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# The Effects of One Year of Volleyball Game on the Amounts of Blood Factors (Red Blood Cells, White Corpuscles, and Hemoglobin) on Male and Female Students

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## ABSTRACT

The present study aims to investigate the effects of one year of volleyball game on the amount of blood factors in non-athlete males and females. This quasi-experimental study was conducted on 44 male and female university students. The subjects were chosen randomly and were then matched and coupled and were finally divided into two treatment and control groups. The treatment group received a one-year volleyball practice program Blood samples were taken from both control and treatment groups 24 hours before the first practice and 24 hours after the final session. Amounts of red blood cells (RBC), hemoglobin and white corpuscles were measured and recorded in pre and posttest. The data collected were analyzed with the dependent and independent T test and variance analysis. The results revealed that, in response to regular long-term sport practices, amounts of blood factors do not differ significantly in healthy non-athlete individuals compared to the control group members receiving no practices. The comparison between pre and posttest results of all four (male and female control and treatment) groups failed to show a significant difference. Moreover, variance analysis on RBC, hemoglobin and white corpuscles did not show a significant difference. It could be concluded that the one- year selected volleyball exercise program does not affect the amount of blood factors (RBC, hemoglobin, and white corpuscles) significantly.
**Key words**: Volleyball game; RBC; White corpuscles; Hemoglobin

## INTRODUCTION

Blood plays a significant role in physical and sport activities. This important function in metabolism and supplying energy needed by different organs and tissues is greatly influenced by short and long-term physical activities. Blood tissue helps the body with taking oxygen to various parts of the body, removing wastes, and sustaining the level of liquids in it. Since hormones and blood cells actively take part in adjusting and homeostasis of blood glucose and coordinating hormones activities in sport activities, many researchers have become interested in studying the effects of these factors before and after physical and sport activities [1]. Considering these Kratz et al. [2] revealed that the number of red blood cells (RBC) and Hemoglobin (HGB) and the percentage of Hematocrit (HCT) increase after sport activities. Smith et al. [3] and Huang et al. [4] reported similar results and confirmed changes in white blood corpuscles (WBC), RBC and HGB after physical activities. Abuzandeh et al. [1] studied on blood factors in semi-professional athletes and concluded that the amount of HCT, HGB, WBC, and placket (PLT) differ significantly before and after physical activities. Moreover, Arne et al. [5] showed that the rate of mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), HCT, RBC, PLT and HGB changed greatly before and after physical activities. the revealed that the amount of HCT, HGB and MCV had decreased significantly but the rate of PLT and MCH had increased noticeably. Nagashima et al. [6] conducted similar study on one-session intense exercise program in lying and standing positions and reported an increase in HGB and HCT and a significant decrease in the volume of plasma in both positions. Huey-June et al. [7] reported that there was a significant increase in the amount of PLT and WBC after a 24-hour super marathon but red blood cells distribution volume (RDV), HCT, MCV, HGB, and RBC did not change greatly. It should be noted that the type, severity, and length of sport exercises influence blood volume and hematocrit. Several studies have demonstrated that the volume of plasma increases after sport exercises however, some have rejected the change in the amounts of blood factors. Boorthhood et al. [8] failed to find a significant difference in the density of HGB, RBC, HCT and number of Erythrocyte in individuals who had and had not exercised. Furthermore Michael et al. [9] observed real losses in the density of hemoglobin, hematocrit and number of white corpuscular cells in peripheral blood after intense sport exercises. Effects of sport exercises on various individuals differ greatly and these effects are in a direct relationship with the blood system for blood factors (WBC, RBC and HGB) play an important role in performing physical

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activities [10, 11, 12, 13]. Researchers have investigated these effects and have found that compatibility with the exercise increases the WBC, RBC and plasma and this increase in plasma and its different components in aerobic exercise may affect sport performance in a positive way [14, 10, 15, 11]. However, some scientists doubt about the strong influences physical activities may have on physiological parameters of blood [16, 17, 13]. They believe there is still a lot to be probed in the field. The present paper, then, attempts to study the effects of a selected volleyball exercise program on the amounts of blood factors (WBC, RBC and HGB) in young male and female university students.

## MATERIAL AND METHODS

This quasi-experimental study was conducted on 60 subjects of 19 to 21 years old.

**Sampling**

All subjects were selected with their permission and through random sampling. Then they were homogenized and coupled in two categories of men and women and grouped into four groups of experimental men, experimental women, control men and control women. The experimental groups entered a one-year long exercise program but the control group did not go under any exercise. The control groups were also advised not to do extra activities beyond their daily activities and to avoid hormonal medicines. Since the exercise program was rather long and there was a probability of loss in the number of the subjects, the number was above the standard numbers for studies of these kinds. Then at the end of the study, 44 subjects were analyzed. It is worth mentioning that the sleeping habits of the subjects were not considered in the study and their diet included the university food.

**The Exercise Program**

The Exercise program included a one-year long volleyball exercise with three 90-minute sessions in a week. The intensity and length of the exercises were predefined and included 8 minutes of stretching, 12 minutes of aerobic running with a 70% maximum heart rate, 7 minutes of muscles' warm-up, 18 minutes of practicing volleyball skills, 40 minutes of a competitive game of volleyball and finally 5 minutes of recovery activities. All the sessions were held in an indoor hall between 8:30 to 10:30 in the morning. The exercises were planned to keep the day and night rhythm. The subjects practiced in two different halls at the temperature of 25±5 centigrade.

**Blood Sampling**

The first sampling was done 24 hours before the first exercise session and the next one was conducted 24 hours after the final session. 24 hours before the first session, in coordination with the Pasture Pathology Laboratory, at 9 in the morning, blood samples were taken from all control and experimental groups. The samples were immediately put in a refrigerator and transferred to the laboratory. A year later, the same process was exactly repeated after the final session of exercising.

**Measurement Tools**

Blood factors were analyzed through the Auto Analyzer set made by Roche Inc. in Switzerland. The kits for the test were for the Pasture pathology laboratory and the data collected from two stages of blood sampling from the subjects were analyzed with correlated T test, independent T test, and one-way covariance analysis. SPSS 15 was used for evaluation of the hypotheses.

## RESULTS

The independent T test and covariance analysis were applied to analyze the hypotheses of the study. In order to compare the effects of independent parameter, average amounts of hemoglobin from all groups were compared and this revealed that the calculated T (level of significance= 0.05) was not significantly different among them (Table 1).

Results also revealed that selected volleyball exercises do not have significant effects on the amounts of blood factors in both male and female control and experimental groups. Comparison of the averages calculated for control and experimental groups and calculation of the independent T and the 0.05 level of significance, failed to show a significant difference. Moreover, comparison of the post tests of male and female control and experimental groups did not show a significant difference as well (Table 1).

Comparison of the results for the pre and post test from all four groups (male and female control and experimental) revealed that the amount of white corpuscles does not differ significantly in the pre and post tests (Table 2).

Comparison of the averages extracted for control and experimental groups and calculation of the independent T and level of significance of 0.05fails to show any significance difference in the number of red blood cells in male and female control and experimental groups. However, comparison of the posttest results for male experimental group shows that the number of RBC differs significantly in the posttest (Table 3).

Comparison of the differences between pre and posttests of each parameter of all four groups (ANOVA) and the 0.05 level of significance, no significant difference was observed in the pre and posttests of HGB, WBC, and RBC of the male and female control and experimental groups (Table 4).

In order to determine if gender and group and their interactions had any effects on the factors and parameters, natural distribution of dual genders (male and females) and exercising conditions (control and experimental) was investigated. Then two-way variance analysis was applied to study the effects each category had. The results for the distribution of the data (dual categories) are demonstrated in Table 5.

**Table 1.** Results of the comparison of hemoglobin in the post tests of control and experimental groups

| Group | Average amount of difference | t | Sig. |
|---|---|---|---|
| Male Control | 2.85± 0.48 | 0.586 | 0.057 |
| Female Control | 2± 0.1 | 0.158 | 0.878 |
| Male experimental | 2.58± -0.35 | -0.469 | 0.648 |
| Female experimental | 1.10± -0.33 | -0.942 | 0.371 |

No significant difference (P< 0.05)

**Table 2.** Results of the comparison of white corpuscles in the post tests of control and experimental groups

| Group | Average amount of difference | t | Sig. |
|---|---|---|---|
| Male Control | 2.18± -0.23 | -0.370 | 0.719 |
| Female Control | 1.7± -0.16 | 0.297 | 0.773 |
| Male experimental | 3.52± 0.6 | 0.590 | 0.567 |
| Female experimental | 3.99± -1.53 | -1.21 | 0.256 |

No significant difference (P< 0.05)

**Table 3.** Results of the comparison of RBC in the post tests of control and experimental groups

| Group | Average amount of difference | t | Sig. |
|---|---|---|---|
| Male Control | 2.77±-0.45 | -2.02 | 0.068 |
| Female Control | 0.43± -0.09 | 0.663 | 0.524 |
| Male experimental | 0.816± -0.53 | -2.27 | 0.077 |
| Female experimental | 0.366±0.09 | -0.78 | 0.094 |

No significant difference (P< 0.05)

**Table 4.** Comparison between the data collected from per and post tests on three factors of all four groups (ANOVA)

| Factor | Average of the squares | F | Sig. |
|---|---|---|---|
| HGB | 1.817 | 0.345 | 0.793 |
| WBC | 8.362 | 0.932 | 0.434 |
| RBC | 0.742 | 1.759 | 0.171 |

* The difference is significant (P<0.05).

**Table 5.** Comparison of the changes in the measured factors from four groups between the pre and post test with Two-Way variance analysis

| Factor | Effect of | loan F | loan Sig | Average squares | F | Sig. | Results of the hoc test | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Average difference | Level of freedom | Sig. |
| Change in HGB | Gender | 2.123 | 0.113 | 0.360 | 0.068 | 0.795 | - | - | - |
| | Group | | | 4.353 | 0.827 | 0.369 | - | - | - |
| | Interaction gender/ group | | | 0.444 | 0.084 | 0.773 | - | - | - |
| Change in WBC | Gender | 3.365 | 0.028 | 11.536 | 1.286 | 0.264 | - | - | - |
| | Group | | | 0.785 | 0.088 | 0.769 | - | - | - |
| | Interaction gender/ group | | | 13.24 | 1.476 | 0.232 | - | - | - |
| Change in WBC | Gender | 2.648 | 0.062 | 2.152 | 5.101 | 0.029 * | 0.444± 0.197 | 1 | 0.029 * |
| | Group | | | 3.03 | 0.00 | 0.999 | - | - | - |
| | Interaction gender/ group | | | 0.073 | 0.173 | 0.680 | - | - | - |

* The difference is significant (P<0.05).

## DISCUSSIONS

The present study showed that one year of volleyball exercises (three 90-minute sessions a week with certain intensity) does not have a significant effect on the amount of HGB, WBC and RBC of the subjects.

However, there was a significant change in the RBC of the males in the pre and posttests. In spite of the exercise methods they tested, these findings concur with the findings of MuJika et al. [18] Shepherd et al. [19]; Brownlie et al. [20]; Appenzeller et al. [21]; Ryan et al. [22]; Church et al. [16]; Rahmani-Nia et al. [11] and Chakmakchi et al. [14]. Researchers believe that jogging and running risk RBCs mechanically and their breaking may be the main reason for anemia in long-distance runners [18, 19].accumulation of lactic acid after intense exercising does also damage RBC and this breaks HGB and finally it decreases the level of HCT and HGB in the blood [20]. Some scholars have also concluded that the 2.6 % decrease in the HGB and 3.4 % decrease in the HCT at the exercising time are the result of the damages on RBC at the beginning of the exercising [21]. Accordingly, short-time intense exercises kill more RBC and increase the volume of plasma. This later decreases the density of HGB in the blood and the body has to work hard to make up for this loss [22, 23]. These findings concur with the findings of the present study. Moreover, some researchers have found great losses in the density of HGB and HCT and number of erythrocytes in peripheral blood after intense sport exercises [11]. A sudden fall in the level of HGB, RBC and WBC was also observed after one warm-up and skill exercising session causing a decrease in the amount of the oxygen reaching active tissues and organs [5]. Schumacher et al. (2002) reported a significant reduction in HBC, HCT, RBC, serum iron, density of transferrin, and serum ferritin after 8 weeks of aerobic exercises below maximum in the 50 to 70 % maximum oxygen level [24]. However, Khallaghi (2001) observed this loss as the result of both aerobic and non-aerobic exercises [25]. Concurring this finding, Huey - June et.al. (2004) discovered that the density of albumin, hemoglobin, and globulin does not change in marathon runners but on the second day, after the race, they fall greatly and reaches back to its original density after the ninth day [7]. Results of the study conducted by Amir-Sasan demonstrated no big difference in the amount of HGB in both pre and post tests and a little loss of RBC [26]. This decrease was significant in case of the men's experimental groups. Furthermore, results of this study show that the intrinsic immunity indexes of both males and females experience significant fall after aerobic exercises with average intensity. This decrease is negligible in case of aerobic exercises with little intensity. On the other hand results of the studies conducted by Kratz et al. [27, 2], MuJika et al. [18], Ahmadi-Zadeh [21], Smith et al. [17, 3], Church et al. [16] Tripette [13], Connes et al. [10], Jafari [15], Rahmani-Nia et al. [11] and Chakmaki et al. [14] contradicted with the results of the above mentioned studies. It seems as if the most important reason for this contradiction lies in the intensity and methods of exercises and gender of the subjects [14]. Unlike the present study, these studies have been conducted on one gender and different exercise program had been assigned for the subjects [16, 10, 13]. It can be concluded that as the physical fitness increases after sport activities, capacity of carrying oxygen increases through a rise in the number of blood factors like erythrocytes, and added density of hemoglobin and hematocrit [16, 2]. Other studies have revealed that aerobic and step exercises increase the amount of WBC in women. Researchers believe the reason for this is the severe response of the immune system to sport activities on one hand and lymphocytes entering and settling in the capillaries as a result of high blood current in the vessels after sport activities on the other [14]. However, MuJika et al. [18] believe that several exercise adjustments are made and blood factors increase. In case of Taper III specifically, this increase is significant. It may be induced by the type of the exercise and its intensity i.e. providing energy in continuous exercises is done mainly through ATP-PC system thus in an aerobic system, more oxygen is needed and blood factors related to oxygen grow as well. Other scholars relate this increase to several factors like reduction of blood plasma, increase in the blood flow of the active organs of the body and the difference in the artery-vein, contraction of the spleen covering and later on the release of RBC in the general blood system [7, 25]. Since higher heart rate is in a direct relationship with the intensity of the exercise, as the intensity of the exercise increases, the artey-vein blood becomes more different. The difference in the artery-vein blood and the high flow of blood increases the number of RBCs [15, 17, 3]. Physical activities increase the working power and ease maximum oxygen reach and as a result, changes are made in the peripheral blood including the erythrocyte system. It is believed that athletes doing regular sport activities have higher densities of HGB, RBC and larger number of erythrocytes in in their peripheral blood compared to those not exercising. Therefore, long sport and physical exercises may because liquids replace, and reduce intestinal fluid (up to 20%). It may also reduce the volume of blood as a result of sweating and increase the density of HGB, RBC and HCT in the blood [10, 2]. Studies show that intense physical activity is another factor affecting HGB and HCT in the time of imbalance in body water. Since the present study's exercise program one year to complete, adjustments made are like other findings [10, 12, 24, 13] is induced by aerobic exercise and this increased the volume of plasma and the number of RBCs in male athletes' blood. However, adjustments after continuous volleyball exercises with similar intensities do not cause big changes in blood factors and as a result, no difference is observed between the male and female control and experimental groups. Accordingly, Tripette [13] observed a significant fall in the RBC after cycling and marathon exercises [13] but Connes et al. [10] reported no big change in the density of HGB, RBC and HCT and the number of erythrocytes in those who had exercised and had not exercised. It seems as if most studies reporting no change in the amount of HGB were affected by lack of iron that has a negative effect on the production of HGB. In case of the present study, nutrition with university food and iron deficiency affected the increase in the number of HGB negatively. This concurs with the findings of the studies conducted by Rahmani-Nia et al. [11], Tripette [13], and Connes et al. [10] reporting significant decreases in the density of the HGB and HCT of the peripheral blood after intense sport exercises. In short, there are several theories concerning the decrease in the RBC: some researchers believe

the following three pathologic factors affect this: 1- disruption in the process of producing RBC; 2- Reduction of blood and 3- damages to RBCs after mechanical hits of the leg to the ground [26]. Thus, it could be said that beside the different factors like intensity and time of exercises, and water in the decrease or increase of HGB, RBC and WBC, other parameters like energy systems connected to physical activities play an important role.

## CONCLUSION

variety of the factors influencing blood factors, induce contradiction in the results several studies report this means that no single conclusion can be drawn from these findings but the researchers in the present study could demonstrate that despite similar exercise programs for both men and women, there are some differences between them and showed that the effects of these exercises on the amount of RBC in men is quite significant. However, it could not be concluded that sport exercises do not affect women's blood factors and this needs to be investigated in further studies.

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