



The Effect of Station Training on Certain Immune System Cells in Junior Football Tennis Players

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Abstract

Based on the foregoing, the significance of this research is highlighted by the need to study the physiological and immunological changes resulting from applying the station training method in football tennis. This represents an important scientific domain, as it provides a deeper understanding of the relationship between training load and the body's responses, and contributes to enhancing modern training methods and improving athletes' competitive levels.

Introduction

1-1 Research Significance and Problem

Despite notable advances in sports physiology and its scientific contributions to interpreting the effects of physical loads on various body systems—such as the circulatory, respiratory, and musculoskeletal systems—studies addressing the effect of physical activity on the immune system remain limited and insufficiently widespread. Although the immune system is one of the most vital systems linked to an athlete's health and their ability to withstand physical stress, much of the research in this area remains individual efforts focused on limited components of immune blood indicators. This underscores the need for more studies that address this vital aspect more broadly and deeply.

Understanding the immunological effects of physical exertion is an important foundation for guiding the health care of athletes, improving their functional condition, and developing training programs more suitable for protecting their health and enhancing their performance efficiency.

In light of this, the research problem emerges from the lack of clarity regarding the effect of using the station training method in developing certain immune variables among football tennis players. This makes it necessary to study this modern scientific approach to determine its effectiveness compared to traditional methods.

1-2 Research Objectives

- To identify the effect of station training on certain immune variables among football tennis players (such as total WBC and white blood cells).
- To determine the relationship between physical improvement and immunological change among football tennis players, with the aim of understanding the physiological correlation between physical load and immune response.

1-3 Research Hypotheses

- There is a statistically significant difference between the pre-test and post-test measurements of the experimental group in certain immune variables (total WBC and white blood cells), in favor of the post-test measurement.
- There are statistically significant differences between the experimental and control groups in the post-test measurement of immune variables, in favor of the experimental group.

1-4 Research Scope

Human Scope: Junior players of Al-Gharraf Club in football tennis, aged 13–16 years.

Temporal Scope: From 15/10/2024 to 17/12/2025.

Spatial Scope: The indoor hall of Al-Gharraf Club in football tennis; Al-Habboubi Hospital Laboratory.

3-1 Research Methodology

The researcher adopted the experimental method, which is defined as: "The method in which we manipulate and control an independent variable to observe its effect on a dependent variable, while noting and interpreting the resulting changes, whether the experiment involves one independent variable and one dependent variable, or more than one of each."

3-2 Research Population and Sample

The researcher defined the research population as football tennis players in the junior age category (13–15 years), in accordance with the International Football Tennis Law of 2017. The researcher specifically identified football tennis players in Thi-Qar (the Specialized School in Thi-Qar). The research sample was selected using the purposive method, limited to Al-Gharraf Club players of the mentioned age category. The total number of players was 16, representing 100%.

3-3 Homogeneity and Equivalence of the Research Sample

3-3-1 Sample Homogeneity

Table (1): Sample Homogeneity in Some Basic Variables

Variable (Unit of Measurement)	N	Mean	Median	SD	Skewness Coefficient
Training Age (years)	16	1.78	2.02	0.62	0.309
Chronological Age (years)	16	13.31	13.00	0.62	0.537

Body Height (cm)	16	1.54	1.56	0.066	0.980
Body Weight (kg/m ²)	16	46.34	45.25	5.98	0.684

Normal distribution skewness coefficient is set between (± 3)

3-3-2 Equivalence of the Research Sample

As required by the experimental design in this research, it was necessary to verify the baseline equivalence of both groups in the pre-test results. The researcher therefore statistically analyzed the pre-test results, as shown in Table (2):

Dependent Variables	Unit Measurement	Group	Mean	SD	t-test	Sig.	Significance
Total WBC	microliter	Experimental	8.123	0.675	0.422	0.685	Non-significant
		Control	8.233	0.179			
Neutrophils	microliter	Experimental	53.292	5.946	0.351	0.736	Non-significant
		Control	54.286	3.938			
Lymphocytes	microliter	Experimental	35.267	3.108	0.913	0.392	Non-significant
		Control	33.660	4.091			
Monocytes	microliter	Experimental	6.183	1.118	0.610	0.561	Non-significant
		Control	5.903	0.625			
Eosinophils	microliter	Experimental	1.183	0.355	1.333	0.224	Non-significant
		Control	1.523	0.514			
Basophils	microliter	Experimental	0.313	0.009	0.215	0.836	Non-significant
		Control	0.325	0.008			

3-4 Identifying Main Research Variables

The researcher selected a number of immune system cells with the help of experts and specialists in sports training physiology to survey their opinions on appropriate nominations. The researcher used the Chi-square (χ^2) test and percentage to determine the agreement rate, adopting a threshold of 85% or higher. The χ^2 value at degree of freedom (14) and significance level (0.05) is 3.84, as shown in Table (3).

Table (3): Results for Identifying Functional Variables

Category	No.	Variable	Agreed	Agreement %	Disagreed	Disagreement %	χ^2 Calculated	χ^2 Tabulated
WBC Immune Cells	1	Total White Blood Cells	15	100%	0	0%	15	3.84
	2	Eosinophils	14	93.33%	1	6.66%	11.26	3.84
	3	Basophils	15	100%	0	0%	15	3.84
	4	Neutrophils	15	100%	0	0%	15	3.84
	5	Monocytes	14	93.33%	1	6.66%	11.26	3.84
	6	Lymphocytes	15	100%	0	0%	15	3.84

Number of experts = (15); χ^2 value at df (14) and significance level (0.05) = 3.84

3-5 Pilot Study

The researcher conducted a pilot study on Tuesday, April 22, 2025, with 4 players from the research sample. The study involved drawing a blood sample of 5 cm³ per player. The purpose was to calibrate the medical and laboratory measurement instruments used in the research, to familiarize with the blood drawing procedure, to confirm the sample's normal levels, and to compare them with international standard levels for the variables used to measure certain immune system functions.

3-6 Pre-Tests

The researcher conducted pre-measurements on Thursday, April 24, 2025, involving drawing a blood sample of 5 cm³ per player. The purpose was to calibrate the medical and laboratory measurement instruments used in the research.

3-7 Training Program

The researcher designed a proposed training program based on the available facilities and the general physical levels of the research sample members, taking into account the nature of the training environment and the availability of equipment and auxiliary tools. The program consisted of 24 training units, at a rate of 3 units per week for 8 weeks, designed based on the results of the pilot study conducted previously.

The exercises were designed using varied training stimuli and tools related to the nature of the game's requirements, while considering the developmental characteristics and training age of the 13–15 age group to ensure appropriate training load and achieve the best physical response.

Regarding training methods, the program relied on high-intensity interval training as well as repetitive training. These methods were employed within the specific preparation phase in accordance with the defined objectives. To achieve the principle of motivation and competition, the researcher applied the competitive approach in executing some units, alongside the station training method, which aims to develop multiple physical capacities within a single training unit. The importance of the station training method lies in its ability to organize exercises according to their importance and develop primary requirements above all else.

3-8 Post-Tests

After the training program was implemented, post-tests were conducted for the research sample (both experimental and control groups) on Saturday, June 21, 2025, at the indoor hall of the football tennis players at Al-Gharraf, under conditions similar to those of the pre-tests in terms of the testing environment, location, and equipment used.

3-9 Statistical Methods

The researcher verified the results using the Statistical Package for the Social Sciences (SPSS), Version 26, which automatically calculated the required statistical values.

4-1 Presentation and Discussion of Pre- and Post-Test Measurements of Certain Immune System Cells Between the Experimental and Control Groups

Table (4)

Immune Measurements	Unit	Group	Comparison	Mean	SD	Diff. Mean	Diff. SD	t calc.	Sig.	Significance
Total WBC	μL	Experimental	Pre	8.123	0.675	0.991	0.580	4.589	0.003	Significant
			Post	9.095	0.637					
		Control	Pre	8.233	0.197	0.022	0.063	0.996	0.352	Non-significant
			Post	8.256	0.244					
Neutrophils	μL	Experimental	Pre	53.292	5.946	4.742	5.630	2.382	0.004	Significant
			Post	58.035	4.597					
		Control	Pre	54.286	3.938	1.253	3.762	0.943	0.377	Non-significant
			Post	53.032	3.738					
Lymphocytes	μL	Experimental	Pre	35.267	3.108	4.138	2.643	4.428	0.003	Significant
			Post	39.406	5.133					
		Control	Pre	33.655	4.095	0.312	1.129	0.783	0.459	Non-significant
			Post	33.967	4.067					
Monocytes	μL	Experimental	Pre	6.183	1.118	1.125	1.113	2.857	0.002	Significant
			Post	7.308	1.023					
		Control	Pre	5.903	0.625	0.017	0.034	1.451	0.100	Non-significant
			Post	5.921	0.634					
Eosinophils	μL	Experimental	Pre	1.183	0.355	0.520	0.488	3.013	0.002	Significant
			Post	0.663	0.438					
		Control	Pre	1.523	0.514	0.123	0.354	0.988	0.356	Non-significant

Basophils	μL	Experimental	Post	1.647	0.503					
			Pre	0.313	0.009	0.015	0.013	3.240	0.001	Significant
		Control	Post	0.016	0.010					
			Pre	0.032	0.008	0.002	0.007	1.000	0.351	Non-significant
			Post	0.300	0.010					

$N = 7$ per group; $df = (n-1)$ per group; Significance level ($Sig.$) ≥ 0.05 ; tabulated value = 1.895

4-1-2 Discussion of Pre- and Post-Test Results of Certain Immune System Cells Between the Experimental and Control Groups

Physical exercise is considered one of the factors that significantly affects the functions of the immune system. An increase or decrease in the levels of Total White Blood Cells (WBC) is part of the body's immune response against infection or inflammation. This increase may reflect strong stimulation of the immune system as a result of the physical stress caused by exercise. Physical stress leads to increased secretion of cytokines and hormones such as adrenaline and cortisone, which stimulate the immune system and contribute to the production of white blood cells.

The increase in white blood cells during and after exertion may result from stimulation of the bone marrow to produce new white blood cells. This bone marrow stimulation reflects the body's need to enhance its defensive capacities due to the immune conditions the body faces during exertion. The researcher attributes these significant differences between pre- and post-tests in favor of the experimental group to the fact that intensive and regular training leads to temporary changes in the number and distribution of white blood cells in the circulation. These changes may also include the proliferation of white blood cells, and can be linked to the hormonal changes that occur during or immediately after training, as confirmed by McCarthy & Dale (1988), who stated that an increase in white blood cells is one of the changes observed during training, and can reach double the resting count. This increase may persist after training for more than 24 hours, especially after certain types of training, and is related to variables such as training load intensity and duration, as well as fitness level.

Regarding Neutrophils: Changes in neutrophil levels are part of the body's response to physical exercise. Intensive exercise may contribute to changes in the distribution of immune cells in the body, initially leading to an increase in neutrophils followed by a decrease after exertion due to the reduction of the inflammatory response that can occur post-exercise. Exercise may cause temporary physical stress in muscle tissues, leading to an initial increase in neutrophils to combat minor inflammation or injuries. After exertion, the need for neutrophils decreases due to the body's recovery response, causing a decrease in these cell levels. Prolonged intense exercise can generally elevate inflammation levels and thus increase the risk of injury and chronic inflammation. In contrast, moderate or intense exercise with adequate rest periods can achieve maximum benefit.

Regarding Lymphocytes: The significant increase in the mean number of lymphocytes in the post-test results of the experimental group may be the result of immune system stimulation. Studies focusing on changes in the immune system often associate an increase in lymphocyte count with a positive immune response. Although there was also an increase in the mean lymphocyte count in the control group, the change was not as significant as in the experimental group. This increase might be due to natural changes or physical stress effects, suggesting that the control group experienced non-specific or random effects. It can be concluded that the intervention in both groups led to improvement, but the effect in the experimental group was more pronounced and statistically significant. After exertion, the number of lymphocytes in the blood increases as part of the body's response, as the body distributes immune cells from lymphatic tissues (such as lymph nodes) into the bloodstream to respond to any injury or resulting stress. Lymphocyte levels can increase briefly after exertion as part of enhancing the immune response. Regular exercise stimulates the immune system and improves immunological memory, leading to a faster and more effective response upon future exposure to pathogens.

Regarding Monocytes: The results of this study show that physical exertion leads to a significant increase in monocyte count in the experimental group, indicating a normal immune response of the body after exertion. These results enhance our understanding of how exertion affects the immune system and how the immune system can enhance the body's recovery after physical exertion. Exercise may cause minor injuries or irritation in tissues, especially muscles. Monocytes are not limited to a cleaning role; they are also an important link between the innate and adaptive immune systems, helping to stimulate lymphocytes and produce antibodies. Physical exertion causes increased levels of inflammation in the body, activating the immune system. After physical exertion, monocytes may transform into macrophages to assist in the healing process and remove damaged cells, increasing mild inflammation to stimulate tissue healing. This response is part of the recovery process the body needs after physical exertion.

Regarding Eosinophils: These results indicate that the experimental intervention produced a regulated immune effect that led to calming excessive inflammatory activity and achieving a better balance in immune indicators. The stability of values in the control group reinforces the credibility that the change in the experimental group is actually the result of the experimental program and not random changes. Based on the foregoing, it can be concluded that the training intervention effectively contributed to improving immune indicators and reducing hypersensitivity responses, demonstrating its success in influencing one of the vital immune pathways represented by regulating eosinophil counts in the blood.

Regarding Basophils: Table (1) results showed a significant decrease in mean basophil cell values among members of the experimental group between pre- and post-tests, confirming that the change in the experimental group is attributable to the effect of the proposed training program. The decrease in the percentage of basophil cells is interpreted in light of their physiological function—they are granular white blood cells that secrete histamine and heparin and participate in allergic and inflammatory responses. This decrease indicates an improvement in immune balance and a reduction in inflammatory responses, resulting from the positive physiological adaptation caused by regular and organized physical training.

Accordingly, it can be said that station training for the physical capacities of football tennis players produced positive physiological effects reflected in immune blood components, including a decrease in basophil cells. This indicates an increase in the body's efficiency in dealing with physical and immune stress in a more balanced and regulated manner, which contributes to raising athletic performance levels and maintaining overall immune health.

4-2 Presentation, Analysis, and Discussion of Post-Test Immune System Cell Measurements Between the Two Groups

Table (5): Means, Standard Deviations, and Calculated t-values for Post-Test Measurements Between the Experimental and Control Groups for Certain Immune System Cells

Variable	Group	N	Mean	SD	t calc.	Sig.	Significance
Total WBC	Experimental	8	9.053	0.626	3.160	0.001	Significant
	Control	8	8.256	0.244			
Neutrophils	Experimental	8	58.035	4.597	4.166	0.004	Significant
	Control	8	53.032	3.738			
Lymphocytes	Experimental	8	39.406	5.133	2.837	0.002	Significant
	Control	8	33.967	4.067			
Monocytes	Experimental	8	7.308	1.023	3.358	0.001	Significant
	Control	8	5.921	0.634			
Eosinophils	Experimental	8	0.663	0.483	5.468	0.001	Significant
	Control	8	1.647	0.503			
Basophils	Experimental	8	0.016	0.010	2.582	0.004	Significant
	Control	8	0.030	0.010			

$df (n1 + n2 - 2) = (12)$; Significance (Sig.) ≥ 0.05 at significance level 0.05; tabulated value = 2.145

4-2-2 Discussion of Post-Test Results of Certain Immune System Cells Between the Two Groups

Total WBC: After reviewing a number of previous sources and studies, the researcher noted that some studies found an increase in white blood cells after exertion while others found a decrease. This is due to the nature, intensity, volume, and characteristics of the sample or their age. This is confirmed by McCarthy et al. (1992), who stated that performing exercises on a stationary bicycle for 8 minutes leads to a noticeable increase in the number of white blood cells.

Neutrophils: Table (2) indicates the mean of the experimental group, but the result is not statistically significant compared to the control group. The decrease in neutrophil percentage after training indicates a temporary functional shift in the distribution of white blood cells, as neutrophils tend to increase after acute exertion but return or decrease with regular training due to improved specific immune efficiency. Research by Nieman (2000) and Petersen (2005) found that continuous training leads to stabilization of neutrophil levels and reduction of chronic inflammation, which is considered a sign of positive immune system adaptation rather than weakness.

Lymphocytes: Table (2) indicates significant differences between the experimental and control groups in favor of the experimental group. This increase in lymphocyte levels is evidence of improved cellular immunity, as these cells play a pivotal role in combating viral infections and forming immunological memory. Studies such as Suzuki et al. (2020) indicated that regular moderate exercise raises the number of lymphocytes and improves their functional effectiveness, especially in athletes who undergo disciplined programs over time. The increase in lymphocytes reflects positive adaptation in the specific immune system, which enhances the body's resistance to stress and muscle fatigue.

Monocytes: Table (2) indicates significant differences in favor of the experimental group. The increase in monocytes after training reflects an increase in phagocytic activity, which is one of the body's primary defense mechanisms against pathogens. Research by Shephard & Shek (1999) indicates that regular physical activity increases the effectiveness of monocytes and is associated with improved ability to eliminate damaged cells. The training program contributed to raising the efficiency of non-specific immune defense through increased monocyte levels.

Eosinophils: Table (2) indicates non-significant differences between the experimental and control groups. This slight decrease in eosinophils in the experimental group may be linked to a decrease in allergic and inflammatory reactions due to improved hormonal balance resulting from regular training. Studies by Tvede et al. (1992) show that long-term training contributes to stabilizing eosinophil levels as a result of decreased rates of chronic

inflammation. The non-significance indicates that the exercises did not negatively affect this type of cell, pointing to immune balance and physiological stability.

Basophils: Table (2) indicates significant differences between the experimental and control groups in favor of the experimental group. The decrease in basophils is considered an indicator of decreased allergic and inflammatory responses, which is consistent with Walsh et al. (2011), who noted that regular training reduces the activity of inflammatory cells by reducing histamine and inflammatory cytokine secretion. This change is interpreted as a protective adaptation of the body to chronic stress. The significant decrease in basophils after training reflects an improvement in immune balance and a reduction in inflammatory sensitivity resulting from exertion.

5-1 Conclusions

- Levels of certain blood cells associated with inflammatory response, such as Basophils, significantly decreased after applying the training program, indicating a positive physiological modification in immune response mechanisms and a reduction of inflammatory effects resulting from physical stress.
- Statistically significant differences were found between the experimental and control groups in favor of the experimental group, proving that the physiological and physical improvement is directly the result of the proposed training program.
- The simultaneous improvement in both immune indicators and physical capacities reflected a complementary relationship between raising the players' physical level and improving immune response, supporting the hypothesis of the effect of regular training in enhancing overall physiological health.

5-2 Recommendations

- The necessity of adopting station training as an effective strategy in athlete preparation programs, given the diversity of loads it provides and its ability to develop more than one physical and functional component at the same time.
- The importance of conducting periodic assessments of players' immune and blood variables to monitor the effect of training load and avoid cases of overtraining or exhaustion.
- Applying active and passive recovery strategies after strenuous training units to support immune and hormonal recovery and maintain load balance.
- Conducting the experiment on other age groups using station training alongside other training methods.

References

1. Farah Alaa Jafar: The Effect of Station Method on Developing Muscular Strength, Flexibility, and Performance in Archery for Junior National Team Players, Thi-Qar University Journal of Physical Education Sciences, Vol. 1, No. 4, Part 2, 2024, p. 224.
2. Wafa Saleh Abd Al-Ridha: The Effect of the Practical Curriculum on Some Functional and Biochemical Variables Among Students of the College of Physical Education, 2008, p. 85.
3. Center for Research in Sports Sciences, Health Sciences and Human Development (CIDESD), Covilhã, Portugal: Inflammatory Effects of High- and Moderate-Intensity Exercises, Vol. 10, 2019.
4. Mohsen, S.N. (2019): A Study of the Effect of Metformin and Enzyme Inhibitors on Rheumatism Enzyme Levels in Women with Hormonal Disorders in Kirkuk City, Thi-Qar University Journal – College of Physical Education and Sport Sciences, Vol. 14, No. 1, p. 64.
5. Noor Mohsen Jawad, Hanna Abd Al-Karim Hussein: The Effect of Physical Exercise on the Immune System, Tenth International Scientific Conference on Arab Women's Sport, February 15–16, 2025, Iraq/University of Babylon/College of Science/Department of Life Sciences.
6. Alaa Hussein Aliwei, Fadyal Abbas Manshad, Ali Naeem Salman (2019): Total and Differential White Blood Cell Count in Patients with Cutaneous Leishmaniasis in Nasiriyah City, Thi-Qar Governorate, Thi-Qar University Journal – College of Physical Education and Sport Sciences, Vol. 14, No. 3, p. 52.
7. Hazem Jasim Khazaal: The Effect of Sports Activity on Some Physical and Biochemical Variables, Journal of Studies and Research in Physical Education, Vol. 29, No. 3, 2019, p. 23.
8. Al-Juma: Immune Response After Physical Exertion: The Effect of Exercise on the Immune System. Journal of Sports Sciences, 45(2), (2020), 120–130.
9. Walsh, N.P., Gleeson, M., Shephard, R.J., Gleeson, M., & Woods, J.A. (2011). Position Statement. Part One: Immune Function and Exercise. Journal of Sports Sciences, 29(S1), S87–S88.
10. Tvede, N., Kappel, M., Halkjaer-Kristensen, J., Galbo, H., & Pedersen, B.K. (1992). The Effect of Moderate Exercise on Lymphocyte Subpopulations and In Vitro Proliferative Responses. Scandinavian Journal of Immunology, 36(5), 519–525.
11. Suzuki et al., 2020. The Effects of Exercise on Immune Function. Frontiers in Physiology.
12. Shephard, R.J., & Shek, P.N. (1999). Immune Responses to Inflammation and Trauma: A Physical Activity Perspective. Sports Medicine, 28(3), 173–198.
13. Nieman, D.C. (2000). Exercise Effects on Systemic Immunity. Immunity and Exercise, 7(2), 128–144.
14. McCarthy, D.A., & Dale, M.M. (1988). The Leucocytosis of Exercise: A Review and Model. Sports Medicine, 6, p. 333.

Sample Training Unit

Week	First	Unit Objectives	Develop explosive power & transitional speed	Intensity	80%
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Unit	First	Day	Sunday	Work:Rest Ratio		1:3
				Main Duration	Section	31.01 minutes

Station	Exercise Code	Exercise Duration	Reps	Rest Between Reps	Sets	Rest Between Sets	Total Work Time	Rest Reps	Rest Sets	Total Exercise Time	Total Station Time
Station (1)	A1	6.13s	3	18.39s	4	24.52s	73.56s	147.12s	98.08s	5.31 min	14.58 min
	A2	5.65s	3	16.95s	4	22.6s	66.72s	135.6s	90.4s	5.27 min	
Station (2)	A3	4.62s	3	13.86s	4	18.48s	55.44s	110.88s	73.92s	4.00 min	16.52 min
	C1	12.45s	3	37.35s	2	49.8s	74.7s	149.4s	99.6s	5.39 min	
	C2	11.72s	3	35.16s	2	46.88s	70.32s	140.64s	93.76s	5.07 min	
	C3	16.53s	3	49.59s	2	66.12s	99.18s	198.36s	66.12s	6.06 min	