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The Impact of a Training Program for Development Strength Endurance with Taking L- Arginine on Body Composition and 5000m Running Records.

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Abstract

The purpose of the study was to find out the effects of Strength Endurance exercises program and taking L- Arginine on body composition and (5000) m running records. To achieve the purpose of the study, eighteen apparently healthy players from the infantry in Armed Forces selected as subjects who are playing (5000) m running. They were randomly divided into two groups of (9) subjects of each group. Group one acted as an experimental group who underwent strength endurance exercises with L- Arginine intake, and group two acted as a control group who underwent strength endurance exercises with placebo capsules for eight weeks for both groups two times a week. The subjects were tested on selected criterion variables such as strength endurance tests, body composition evaluation, and records of (5000) m running, that's immediately before and after the training period. After souring of the equivalent of the two groups, the suggested program had achieved. The result of the present study had revealed that there were a significant difference found among the experimental and control group in muscle mass (MM), the rate of water (RW), the rate of fat (RF), the rate of burn (RB), legs strength endurance (LSE), arms strength endurance (ASE), core strength endurance (CSE), and the records of (5000) m running for the experimental group compared with the control group. Whereas there was no significant difference in back strength endurance (BSE). The researchers recommended with Supplying of L- Arginine with Strength Endurance exercises for players of long-distance to increase the ability to performance which is affect the record levels.

***Key words**: Strength endurance, L- Arginine, 5000m running.*

Introduction:

In the sport of athletics, long-distance events are defined as races covering three kilometers (1.86 miles) and above **(11)**. The (5000) meters running is considered as a premier event that requires tactics and superior aerobic and anaerobic conditioning. Training for such an event may consist of a total of (60–200) kilometers (37–124 miles) a week, although training regimens vary greatly. The (5000) m is often a popular entry-level race for beginning runners **(15)**.

So the runner who runs (5000) m has building blocks are also known as bio-motor abilities, which USA Track & Field (USATF) defines as the "abilities in the biological and motor domains that enable success in athletic performance." In other words, they're the specific components of fitness that, when put together, help you succeed in any sport. For example: Power is the combination of strength and speed while agility is a combination of speed and coordination and the most needed element for this event is strength endurance which is mixing of muscle strength and endurance.

It's possible to train all facets of strength even in a distance running program, though of course they're not all a primary focus like Strength Endurance which mean sustaining force production. It is partially built by using general strength exercises, though not completely. It'll need high repetitions or extended stabilization (like a plank) to develop strength endurance. Strength Endurance training should be an important component in an endurance athletes training protocol **(32).**

A combination of strength and endurance training has been shown to improve maximal force production without increasing muscle hypertrophy or body mass shape **(1).** "Millet et al", (2002) shows that combining of both endurance and strength increases maximal strength and running economy compared to endurance training alone **(20)**.

Circuit type of training that includes both highly explosive strength and endurance training has been shown to improve (5-k) running performance and peak treadmill running performance through running economy **(22).**

"Stephen Magness", (2010) was defining strength endurance that it is "Increasing the ability to use a certain

percentage of your maximum strength over a longer period of time **(30).**

As researchers who train long distance runners prefer to give L-Arginine with Strength Endurance training because, L-Arginine is extremely popular among healthy people engaging in resistance training exercises **(2).**

Generally, L-Arginine is marketed as nitric oxide stimulators, which purpose to increase muscular strength and endurance as potential benefits to the user. The premise of these claims is that they increase the availability of L- Arginine in the system, thus augmenting synthesis of nitric oxide release by way of the enzyme nitric oxide syntheses reaching stability and adaptation **(36).**

It is believed that this increase in nitric oxide will allow for improved blood flow **(25),** and this could potentially be beneficial for individuals performing strength exercises. Further, an elevation in blood flow could theoretically improve exercise performance by increasing nutrient delivery and/or waste-product removal from exercising skeletal muscles **(18).**

L- Arginine-based supplementation has produced mixed results with some studies reporting ergo-genic benefits in anaerobic power **(4)**, muscular strength **(27),** and muscular endurance **(9)**, while others have found no effect on these same performance variables **(8)**, Specifically "Santos et al", (2002) who reported decreasing muscular fatigue following L-Arginine ingestion only **(27)**, while "Greer and Jones" (2011) **(2)** reported no ergo-genic benefits during muscular endurance exercises **(9)**. Therefore, the aim of this study was to determine the efficiency of L-Arginine as a potential ergo-genic aid with strength endurance exercises on body composition and (5000) m running records.

Subjects and methods :

Eighteen apparently healthy Players from the infantry in Armed Forces which run (5000) m participated in the study. The subjects were randomly divided into two groups. The experimental group (L-Argenine-supplemented group) (RG, n = 9) with average age (26.2) years, average height (170.2) cm, and average weight (65.45) kg ingested (500 mg) of L- Arginine capsules daily for two months, and the control group (placebo group), (PG, n = 9) with average age (27.2) years, average height (173.6) cm, and average weight (64.28) kg took placebo capsules for two months too (30) minutes before the training unit after breakfast Prior to the study for both .

Each athlete had been engaged in strength endurance training proposed in this study (for two times per week throw two months). Subjects completed a health history questionnaire and signed a statement of informed consent. The athletes were briefed about the aim and the protocol of the study. Informed written consent was obtained from all of the subjects and the coach.

The measurement:

The measures were performed before the training program in (10/2013) for all the study variables which are: Muscle mass (Mm), The rate of fat (RF), The rate of water (RW), The rate of Burn (RB), and all of these were measured by body Composition device, Legs strength endurance (LSE) by Squat Test , Arms strength endurance (ASE), by Push-Ups Test, Core strength endurance (CSE) by Sit-Ups Test, Back strength endurance (BSE) by push-Ups Test for back from lie, and (5000) m record by time. The Measures were performed after the training program in (12/2013) for all the study variables.

The supplementation:

The players of the experimental group were Taken one capsule daily containing (500) ml of amino acid (L-Arginine), also the players of the control group were taken placebo capsule (with inert materials from carbohydrates) daily to remove the psychological factor with the players, also before half an hour of basic training for two consecutive months (attach 2).

Exercise protocol (training program):

Subjects warmed up for (20) minutes then, perform general strength exercises for (legs- arms- back- core) with high repetitions to improve strength endurance. The subjects perform general strength exercises using the interval training with low intensity (50%: 80%) in special training interval through training style circuit rated for being good way to develop the strength endurance for a period of (8) weeks at a rate of twice a week to be between each time training at least (48) hours and leads after basic training that was found shortly enough rest. It should not be exceeded two exercises to the same muscle group and must contain training circuit on different muscle groups. And repeat the exercises between (2: 4) times from the beginning to the end of the program. No. of circuit per session (1 -3), Rest interval not less than (3: 5) minutes between each session (circuit), and the rest period (30:60) second between each exercise and another (Table 1).

Table (1)

Guidelines for circuit training for strength endurance	
Load	Low – Medium (50% -80%)1RM
No. of exercises	9
Time per station	45 -90 seconds (110N/min)
No. of circuit per session	1 - 3

Guidelines for circuit training for strength endurance	
Rest interval between sets	30- 60 seconds
Rest interval between circuit	3 -5 min

Guidelines for circuit training for strength endurance	
NO. of repetition	2 - 4
Frequency	2×Week
No. of weeks	8

Results:

Table (2)
Means, standard deviation, kurtosis, and skewness of (5000) m running

Variables	T. unit	Experimental group n=9				Control group n=9			
		M	S.D	K	S	M	S.D	K	S
Age	Year	26.22	2.048	-1.432	-0.046	27.22	1.715	-1.649	-0.630
Weight	Kg	65.45	3.417	0.087	-1.084	64.28	3.092	-1.258	-0.551
Height	Cm	170.2	1.500	-1.714	-0.286	173.66	2.645	-0.380	-0.214
T. age	Year	7.00	3.865	0.003	0.234	6.88	1.691	-0.986	-0.576
SYS.P	Mm/z	102.5	4.065	-0.375	0.558	105.33	3.082	-0.333	0.454
DI.P	Mm/z	67.40	2.676	-0.722	-0.487	66.63	2.513	-1.548	-0.220
HR	PULS	60.87	2.530	1.002	0.956	60.22	3.308	0.036	0.149

The variables that maybe likely to affect the results of the research as (Age- Weight, Height .Training age, Systolic pressure (SYS.P), Diastolic pressure (DI.P), Heart rate (HR) are presented in table (2) and all values of the skewness lies between (±3) which achieved the equivalent of the subjects.

Table (3)
Wilcoxon Sign Ranks Test for some variables of experimental group and control group before program

Variables	Test	average	Mean of Rank	Sum of Ranks	Difference		% of difference	Z	P.V
					D	N			
RF	experimental	7.9	0.00	0.00	–	0	1.7	-1.432	0.180
					+	2			
	control	7.53	1.50	3.00	Ties	7			
					Total	9			
MM	experimental	32.22	3.12	12.50	–	4	2.7	-1.355	0.176
					+	1			
	control	33.13	2.50	2.50	Ties	4			
					Total	9			
RB	experimental	1493.21	5.00	20.0	–	4	1.9	-1.016	0.310
					+	3			
	control	1523.11	2.67	8.0	Ties	2			
					Total	9			
RW	experimental	41.73	0.00	0.00	–	0	4.19	-1.032	0.300
					+	5			
	control	39.98	3.00	15.00	Ties	4			
					Toal	9			
LSE	experimental	45.22	0.00	0.00	–	0	1.7	-1.342	0.180
					+	2			
	control	44.44	1.50	3.00	Ties	7			
					Total	9			
ASE	experimental	34.56	1.50	1.50	–	1	1.6	-0.816	0.414
					+	2			
	control	34.00	2.25	4.50	Ties	6			
					Total	9			

Variables	Test	average	Mean of Rank	Sum of Ranks	Difference		% of difference	Z	P.V
					D	N			
CSE	experimental	41.67	2.00	6.00	–	3	3.45	-1.604	0.159
					+	0			
	control	43.11	0.00	0.00	Ties	6			
					Total	9			
BSE	experimental	43.0	1.50	3.00	–	2	2.27	-1.342	0.180
					+	0			
	control	44.0	0.00	0.00	Ties	7			
					Total	9			
5000m running	experimental	18.95	3.00	3.00	–	1	0.65	-0.730	0.465
					+	3			
	control	19.07	2.33	7.00	Ties	5			
					Total	9			

Table (3) shows no positive significant differences in all variables for the pretests of the experimental and the control group, which achieve the equivalent of the two groups.

Table (4)
Wilcoxon Sign Ranks Test for some variables of control group before and after program

Variables	Test	average	Mean Rank	Sum of Ranks	Difference		% of difference	Z	P.V
					D	N			
RF	Before	7.53	4.38	17.50	–	4	4.7	-0.593	0.553
					+	3			
	After	7.17	3.50	10.50	Ties	2			
					Total	9			
Mm	Before	33.13	3.00	3.00	–	1	10.16	-2.318**	0.020
					+	8			
	After	36.88	5.25	42.00	Ties	0			
					Total	9			
RB	Before	1523.11	3.00	9.00	–	3	4.72	1.260	0.208
					+	5			
	After	1598.56	5.40	27.0	Ties	1			
					Total	9			
RW	Before	39.98	0.00	0.00	–	0	10.57	-2.023**	0.043
					+	5			
	After	44.71	3.00	15.00	Ties	4			
					Total	9			
LSE	Before	44.44	5.00	5.00	–	1	8.48	-1.823*	0.068
					+	7			
	After	48.56	4.43	31.00	Ties	1			
					Total	9			
ASE	Before	34.01	0.00	0.00	–	0	16.6	-2.668**	0.008
					+	9			
	After	40.78	5.00	45.00	Ties	0			
					Total	9			
CSE	Before	43.11	0.00	0.00	–	0	15.28	-2.668**	0.008
					+	9			
	After	50.89	5.00	45.00	Ties	0			
					Total	9			
BSE	Before	44.01	0.00	0.00	–	0	15.54	-2.716**	0.007
					+	9			
	After	52.11	4.38	17.50	Ties	0			

Variables	Test	average	Mean Rank	Sum of Ranks	Difference		% of difference	Z	P.V
					D	N			
					Total	9			

Table (4) shows clear positive significance differences in (Mm, RW, LSE, ASE, CSE, and BSE), and no significant difference in (RF) and (RB) at the post tests of the control group.

Table (5)

Wilcoxon Sign Ranks Test for some variables of experimental group before and after program

Variables	Test	average	Mean Rank	Sum of Ranks	Difference		% of difference	Z	P.V
					D	N			
RF	Before	7.9	3.00	15.00	–	5	21.52	-2.023**	0.043
					+	0			
	After	6.2	0.00	0.00	Ties	4			
					Total	9			
Mm	Before	32.22	0.00	0.00	–	0	19.67	-2.668**	0.008
					+	9			
	After	40.11	5.00	45.00	Ties	0			
					Total	9			
RB	Before	1493.22	0.00	0.00	–	0	12.04	-2.521**	0.012
					+	8			
	After	1697.56	4.50	36.00	Ties	1			
					Total	9			
RW	Before	41.73	0.00	0.00	–	0	13.53	-2.214**	0.027
					+	6			
	After	48.26	3.50	21.00	Ties	3			
					Total	9			
LSE	Before	45.22	0.00	0.00	–	0	18.77	-2.692**	0.007
					+	9			
	After	55.67	5.00	45.00	Ties	0			
					Total	9			
ASE	Before	34.56	.00	.00	–	0	23.57	-2.666**	0.008
					+	9			
	After	45.22	5.00	45.00	Ties	0			
					Total	9			
CSE	Before	41.67	0.00	0.00	–	0	23.62	-2.668**	0.008
					+	9			
	After	54.56	5.00	45.00	Ties	0			
					Total	9			
BSE	Before	43.01	3.00	15.00	–	0	19.18	-2.675**	0.007
					+	9			
	After	53.22	0.00	0.00	Ties	0			
					Total	5			

Table (5) shows clear positive significance differences in all variables for the post tests of the experimental group.

Table (6)
Wilcoxon Sign Ranks Test for some variables of experimental and control group after program

Variables	Test	average	Mean Rank	Sum of Ranks	Difference		% of difference	Z	P.V
					D	N			
RF	experimental	6.23	3.00	15.00	–	5	13.23	-2.032**	0.042
					+	0			
	control	7.18	0.00	0.00	Ties	4			
					Total	9			
Mm	experimental	40.11	0.00	0.00	–	0	8.02	-2.207**	0.027
					+	6			
	control	36.89	3.50	21.00	Ties	3			
					Total	9			
RB	experimental	1697.56	0.00	0.00	–	0	5.83	-1.841*	0.066
					+	4			
	control	1598.56	2.50	10.00	Ties	5			
					Total	9			
RW	experimental	48.26	0.00	0.00	–	0	7.35	-2.371**	0.018
					+	7			
	control	44.71	4.00	28.00	Ties	2			
					Total	9			
LSE	experimental	55.67	0.00	0.00	–	0	12.77	-2.384**	0.017
					+	7			
	control	48.56	4.00	28.00	Ties	2			
					Total	9			
ASE	experimental	45.22	0.00	0.00	–	0	9.82	-2.375**	0.018
					+	7			
	control	40.78	4.00	28.00	Ties	2			
					Total	9			
CSE	experimental	54.56	0.00	0.00	–	0	6.7	-2.388**	0.017
					+	7			
	control	50.89	4.00	28.00	Ties	2			
					Total	9			
BSE	experimental	53.22	1.50	3.00	–	2	2.08	-0.743	0.458
					+	2			
	control	52.11	3.50	7.00	Ties	5			
					Total	9			

Table (6) shows clear positive significance differences in Mm, RW, LSE, ASE, CSE, RF, RB, variables for the experimental group compared with the control group whereas no significant difference in BSE.

Chart (1)

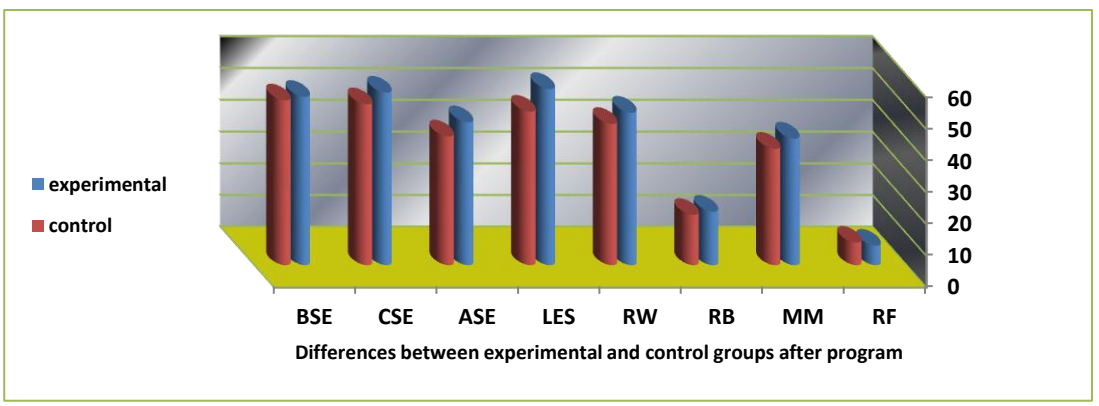
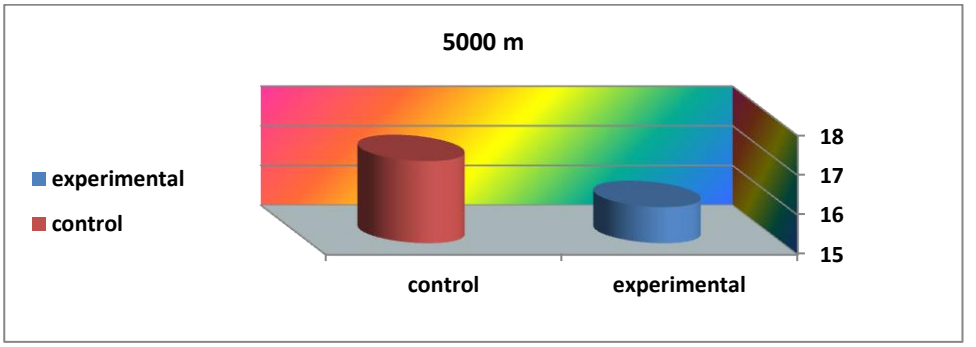


Table (7)
Wilcoxon Sign Ranks Test for (5000m records)

Variables	Test	average	Mean Rank	Sum of Ranks	Difference		% of difference	Z	P.V
					D	N			
5000m Experimental	before	18.95	0.00	0.00	–	9	16.04	-2.666**	0.008
					+	0			
	after	15.91	5.00	45.00	Ties	0			
					Total	9			
5000m control	before Test	19.07	0.00	0.00	–	9	10.49	-2.666**	0.008
					+	0			
	after	17.07	5.00	45.00	Ties	0			
					Total	9			
5000m after program	Experimental	15.91	0.00	0.00	–	0	6.79	-2.524**	0.012
					+	8			
	control	17.07	4.50	36.0	Ties	1			
					Total	9			

Table (7) shows clear positive significance differences at **(**5000 m records) for both the experimental and the control group for the post tests with advantage percent of the experimental group (16.04%) and (10.49 %) for the control group And shows clear positive significance differences at **(**5000 m records) of the experimental and the control group at the post tests for the experimental group with achieving percent (6.79%).

Chart (2)



Data Analysis:

All statistical analyses were performed using the non-parametric statistics for samples less than (10). It includes the Descriptive Statistics, % of differences and Wilcoxon Signed Ranks when ($p<0.05$).

Discussion

The present study shows that **Strength Endurance** exercises training yields a positive influence on the **performance** of well-trained athletes of (5000 M), during the training period

Changes of performance: The results of the present study refers to the improvement in performance of the two groups between before and after program (Strength Endurance exercises) for (LSE, ASE, CSE, BSE, 5000 m running) where affect on body composition positively table (4),(5),(7) which agreed with the results of previous studies of "Gregoire P", et al, (2002) **(10)**, "Sedano SL" et al, (2013) **(28)**, which reported improvement of the economy after a combining of strength+ endurance training in endurance athletes, whereas no changes in endurance- only athletes .

(5-km) performance, running economy and "muscle power" of well-trained athletes improved after (9) wk of endurance -strength training, whereas no changes were observed in a control group - endurance- training group **(22)**.

In another study it is clear that the indication of master endurance athletes seem to benefit from concurrent strength and endurance training because, the rate of force development may be crucial for performance

improvement, this consider as one of the major determinants of endurance performance **(24).**

Change of performance with L- Arginine supplementation: The results of the present study that showed the improvement in performance for (LSE, ASE, CSE, BSE, 5000m running) which achieved the increase of muscle mass and rate of water table (4), (5), (6),(7) for the experimental group (L-Arginine group) compared with the control group (placebo group), after Strength Endurance exercises training,) are in the same line with results of previous studies of "Campbell BL", et al (2006) **(4)** and "Little JP", et al (2011) **(18),** which elucidate the importance of L- Arginine supplementation for achieving high improvement of performance in trained adult men and muscular endurance**.**

L- Arginine supplementation or injection does not make any effect on muscle endurance without joining exercises with it**,** that's obviously achieved in "Greer BK", and "Jones BT's " (2011) **(9)** study, and which confirmed also at "As-Elam RP", et al (2002) **(6),** Where refers that subjects who were taking the L- Arginine scored significantly higher in total strength (TS) than subjects on placebos. They were concluded that L- Arginine taken in prescribed doses with a high intensity strength training program, can increase (TS) and lean body mass (LBM) in a relatively short period of time. L- Arginine also aid in recovery from chronic stress by quelling tissue breakdown.

Long-term of oral L-Arginine supplementation in humans improves coronary small-vessel endothelial function in association with a significant improvement in symptoms and a decrease in plasma endothelia concentrations, which helps to increase the activity of the circulatory system and internal burning (metabolism) and thus increases the percentage of water in the body **(17)**.

The researchers attributed this to the importance of L-Arginine which is considered a precursor for nitric oxide production and has the potential to improve blood flow and nutrient delivery to muscles that increases strength endurance. It is also achieves the improvement of human performance and pushes the athletes to reach the top of performance as soon as possible (**31), (21), (3).**

Nitric oxide (NO) plays an important role in many functions in the body regulating vasodilatation, blood flow, mitochondrial respiration and platelet function. L-Arginine is the main precursor of (NO) via nitric oxide syntheses (NOS) activity and it helps to have a perfect muscular growth and reduces the time of recovery because, of its function which cause non- contract of smooth muscles **(35)**.

Change of body composition: The results of the present study that showed the improvement in the experimental group between before and after program tests in (Mm), (RW), (RB), (RF) ($p < 0.05$) table (5). And the control group showed the improvement in (Mm), (RW) but not positive significance differences in (RB), (RF) table (4).The researchers attributed this to Strength Endurance training in current study, that in agreement with previous studies of "Hwi Ryun Kwon, et al (2010) and "Kwon YC, et al" (2002), that reported the improvement of strength endurance by low-intensity resistance training where refers to significantly increasing in muscle mass and strength, and positive significant decreasing at total fat mass in obese females **(14), (16).** "Campbell, et al" (2006) showed that the improvement of strength endurance training increased the total body water and decreased Fat mass in older adults, and he clear that with resistance training, the mean energy intake required for body weight maintenance increased by approximately (15), Increased energy expenditure included increased resting metabolic rate and the energy cost of resistance exercise (4).

L-Arginine supplementation in humans helps to increase the activity of the circulatory system and internal burning (metabolism) and thus increases the percentage of water in the body, muscles volume and reduces fats (17) which is achieved at "Hussein, H and Nader's" (2007) study where found that the increase in muscle mass considered as an indicator to increase the percentage of water in the body (13).

The researchers attributed that L-Arginine supplementation relaxes blood vessels, it might have cardiovascular benefits for some people. L- Arginine plays an important role in cell division, the healing of wounds, removing ammonia from the body, immune function, and the release of hormones **(33), (29**) So most of scientists recommends of medical intake of L-Arginine **(23).**

Data obtain from this study are in agreement with previous studies **(6),** which reported that supplementation with nitric-oxide-inducing supplements had effect on body composition (Mm, RF, RW,RB) which L-Arginine is administered through the veins and stimulates the secretion of growth hormone, and is used in growth hormone stimulation tests **(34)**. Some studies have found that oral L-Arginine supplementation is also effective at increase resting (GH) levels which form body muscles (**5).**

"Forbes, SC and Bell" (2011) indicate that human growth hormone (GH) can turn back body's internal clock, helping rapidly build muscles, slash fat and Metabolic rate **(7)** and it is also clear that (GH) increases lean tissue and skeletal muscle mass in adults human, this suggests a role for (GH) in

the regulation of body composition of adult humans which influenced with L- Arginine presence **(26).**

It is obviously that (GH) administration in endurance-trained male athletes has a net anabolic effect on whole body protein metabolism at rest and during and after exercise **(19),** induced a positive nitrogen balance in the body and has a protein in muscle which increases the muscle mass and increase strength **(12).**

Conclusion

Strength – Endurance exercises with L- Arginine supplement, is considered as a key factor in stimulating the production of nitric oxide which leads to an improvement in the rate of top performance in exercise, races, body composition and increasing nutrient delivery and/or waste-product removal from exercising skeletal muscles, Such as in the current study.

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