Effect of zinc supplementation on immune responses of track and field students

*Dr/ Amal H Alshareefi **Dr/ Fatma Allam Hussein Ali
***Dr/ Sanabel B Alkhalaf ****Dr/ Aishah Y Alwahaib

Abstract

Aim: of current study is to identify the impact of zinc supplementation on the Protein immune and Indices of infections at rest and after effort among Students of the College of Physical Education, section of sport Training and Movement Sciences , major in track and field.

Methodology: The researchers followed the experimental method on an intended sample. A total of (9) Students of the College of Physical Education, section of sport Training and Movement Sciences, major in track and field. in the study. All were aged between (20) and (22). The anthropometric measurements used included weight (kg), height (cm). In order to determine the body mass index (BMI), the calculation was based on height and weight (kg/m).four blood -report tests were used in current study (before in rest and following exercise, then after test in rest and following exercise)to determine the Protein immune(IgG, IgM, IgA) and Indices of infection(CRP) of blood levels. For 24 weeks, a zinc gluconate supplement (76 mg tablet) was taken one hour before the practical lecture.

Statistics: Analysis of the data was done using SPSS Version 25 to determine the (Arithmetic mean, Standard deviation, Median, Coefficient of Skewness, Coefficient of Kurtosis).In addition paired samples T test was used to analyze the differences between pre- and post measurements. The percentage of improvement , the effect size according to Cohen's D equations and the effect size according to Eta square were calculated.

Results: The study finds that Zinc supplement reduces inflammatory indications because it improves anti-proteins among athletes. The result reveals that the effect of taking zinc supplement is high on the measures under investigation except for (IgG before the effort).

Conclusion: Zinc supplementation reduced inflammatory markers and improved immune proteins, according to the findings. All biochemical parameters were significantly affected by taking zinc supplementation, with the exception of (IgG before physical activity), which was average.

Keywords: zinc, ammunition system, nutrition, exercise.

* Department of Physical Education & amp. Sports College of Basic Education Public Authority for Applied education & Training.

** Department Of Health Sciences College of Physical Education for girls Alexandria University.

*** Department of Physical Education & amp. Sports College of Basic Education Public Authority for Applied education & Training

**** Department of Physical Education & amp. Sports College of Basic Education Public Authority for Applied Education & Training.

Introduction

Protection against infection of bacterial, viral, fungal or parasitic origin is known as immunity. The end-stage B cells are the plasma cells that generate immunoglobulins. Four chains make up antibodies, namely, two heavy chains that are the same and two light chains that are the same. Antigen binding is performed by that section of the antibody molecule with potential for diversity that is created by the pairing of the different portions of the heavy and light chains. Antibody function is determined by the heavy chain area that does not vary and is associated with one of four classes, namely, M, which yields the IgM antibody, G1-4, which yields the IgG1-4 antibody, A1-2, which yields the IgA1-2 antibody, D, which yields the IgD antibody, and E, which yields the IgE antibody. Recent infection can be effectively detected by measuring IgM with pathogen specificity as this is the initial antibody released in the context of a primary immune response. Meanwhile, the second antigen exposure is associated mainly with IgG. An immune complex results from the binding of IgG and IgM to antigen, in which case both antibodies serve as complement activators of highest efficiency. Due to its ability to permeate the placenta, the IgG antibody can expose the foetus both to immunity and to disease. As regards the IgA antibody, it is found in secretions, such as tears, saliva, and GI tract, and its role is to protect the mucosae (Kumar & Clark, 2009).

The ability of the human body to withstand the action of infectious agents depends primarily on the immunoglobulins IgA, IgM, and IgG. They are present in the serum and tissue fluids and confer protection from various bacteria, viruses, and parasites (Camacho et al., 2020). Furthermore, proteins, tissues, and organs are among the biological structures that counteract conditions targeting the immune system. The immune system is distinguished into the innate immune system, which is a defence mechanism that lacks specificity and is activated instantly upon the appearance of an antigen, and the acquired immune system, which is a defence mechanism with antigen specificity and is otherwise called adaptive immunity (Khanam, 2018).

The general assumption among athletes and coaches is that immune system activity is diminished by intense physical training on a regular basis, as reflected in a decrease in the number and activity of lymphocytes and antibodies (Mottaghi, 2014). This increases the risk of development of upper respiratory tract infections. The wide range of cells, proteins, and compounds that make up the immune system exhibit sensitivity to various stimuli, including intense and protracted physical activity (Gleeson, 2006; Pedersen & Hoffman-Goetz, 2000). Several authors reported that elite athletes experienced diminished performance and endurance as a result of changes in immunity (Mckune et al., 2006; Nieman & Nehlsen-Cannarella, 1991), which negatively affected immune function and made them more prone to infections (Gleeson, 2006).

The impact of physical activity on immunity depends on the nature and regime of the physical activity and how long and intense is (Hejazi & Hosseini, 2012). In turn, changes in immunity promote inflammation in the muscles, as occurs in elite athletes (Córdova et al., 1995). For instance, the IgM levels were found by Petibois et al. (2003) to be elevated in elite rowers over a period of a year, whereas Mashiko et al. (2004) reported a 15% reduction in IgM levels following a period of rugby exercise of 20 days performed in two-hour sessions six days per week. Furthermore, there is evidence that the immune system is inhibited by intense exercise as reflected in the decrease in the number of lymphocytes and in the number and activity of natural killer cells and antibodies (Mottaghi et al., 2014).

For maintenance of health and best physiologic function, a small concentration of the mineral element zinc is necessary (Am J Clin Nutr, 2000). Zinc is essential for bolstering the immune system by supporting its strength, which is why zinc deficiency can have adverse health effects, weakening the immune system and slowing down wound healing. Furthermore, by acting as an antioxidant, zinc is recognised to enhance immunity. It also attenuates the action of oxidative stress markers and the production of inflammatory cytokines (Hernández-Camacho, 2020).

As a metal belonging to group IIb, zinc fulfils a broad variety of physiological roles within the human body and it controls several immune system dimensions, including the skin barrier, mucous membrane, and gene modulation in lymphocytes (Fraker et al., 2000). Furthermore, zinc has action against oxidants and inflammation (Saeedy, 2019). Additionally, it may target viruses by enhancing interferon gamma levels and minimising the docking of common cold viruses to binding site, although the precise way in which it achieves this is still unknown.

The antioxidant and anti-inflammatory actions of zinc are the basis of the therapeutic effects of zinc lozenges for URI treatment. Hence, zinc lozenges may demonstrate tolerogenic effects on immunity as well (Walsh, 2019). Furthermore, a number of processes of critical importance for innate immunity (e.g. phagocytosis, intracellular killing, cytokine production) are modulated by zinc. Meanwhile, insufficient availability of zinc affects the adaptive immunity through decreased production and function of T cells and decreased production of B cell antibodies (Hernández-Camacho, 2020). Moreover, it has been reported that zinc supplementation attenuated muscular injury in amateur boxers of young age (Karakükçü et al., 2019). Zinc is also involved in muscle development and repair and in the production of energy.

Individuals engaging in exercise must include such micronutrients in their diet to maintain their immune system strong and minimise inflammatory processes. It is known that exercise performance depends on zinc status, but more research must be conducted to determine how much zinc athletes’ diet should contain. Presently, it is recommended that the diet of athletes and individuals performing intense exercise on a regular basis should include 14 and 8 mg/day for male and female individuals, respectively (National Health and Medical Research Council, 2006).

As discussed above, many different immune activities depend on zinc and excessive physical exercise impact athletes immune system and performance. As argued by Calder (2013), nutrition, immunity, and infection are directly correlated. Furthermore, it has been reported that athletes without health problems exhibited changes in immune response following intense physical activity as a result of zinc supplementation. Given these considerations, the present study seeks to investigate how zinc supplementation affects protein immune and infection indices both during inactivity and during activity among students enrolled in track and field modules within the Faculty of Sports Education.

Methodology

Participants:

During the academic year 2018-2019, nine female students from the track and field modules were asked to participate. Aged between 20 and 22 and from the Faculty of Sports Education, they were chosen as purposive samples to take part in this research. The Faculty of Sports Education approved the study and written consent was obtained from every participant before the study began.

Table (1)

Statistical description of the research sample for the basic variables under study before conducting the basic study (N = 9)

Statistical description Variables	Unit	Mean	Median	Std. Deviation	Skewness	Kurtosis
Age	years	20.33	20.00	0.50	0.86	-1.71
Height	cm	170.56	171.00	4.79	0.27	-1.21
Weight	kg	68.94	70.50	9.03	-1.70	4.17
BMI	Kg/m^2	23.66	24.02	2.63	-1.73	3.62

From Table (1), the data on the research sample are moderate, non-dispersed, and characterized by normal distribution, where the values of the skewness coefficient ranged between (-1.73 to 0.27). These values are close to zero and are located in the normal curve between (± 3), which confirms the normal distribution of the sample for the basic variables under study before conducting the basic study.

Table (2)
Statistical description of the research sample for the basic variables under study before conducting the basic study (N = 9)

Descriptive stats Variables		Unit	Mean	Median	Std. Deviation	Skewness	Kurtosis
IgM	Before Effort	U/mL	145.33	146.00	53.59	-0.25	-0.41
	After Effort	U/mL	115.44	123.00	43.79	-0.22	-0.54
IgA	Before Effort	U/mL	191.44	196.00	55.29	0.41	-1.13
	After Effort	U/mL	188.44	186.00	52.26	0.56	-0.82
IgG	Before Effort	U/mL	1270.22	1145.00	301.08	1.00	-0.42
	After Effort	U/mL	1285.56	1169.00	286.28	1.04	-0.58
CRP	Before Effort	mg/l	2.31	1.70	1.53	1.34	1.29
	After Effort	mg/l	3.43	3.40	1.56	0.98	1.67

From Table (2) the data on the research sample are moderate, non-dispersed and characterized by normal distribution, where the values of the Skewness coefficient ranged between (-0.25 to 1.34) and these values are close to zero and located in the normal curve between (± 3), which confirms the normal distribution of the sample for the basic variables under study before conducting the basic study.

Method:

The current experimental study took 24 weeks and three days from 4/11/2018 to 23/4/19. The anthropometric measurements used included weight (kg), height (cm), body fat (percentage), and muscle mass (kg, using bio impedance analysis). In order to determine the body mass index (BMI), the calculation was based on height and weight (kg/m). Biochemical measurements were taken as follows. A pre-test was given before treatment and consisted of 2 blood tests, the first in rest and the second after exercising during the subsequent lecture sessions. Then zinc gluconate (76 mm) tablets were administered approximately one hour before the exercise began during lecture. Participants continued to take this supplement daily until the conduct of a second set of measurements approximately 6 months later. At the conclusion of treatment, post-tests were administered, as before 2 blood tests, the first one in rest then the other after exercising during the lecture. All 4 tests blood tests reported the protein immune levels (IgG, IgM, IgA) and Indices of infection (CRP) in the blood.

Statistical analysis: The statistical analysis was found using the SPSS version 25 program, as follows:

- Arithmetic Mean

- Standard deviation
- Median
- Coefficient of Skewness
- Coefficient of Kurtosis
- Paired Samples T test for differences between pre- and post measurements.
- The percentage of improvement
- Effect size according to Cohen’s D equations.
- Effect size according to Eta square.

Results:

Table (3)
Statistical significance of the measurements under study and the percentage of improvement before and after the experiment (N=9)

Statistics Variables		Unit	test Pre		test Post		Paired Differences		t	P value	Improve %
			Mean	.Std	Mean	.Std	Mean	.Std			
IgM	Before Effort	U/mL	145.33	53.59	128.00	52.58	17.33	11.05	4.71**	0.002	11.93%
	After Effort	U/mL	115.44	43.79	131.44	51.41	16.00	10.05	4.78**	0.001	13.86%
IgA	Before Effort	U/mL	191.44	55.29	172.33	59.38	19.11	11.19	5.13**	0.001	9.98%
	After Effort	U/mL	188.44	52.26	176.67	59.30	11.78	9.16	3.86**	0.005	6.25%
IgG	Before Effort	U/mL	1270.22	301.08	1223.44	310.92	46.78	64.32	2.18	0.061	3.68%
	After Effort	U/mL	1285.56	286.28	1247.33	296.51	38.22	32.62	3.52**	0.008	2.97%
CRP	Before Effort	mg/l	2.31	1.53	1.43	0.84	0.88	0.84	3.12*	0.014	37.98%
	After Effort	mg/l	3.43	1.56	2.06	0.94	1.38	0.89	4.65**	0.002	40.13%

Table (3) displays the statistical significance of the measurements under study and the percentage of improvement before and after conducting the basic study. There are statistically significant differences at the level of (0.05) in all the measurements under study except for IgG. For all results, the percentage of improvement ranged between (2.97% to 40.13%).

Table (4)
Significance of the effect size for the measurements under study (N = 9).

Statistics Variables		value t	value P	size Effect square Eta	size Effect Cohen	Indication
IgM	Before Effort	**٤.٧١	٠.٠٠٢	٠.٧١	١.٧٢	High
	Effort After	**٤.٧٨	٠.٠٠١	٠.٧٢	٢.١٤	High
IgA	Effort Before	**٥.١٣	٠.٠٠١	٠.٧٤	١.٧١	High
	Effort terAf	**٣.٨٦	٠.٠٠٥	٠.٦٢	٠.٦٩	High
IgG	Effort Before	٢.١٨	٠.٠٦١	٠.٣٥	٠.٥٠	Moderate
	Effort After	**٣.٥٢	٠.٠٠٨	٠.٥٨	١.٠٤	High
CRP	Effort Before	*٣.١٢	٠.٠١٤	٠.٥٢	١.١٧	High
	Effort After	**٤.٦٥	٠.٠٠٢	٠.٧١	١.٤٠	High

The significance of the effect size for the Eta square:

Less than 0.30: **low** - 0.30 - 0.49**: medium** - 0.50 - 1.00: **high**

From Table (4) of the significance of the effect size for the measurements under study, the effect size values according to the Eta square are greater than (0.50), which indicates that the effect of taking zinc supplement is high on the measures under investigation except for IgG before the effort.

Discussion :

- Current research investigated how zinc supplementation affected protein immune and infection indices both during inactivity and during activity among students enrolled in track and field modules within the Faculty of Sports Education. The results suggested that zinc supplementation enhanced anti-proteins, thereby minimising inflammatory indications. Furthermore, apart from pre-exercise IgG levels, all the examined measures displayed a positive effect of zinc supplementation.

- Accurate biomarkers for zinc status evaluation are yet to emerge (Haase et al., 2006, cited in Wessels et al., 2017). In spite of this, the present paper sought to examine the effect of zinc supplementation on protein immune levels and infection indices in the blood during both physical inactivity and activity. Earlier studies explored the extent to which supplementation with zinc and other elements alleviated the negative impact of intense exercise on the immune system. For instance, Saeedy et al. (2019) observed that supplementation achieved immune function regulation following intense exercise. Furthermore, athletes' IgA increased markedly after zinc supplementation over a six-week period while IgM and IgG increased as well. Similarly, male runners displayed better immune function owing to zinc supplementation for six days prior to intense aerobic exercise (Singh et al., 1994). Meanwhile, Oliveira et al. (2009) found that adolescent athletes in both placebo and zinc supplementation groups exhibited improved antioxidant status after twelve weeks but the improvement was more pronounced in the zinc supplementation group.

- By demonstrating that zinc supplementation attenuated inflammatory indications in athletes by enhancing anti-proteins, the present paper corroborates the findings of earlier studies. Therefore, athletes should consider the impact of zinc supplementation on their immune system during intense physical activity.

Limitations and future research

- There are several limitations to the present paper. One limitation is that prospective participants were worried about potential weight gain from taking food supplements so recruitment was challenging. Additional limitations are the expense related to blood tests and the duration of return of results. In future studies, broader research samples should be employed, including both male and female athlete and non-athlete participants with and without smoking habits and having diets with and without meat. Moreover, participants should display a greater diversity of age groups and BMI values.

Reference :

1- Calder PC. (2013) : Feeding the immune system. Proc Nutr Soc. 2013;72(3):299–309.

2- Çigdem Karakükçü, Yahya Polat, Yasemin Altuner Torun, Adile Irfan Ortaköylüoğlu, Yavuz Katırcılar (2019). Effect of Exogenous Coenzyme Q10 And Zinc Supplementation On Performance And Muscular Injury In Young Amateur Boxers.Journal of Anatolian Medical Research 2019; 4(2):1-21.

3- Clarkson PM, Thompson HS.(2000) . Antioxidants: what role do they play in physical activity and heath? Am J Clin Nutr 2000; 72: 637–647.

4- Córdova A, Álvarez-Mon M, (1995). Behaviour of zinc in physical exercise: a special reference to immunity and fatigue. Neurosci Behav Rev, 19, 439-445.

5- Fraker PJ. Kh'g LE. Lookko r. I'OlInter TL (2000) Thedy· namic link between Ihe integrityofthe irrunune system and zinc status. J Nutr 130: 1399S·14065.

6- Gleeson M, (2006). Immune system adaptation in elite athletes. Curr Opin Clin Nutr Metab Care, 9,659–665.

7- Karla de Jesus Fernandes de Oliveira, Carmen Marino Donangelo, Astrogildo Vianna de Oliveira Jr, Carmen Lucia Porto da Silveira and Josely Correa Koury (2009). Effect of zinc supplementation on the antioxidant, copper, and iron status of physically active adolescents.cell biochemistry and functionCell Biochem Funct; 27: 162–166.

8- Keyvan Hejazi,& Seyyed Reza Attarzadeh Hosseini (2012). Effect of Selected Exercise on Serum Immunoglobulin (IgA, IgG, and IgM) In Middle-Endurance Elite

Runners.International Journal of Sport Studies. Vol., 2 (10), 509-514.

9- Malihe Saeedy, lNahid Bijeh, Mahtab Moazzami (2018).The Effect of Six Weeks of High-Intensity Interval Training With Zinc Supplementation on Some Humoral Immunity Markers in Female Futsal Players. Annals of Applied Sport Science, vol. 6, no. 1, pp. 11-19.

10- Mashiko T, Umeda T, Nakaji S, (2004). Effects of exercise on the physical condition of college rugby players during summer exercise camp. Br J Sports Med, 38, 186–190.

11- Mckune A, Smith L, Semple S, Wadee A, Fickl H, Villa J , Felix Gómez-Gallego, Alejandro San Juan Ferrer, Alejandro Lucia (2006). Changes in mucosal and humoral atopic-related markers and immunoglobulin's in elite cyclists participating in the Vuelta a España. Int J Sports Med, 27, 560–566.

12- Mottaghi MR, Kianmehr M, Amiri M, Rouhani Z, Basirimoghaddam M, Mottaghi S (2014). The Effect Of Intensive Exercise On Salivary Immunoglobulin A, Cortisol And PH Concentrations In Teenage-Girl Swimmers. International Journal of Analytical, Pharmaceutical and Biomedical Sciences. Volume: 3: Issue-4.

13- National Health and Medical Research Council (2006). Nutrient reference values for Australia and New Zealand: including recommended dietary intakes.

14- Neil P. Walsh (2019). Nutrition And Athlete Immune Health: A New Perspective. Sports Science Exchange. Vol. 29, No. 198, 1-7

15- Nieman D, Nehlsen-Cannarella S, (1991): The effects of acute and chronic exercise and immunoglobulins. Sports Med, 11, 183–201.

16- Parveen Kimar & Micheal Clark (2009). Clinical Medicine.Saunders Elsevire. Seventh Edition.

17- Pedersen B, Hoffman-Goetz L, (2000). Exercise and the immune system: regulation, integration, and adaptation. Physiol Rev, 80, 1055–1081.

18- Petibois C, Cazorla G, Deleris G, (2003). The biological and metabolic adaptations to 12 months exercise in elite rowers. Int J Sports Med, 24, 36–42.

19- Sabina Khanam(2019). Impact of zinc on immune response. Immunol Curr Res, an open access journal. Volume 2 • Issue 1.

20- Singh A, Failla ML, Deuster PA (1994): Exercise-induced changes in immune function: effects of zinc supplementation. Journal of Applied Physiology. 1994;76(6):2298-303.

21- T Juan Diego Hernández-Camachoa,, Cristina Vicente-Garcíaa, Douglas S. Parsonsc, Ignacio Navas-Enamoradoc (2020). Zinc at the crossroads of exercise and proteostasis.Redox Biology 35,101529. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5748737/