mg of caffeine per kilogram of body weight in female athletes can reduce lactate production during intense

sportive activities [9]. There are reasons for the possibility of a positive effect of caffeine consumption on anaerobic performance; caffeine may indirectly change the sodium to potassium ratio by altering the concentration of calcium ion, and cause more stability in the intercellular environment, and subsequently improve the conditions for the development of force [5, 10], also it can facilitate the release of calcium from its storage location in muscle cells. This effect increases muscle strength and power for a short period in the high intensity activities [11]. According to conducted researches on the effect of caffeine consumption on anaerobic performance, it seems that the consumption time and amount of caffeine consumed before physical activity can directly affect the performance of athletes. On the other hand, in a study by Woolf *et al.* (2009), participants who had very low caffeine consumption record did not report any differences in Rating of Perceived Exertion (RPE) after a 30-second Wingate test [12]. This study was performed on 18 male athletes, in which experimental group consumed 5 mg of caffeine per kg body weight, and after an hour, their anaerobic performance was evaluated during the Wingate test. Hence, it is suggested that caffeine consumption responses may be different in individuals with continuous intake and consumers with low intake of caffeine [12]. It can also be expected that continuous and acute consumption of caffeine will provide different responses both in terms of performance and biochemical markers in athletes [12]. According to the research history, it seems there is a need for more study on the effect of caffeine consumption in various people with high and/or low intake of caffeine, as well as the effect of continuous intake comparing to acute consumption of caffeine on anaerobic performance and serum lactate.

As stated before, various studies have been done on the effect of caffeine consumption on the anaerobic performance of athletes; however, less as the present study, the effect of continuous and acute consumption of this substance on anaerobic function and serum lactate level and comparison of both of these types of caffeine consumptions have been considered in active people. Plus, in previous studies, we observed the subjects who were caffeine-deprived and

were fed with acute intake of caffeine; and it was not found any study containing a period of anaerobic training along with a certain amount of caffeine consumption. Thus, in the first phase of the present study, we investigated the effect of caffeine or placebo along with 4 weeks of anaerobic training on anaerobic performance, body composition factors and serum lactate level in active men who had low and high intake of caffeine. In the second phase, we examined the effect of cessation of supplementation on before-mentioned factors in caffeine consumers and also, the effect of acute supplementation in consumers with low intake of caffeine. Hopefully, according to the findings of the current study, coaches and athletes could be helped to improve anaerobic performance.

II. Methodology

The method of this study was a quasi-experimental one. Experimental and control groups were compared in the phases of pre-test and two post-tests. The statistical population of this study was Kharazmi University's physical education students aged 19-22 years. Among them 32 students with mean age (21.2 ± 52.33 years), height (175.03 ± 05.8 cm) and weight (67.08 ± 02.35 kg) were selected as the statistical sample by random sampling. Subjects were divided into Two groups (each group $n=16$) of caffeine consumers as experimental group and placebo or control group. They were asked to fill out a questionnaire containing information on the history of caffeine consumption. The subjects consuming a maximum of one cup of tea daily were put in the control group, and those who were consuming 5 cups of tea or a cup of coffee daily were placed in the experimental group. Both groups performed anaerobic training; experimental group received caffeine while, control group received placebo. In this research, active male students were participating in physical education classes during the week and regularly had at least one hour of physical activity per day. In the pre-test phase, body composition test was conducted. In two consecutive days following the same meal at 18 o'clock, a 400-meter run test was performed and after 2 minutes, 5cc of venous blood was taken

from subjects to assess the level of lactate. The next day, a 30-second Wingate test was done to assess the anaerobic power [9].

Then, each day at 17 o'clock, the experimental group has received caffeine-containing capsules, and placebo group received starch-containing capsules for four weeks. Both of groups have performed anaerobic exercise during four weeks. In the next stage and after four weeks of anaerobic training, the first post-test phase including a 400-m run, blood sampling, body composition assessment, and 30-second Wingate test, were conducted similar to the pre-test phase. Then, each group was divided into two equal and homogeneous subgroups. On the next day at 17 o'clock, one of the subgroups of the experimental group, received placebo and the other subgroup received caffeine like before. Subgroups of the control group also received placebo or caffeine (acute intake of supplement was examined here). Then, at 18:00 o'clock the same day, all the subgroups performed a 400-m run test, and after 2 minutes, 5cc of venous blood was collected again [9]. The 400-m run test records were measured by two chronometers and the average of records were registered as the final record of each subject. During the intervention period, subjects in both groups have performed anaerobic exercise for four weeks and three sessions a week. Plus, since the most desirable adaptations are reported at least within 4 weeks, the duration of training in this study was also considered as 4 weeks [13]. The exercise program was designed with the simulation of exercise program of Thomas *et al.*, (sprint runs) [14]. Anaerobic training protocol can be seen in Table 1.

Caffeine was prepared as a powder with 98% purity from the al-Hawi Pharmaceutical Company. Next, gel capsules were filled with 5 mg of caffeine/starch per kg of subjects' body weight. Access to the subjects was easy for the researcher due to their residence in the campus. Caffeine/placebo capsules which were prepared according to the weight of each subject have been consumed every day at 17 o'clock.

Data were analyzed by SPSS software version 15. The normal distribution of data and the homogeneity of variances were assessed by the Kolmogorov-Smirnov test (KS), and the

Levene's test, respectively. Then, t-student test was used to compare the differences within and between groups. Significance level was considered at P values <0.05.

TABLE1. Training Protocol

Session	First week	Second week	Third week	Fourth week
First	> 10-minute warm up > 100m sprint and then 300m slow running (2 times) > 10-minute cool down	> 10-minute warm up > 200m sprint and then 600m slow running (2 times) > 10-minute cool down	> 10-minute warm up > 300m sprint and then 500m slow running (2 times) > 10-minute cool down	> 10-minute warm up > 400m sprint and then 5 minutes active rest (3 times) > 10-minute cool down
Second	Repeating the first session (3 times)	Repeating the first session (3 times)	Repeating the first session (3 times)	Repeating the first session (4 times)
Third	Repeating the first session (4 times)	Repeating the first session (4 times)	Repeating the first session (4 times)	Repeating the first session (4 times)

III. RESULTS

The results showed that the mean of subjects' traits including age, height and weight in experimental group were (21.96 ± 2.41 years), (176.6 ± 2.2 cm) and (66.26 ± 9.7 kg); and in control group were (21.2±2.01 years), (173.5 ± 4.5 cm) and (67.9 ± 8.2 kg), respectively (Total average: 21.52 ± 2.33 years, 175.05± 3.8 cm and 67.02±8.35 kg). Also, the results of the Kolmogorov-Smirnov test and Levene's test showed that the distribution of data in both the experimental and control groups were normal and there was a consistency in the data variance; in the other words, there was no significant difference in baseline status between the two groups. Meanwhile, in the stage of second post-test, the sample size in the experimental group was reduced to 15 due to the absence of one subject; therefore, the records of this subject were discarded.

Table 2 indicates the differences within and between groups of 400-m run and serum lactate level before and after the intervention (pre-test

and first post-test). After four weeks of anaerobic training, it was observed a decrease of 6.52% and 2.68%, in the time of 400-m run, and an increase of 23.26% and 13.98% in serum lactate levels in both caffeine consumers (experimental) and placebo consumers (control), respectively. In both groups, the post-test changes compared to the pre-test ones were significant (P <0.05). Also, the differences between groups show that there are significant differences between experimental and control groups in the 400-m run and serum lactate level (P = 0.001), which is approximately 2 times higher in experimental group. Table 3 represents the differences between groups of Wingate test results and body composition before and after the intervention (pre-test and first post-test). There was no significant difference in none of the performance indicators of the 30-second Wingate test in two groups (P>0.05); while, it was seen a significant difference in weight value between two groups (p=0.035).

Comparison of the first and second post-test data in the subgroups of control group (placebo) in Table 4 show that there are significant differences in the 400-m run performance and serum lactate level between acute consumption of caffeine and no caffeine intake after a period of anaerobic exercise (p =0.001).

Comparison of the first and second post-test data in the subgroups of experimental group (caffeine) in Table 5 indicates that there are significant differences in the 400-m run performance and serum lactate level between continuous consumption of caffeine and no caffeine intake after a period of anaerobic exercise (p =0.001).

TABLE2. Differences within and between groups of 400m sprint and serum lactate level before and after the intervention (pre-test and first post-test)

Variables	Groups	Stages		Pre and post Difference*	P value &	P value \$
		Pre-test*	First Post-test*			
400m sprint ¥	Experimental	74.86±7.80	69.98±7.12	- 4.88±1.41	0.00 1†	0.00 1†
	Control	75.3±8.21	73.28±6.36	- 2.02±1.24	0.00 6†	
Lactate €	Experimental	10.66±1.41	13.14±1.4	2.47±0.58	0.00 1†	0.00 1†

Control	10.44±1	11.9±1.1	1.46±0.8	0.001†
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Both Experimental (caffeine) and Control (placebo) groups performed a four-week anaerobic training; * The numbers are expressed as mean ± standard deviation; & Significance at the level of P<0.05 for the differences within groups; \$ significance level at P<0.05 for the differences between groups; ¥ by second; € by mmol/L; † accepted significance level: P<0.05

TABLE3. Differences between groups of Wingate test results and body composition before and after the intervention (pre-test and first post-test)

Variables	Group	Stages		Pre and post Difference*	t value	P value	
		Pre-test*	First Post-test*				
30-second Wingate	Peak power \$	Experimental	9.93±1.74	12.06±1.17	2.13±1.11	-0.41	0.686
		Control	9.63±1.34	11.49±1.34	1.86±1.81		
	Mean power \$	Experimental	4.82±0.75	5.80±0.67	0.97±0.68	-1.51	0.147
		Control	5.20±0.77	5.78±0.81	0.57±0.48		
Min Power \$	Experimental	1.75±0.38	1.93±0.57	0.18±0.84	-0.14	0.89	
	Control	2.06±0.56	2.22±0.65	0.13±0.49			
Power loss percentage	Experimental	84.74±7.44	83±60	-1.73±11.74	1.05	0.305	
	Control	82.62±9.73	86.2±13.72	3.57±10.68			
Body composition	Weight &	Experimental	66.26±9.7	66.75±9.4	0.49±0.66	-2.27	0.035#
		Control	67.9±8.2	67.6±8.3	-0.3±0.96		
	Fat-free mass &	Experimental	55.6±6.8	55.8±6.5	0.2±1.2	-0.64	0.534
		Control	55.24±5.5	55.2±5.5	0.04±0.51		
Muscle mass &	Experimental	52.6±6.5	52.8±6.3	0.2±1.13	-0.66	0.51	
	Control	52.24±5.2	52.2±5.2	-0.04±0.48			
Body fluid	Experimental	38.5±4.7	37.7±4.6	0.2±0.81	-	0.53	
	Control	38.3±3.8	38.2±3.8	-0.1±0.4			

* Numbers are expressed as mean ± standard deviation; \$ Watts per kilogram of body weight; & by kilogram; # Significance at the level of P<0.05.

TABLE4. Comparison of the first and second post-test control subgroups in 400m sprint and serum lactate levels

Variables	Group	Subgroups	Stages		First and Second post Difference*	t value	P value #
			First post-test*	Second Post-test*			
400m	Co	Caffeine	73.11±	70.29±	-	-	0.001

sprint \$	ntr ol or Placebo	(acute intake)	7.20	7.60	2.82±1.05	4.75	†
		placebo	73.45±6.72	73.16±6.41	-0.29±0.78		
Lactate &	Co ntr ol or Placebo	Caffeine (acute intake)	12.17±1.51	13.18±1.35	-1.02±0.86	-3.14	0.001†
		placebo	11.58±0.51	11.45±0.43	-0.13±0.23		

* The numbers are expressed as mean ± standard deviation; # Significance at the level of P<0.05 for the differences between groups; \$ by second; & by mmol/L; † accepted significance level: P<0.05.

TABLE5. Comparison of the first and second post-test experimental subgroups in 400m sprint and serum lactate levels

Variables	Group	Subgroups	Stages		First and Second post Difference*	t value	P value #
			First post-test*	Second Post-test*			
400m sprint \$	Experimental	Caffeine (continuous intake)	70.27±8.19	70.93±8.9	0.65±0.63	6.46	0.001†
		placebo	69.87±8.67	73.22±8.1	3.34±0.73		
Lactate &	Experimental	Caffeine (continuous intake)	14.04±1.41	13.98±1.77	0.06±0.53	-2.56	0.03†
		placebo	12.52±1.4	11.88±1.45	0.63±0.13		

* The numbers are expressed as mean ± standard deviation; # Significance at the level of P<0.05 for the differences between groups; \$ by second; & by mmol/L; † accepted significance level: P<0.05.

IV. Discussion

The results of the body composition in the present study showed that the difference in mean body weight in the subjects of the caffeine group was significantly higher than that of the placebo group, but other indicators of body composition, such as muscle mass, free-fat mass and total body fluid were not significantly affected. Significant increase in the mean body weight of the caffeine group compared to placebo group

may be due to an increase in lean mass and especially increased muscle mass as well as an increase in total body fluid (however, these indicators alone did not change significantly). Astrup *et al.* examined the effect of caffeine and ephedrine (200 mg and 20 mg, respectively), on energy expenditure and body composition in 40 obese women. It was not observed any significant difference in total weight after eight weeks in both placebo and caffeine along with ephedrine groups; however, the subjects of caffeine and ephedrine group lost 2.8 kg of their free fat mass. In this study, the amount of fat in the experimental group reduced more compared to the placebo group, but was not significant [15]. It seems that if the duration of the study was greater than 4 weeks, this decreased fat mass in the experimental group became significant. Given that the number of studies on the effect of caffeine on body compositions is very small, more research is needed to comment on this.

In our study, there was no significant difference in any of the performance indicators of 30-second Wingate test. The previous studies on the performance indicators of the Wingate test have often examined the acute consumption of caffeine. Davis and Green (2009) showed that caffeine has little effect on the performance of Wingate anaerobic test [6]. Williams *et al.* (2008) investigated the effect of caffeine and ephedrine on the peak power and muscle strength in trained athletes and the 30-second Wingate test was performed in order to determine the peak power, mean power and fatigue index. There was no significant difference between muscle strength, muscular endurance and peak power before and after the consumption of caffeine and ephedrine [16]. Woolf *et al.* (2008) also examined the anaerobic performance of subjects during a Wingate test. Their results showed that higher peak power was obtained during Wingate test after caffeine intake, but it was not reported no significant difference in the mean power, the minimum power and power loss values between caffeine and placebo groups [12]. In a study conducted by Greer *et al.* (2006), 18 male students participating in recreational activities performed 30-second Wingate test after taking placebo or caffeine. They declared that caffeine did not

affect power efficiency in 30 seconds of high intensity cycling [17]. These results are consistent with ours. It should be noted that caffeine consumption on the performance of Wingate test had positive effect in some studies but it was not significant. In this study, we also observed a positive effect of caffeine on peak power, mean power, minimum power, and percentage of power loss which was not significant. Our findings demonstrated that four-week anaerobic exercise improved 400-m run performance in both caffeine and placebo groups, significantly. Plus, it was observed a significant difference between groups in 400-m run record. Since all subjects in the pre-test stage were nearly homogeneous, it seems that the decrease of 400-m run record in the placebo group was probably because of anaerobic exercise, and a further decrease in the record of 400-m run in the caffeine group was due to the effect of caffeine which enhanced positive effect of anaerobic training. Caffeine stimulates sarcoplasmic networks and releases more calcium. Calcium ions play a major role in the process of muscle contraction. It binds to the troponin molecule and activates actin, and eventually muscle contraction occurs. The higher the calcium ions release, the longer the contraction will occur [5]. Thus, it is expected that anyone consuming caffeine, can exercise more quickly and longer.

The findings of the current study showed that either continuous or acute consumption of caffeine has a significant impact on the performance of 400-m run and serum lactate concentration. Since the studies investigating the effect of caffeine on the performance of 400-m run are very few; this research were compared to those estimating the effect of caffeine on anaerobic tests whose performance time was similar to 400-m run time. Anslem *et al.* (1992) reported that the consumption of caffeine (250 mg) increased maximum anaerobic power and blood lactate levels, and improved the maximum strength in sprint runners; however, did not affect the Wingate test results. It seems that caffeine has an energetic effect in activities lasting less than 60 seconds [9]. Wiles *et al.* (2006) measured the performance of eight trained cyclists in a 1-kilometer cycling test on an ergometric bike and showed that consuming 5

mg of caffeine resulted in a 1.3% improvement in the performance time [18]. Crowe *et al.* (2006) investigated reaction-time tests and a 60-second cycling effort, 90 minutes after taking 6 mg caffeine or placebo and suggested that caffeine increased the blood lactate concentration compared to the placebo and control group, significantly; more, the peak power has been reached sooner in caffeine group than placebo and control group during 60 seconds cycling effort. However, peak power, work efficiency, rating of perceived exertion and maximum heart rate did not change significantly [19]. Recently, Davis and Green (2009), in a study on trained subjects, conducted special tests as intermittent sports activities. The results showed that the anaerobic function of the subjects in the caffeine group was significantly improved. According to the results of this study, caffeine consumption appears to be energetic for activities lasting from 60-180 seconds [6]. According to the results of Collomp *et al.*, caffeine elevated the speed of elite swimmers in a 100-m swimming, but did not affect the amateur swimmers speed [20, 21]. With regard to the research findings, caffeine seems to have a positive effect on anaerobic activity which lasts from 60 seconds to 90 seconds. The results of this study were consistent with above-mentioned studies. In our study, there was no significant difference between the effect of continuous and acute consumption of caffeine on 400-m run performance as well as serum lactate level. We observed useful results in both acute and continuous caffeine consumption. To justify this, we can consider the benefits related to caffeine ingestion including elevated mean power output, stimulation of motor activity and increase in alertness and ability to concentrate as well as reduced sensation of pain and exertion, delayed feeling of fatigue and increased fatty acid oxidation. Plus, it was reported that the inhibition of adenosine receptor, especially in the central nervous system, is probably a mediator of caffeine's ergogenic properties. Caffeine is able to counteract many of the inhibitory effect of adenosine on neuroexcitability, neurotransmitter release, and arousal by binding adenosine receptors [23]. More, in our study, cessation in caffeine use resulted in loss of performance in 400-m run and

decreased blood lactate level. It should be mentioned that caffeine reduces the rate of perceived exertion and labor pressure during exercise. This phenomenon has beneficial effects on maximum neural firing rate and the transmission of neural impulses to the motor unit which allow for more sustained and stronger muscle contractions [5]. Caffeine is also very similar to adenosine molecules and therefore, it can be attached to the adenosine receptors, and inhibits the messages for resting phase [5, 22]. Caffeine also stimulates sarcoplasmic network and higher calcium is released. Then, the prolonged contractions are occurred due to high concentration of calcium [13]. In the end, the results of this study showed that consumption of caffeine with anaerobic training, compared with the same exercise but without caffeine consumption had a significant effect on anaerobic function at 400-m run and serum lactate levels which confirmed the useful effect of caffeine on anaerobic performance.

V. CONCLUSION

Anaerobic training for 4 weeks with and without caffeine consumption decreased the time of 400m-run and elevated serum lactate levels (higher differences were observed in caffeine group); whereas, had no significant effect on Wingate test results and body composition values. Acute consumption of caffeine in placebo group also decreased the time of 400m-run and elevated serum lactate levels. Totally, acute and continuous consumption of caffeine along with anaerobic exercise improved anaerobic performance; while increased serum lactate levels in active men.

VI. ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was conducted in accordance with the ethical guidelines of the Kharazmi University, Tehran, Iran.

VII. HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All human research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and

with the Helsinki Declaration of 1975, as revised in 2013.

VIII. CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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