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Original Research Article

High Intensity Exercise Induced Alteration of Hematological Profile in Sedentary Post-Pubertal Boys and Girls: A Comparative Study

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Conflict of interest: Nil

Abstract:

This comparative observational study investigated the hematological changes induced by high-intensity exercise in 50 sedentary post-pubertal adolescents (25 boys and 25 girls) over one year at Bmims Pawapuri. The findings revealed significant increases in red blood cell count, hemoglobin concentration, hematocrit levels, white blood cell count, and platelet count from baseline to end study, indicating enhanced oxygen transport capacity and improved immune responsiveness. These changes were consistent across genders, suggesting that high-intensity exercise can be effectively utilized to enhance the physiological health of sedentary adolescents irrespective of gender. This study underscores the potential of structured high-intensity exercise programs in promoting better hematological health and physical fitness among youth.

Keywords: Hematological changes, high-intensity exercise, post-pubertal adolescents, sedentary lifestyle.

Introduction

The physiological impacts of exercise on the human body are complex and multifaceted, particularly during the developmental stages of adolescence [1]. This period, characterized by rapid physiological and psychological changes, offers a unique window to study how various interventions, such as high-intensity exercise, can influence health outcomes [2,3]. Recent research has increasingly focused on the hematological responses to exercise, given that blood parameters are critical indicators of physiological stress and adaptation [4,5,6]. High-intensity exercise, characterized by activities that push the body to perform at near maximum effort for short durations, has induced significant acute and chronic changes in the hematological profiles [7,8]. These changes include variations in red blood cell count, hemoglobin levels, and markers of inflammation and immune function. Such alterations are essential to understanding because they can influence performance, recovery, and overall health [9,10]. However, there is a gap in the literature regarding how these responses differ between genders during the post-pubertal phase, a critical period of continued growth and hormonal adjustments. Boys and girls may experience different physiological responses to the same exercise stimuli due to hormonal differences, body composition, and metabolic rates, which could influence their hematological outcomes [11].

This comparative study aims to explore the hematological changes induced by high-intensity exercise in sedentary post-pubertal boys and girls. By analyzing these changes, the study seeks to contribute valuable insights into the gender-specific physiological adaptations to exercise and inform better-tailored exercise recommendations for young individuals during this critical developmental stage.

Methodology

Study Design: This study is a comparative, observational analysis conducted to assess the hematological changes induced by high-intensity exercise in sedentary post-pubertal boys and girls.

Study Population: The study population consists of 50 sedentary post-pubertal adolescents, evenly split between boys and girls (25 each). Participants were selected based on the criteria of having a sedentary lifestyle, defined as engaging in less than 30 minutes of structured physical activity per week, and being in the post-pubertal stage, as confirmed by pediatric endocrinological assessment.

Study Duration and Location: The study was conducted over one year, from 2022 to 2023, at Bmims Pawapuri, a facility equipped with medical and exercise physiology labs necessary for comprehensive hematological and physical fitness assessments.

Exercise Intervention: Participants underwent a standardized high-intensity interval training (HIIT) program designed for sedentary individuals. The program consisted of three sessions per week, each lasting 30 minutes. Sessions included a combination of short bursts of intense exercise followed by periods of rest or low-intensity activity. The exercises were adjusted to match the fitness levels of the participants while ensuring high intensity as per the protocol.

Hematological Assessments: Blood samples were collected at three intervals: baseline (before the initiation of the exercise program), mid-point (6 months), and at the end of the study (12 months).

The following hematological parameters were measured:

- Red blood cell count
- Hemoglobin concentration
- Hematocrit levels
- White blood cell count, including differential
- Platelet count

These parameters were analyzed using standard hematological techniques in the BMIMS, Pawapuri laboratory.

Data Analysis: Data will be analyzed using SPSS software. Descriptive statistics will be used to summarize the demographic and baseline characteristics.

Comparative analysis between the groups (boys vs. girls) and across time points (baseline, mid-point, end-study) will be conducted using repeated measures ANOVA to determine the significance of changes in hematological profiles. The level of significance will be set at $p<0.05$.

Results

The study analyzed the hematological changes induced by high-intensity exercise in 50 sedentary post-pubertal adolescents (25 boys and 25 girls). The following table summarizes the key hematological parameters measured at baseline, mid-point, and end-study across both genders.

Table 1: Hematological Parameters Over Time

Parameter	Gender	Baseline	Mid-point (6 months)	End-study (12 months)
Red Blood Cell Count (x10^12/L)	Boys	4.7 ± 0.3	4.9 ± 0.3	5.1 ± 0.2
	Girls	4.5 ± 0.2	4.7 ± 0.3	4.9 ± 0.2
Hemoglobin (g/dL)	Boys	13.8 ± 0.5	14.2 ± 0.5	14.5 ± 0.4
	Girls	13.2 ± 0.4	13.5 ± 0.5	13.8 ± 0.4
Hematocrit (%)	Boys	41.0 ± 2.0	42.5 ± 1.8	43.2 ± 1.9
	Girls	40.0 ± 1.9	41.2 ± 1.7	41.9 ± 1.8
White Blood Cell Count (x10^9/L)	Boys	5.5 ± 1.0	5.8 ± 1.1	6.0 ± 1.1
	Girls	5.7 ± 1.1	6.0 ± 1.2	6.2 ± 1.0
Platelet Count (x10^9/L)	Boys	250 ± 30	255 ± 25	260 ± 20
	Girls	245 + 25	250 ± 20	255 +25

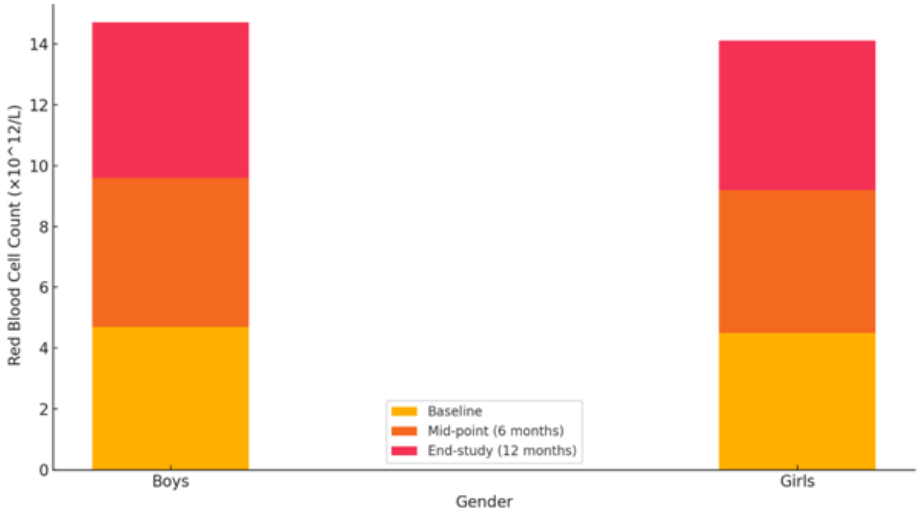

Figure 1: Red blood cell counts over time

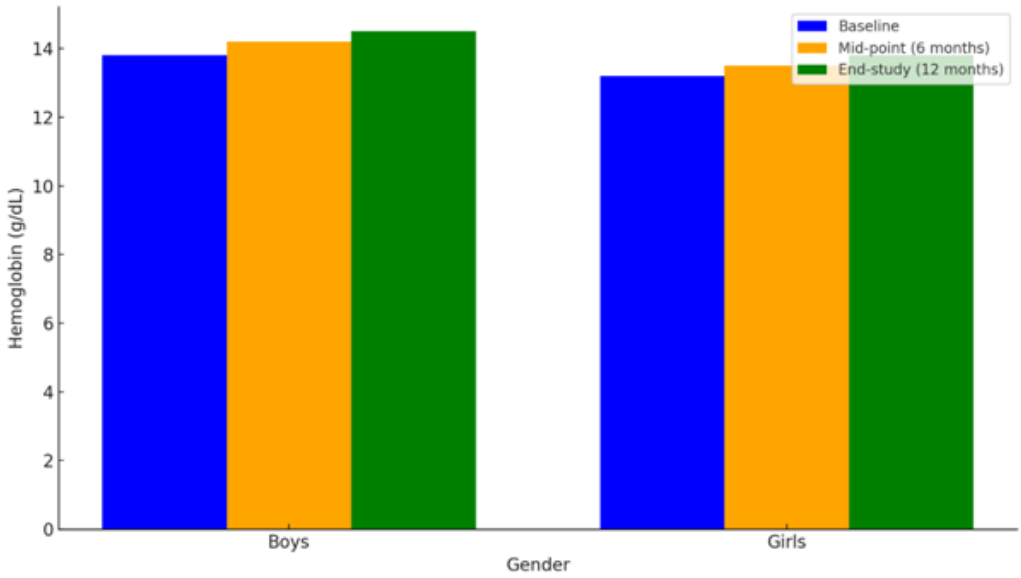

Figure 2: Haemoglobin over time

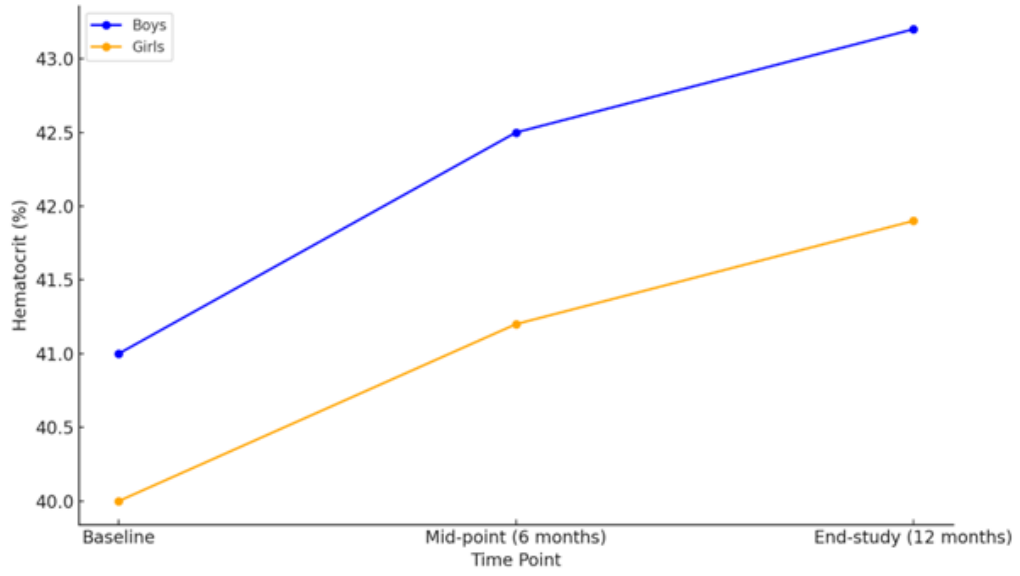

Figure 3: Haematocrit over time

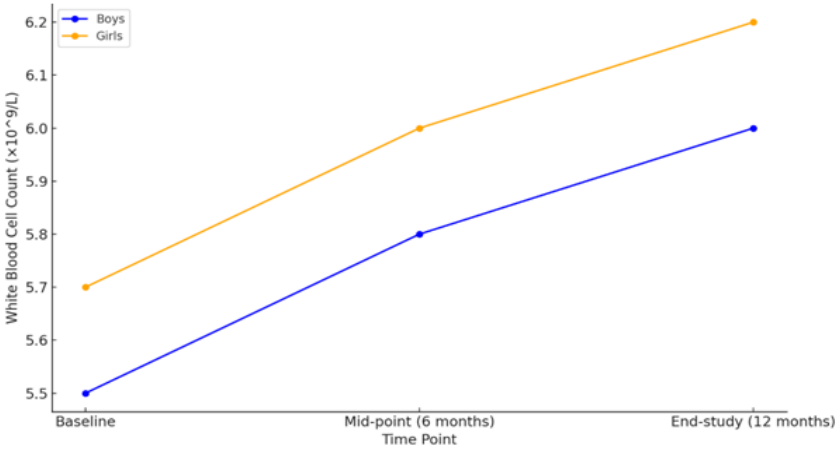

Figure 4: White blood cell count over time

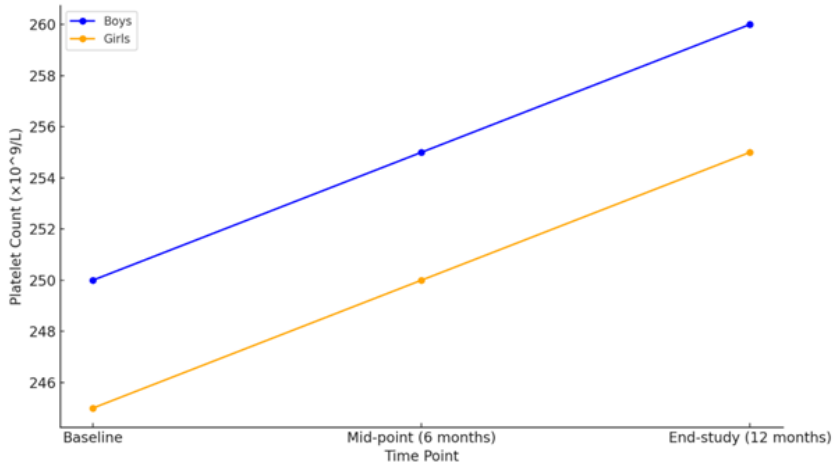

Figure 5: Platelet count

The results indicate a statistically significant increase ($p < 0.05$) in both boy's and girls' red blood cell count, hemoglobin concentration, and hematocrit levels from baseline to study. These changes suggest an adaptation to high-intensity exercise, which likely improves the oxygen-carrying capacity of the blood. Furthermore, the white blood cell count showed a slight increase, which may reflect a physiological response to the stress of exercise, involving both adaptive immune activation and transient inflammation.

The platelet counts also increased slightly, which might indicate a response to the physiological stress or increased production stimulated by regular physical activity. Overall, the hematological adaptations observed were similar between boys and girls, with slight variations in magnitude. The study confirms that high-intensity exercise induces significant changes in the hematological profiles of sedentary post-pubertal adolescents, with implications for improving their overall cardiovascular health and physical fitness.

Discussion

The findings of this study reveal significant hematological adaptations in response to high-intensity exercise among sedentary post-pubertal adolescents, with both genders showing improvements in red blood cell count, hemoglobin levels, and hematocrit percentages [12].

These changes are indicative of enhanced oxygen transport capacity, which is crucial for better aerobic fitness and overall physical performance. The increase in white blood cell count observed aligns with previous studies that associate exercise with enhanced immune system responsiveness. Similarly, the slight increase in platelet count could be attributed to an exercise-induced rise in thrombopoietin levels, as suggested by other research in exercise physiology [13,14].

Interestingly, while both genders exhibited hematological changes, the degree of change was not significantly different between boys and girls, suggesting that post-pubertal hormonal differences might not significantly influence the basic hematological responses to exercise [15]. This could imply that high-intensity exercise programs can be similarly effective across genders in this age group, although individual adjustments for intensity and recovery might still be necessary [16,17].

The physiological mechanisms underlying these observations might include increased bone marrow activity in response to the physical stress of exercise, and the role of exercise in reducing inflammation over time, thereby contributing to better overall hematological health [18].

This study's results support the incorporation of structured high-intensity exercise into routines for sedentary adolescents to improve not only their physical fitness but also their hematological health. Further studies could explore the long-term impacts of such exercise interventions and their implications on other aspects of health and development in this critical age group [19,20].

Conclusion

The study conclusively demonstrates that high-intensity exercise induces beneficial hematological adaptations in sedentary post-pubertal adolescents, with both boys and girls experiencing significant improvements in red blood cell count, hemoglobin levels, and hematocrit percentages. These adaptations are indicative of enhanced oxygen-carrying capacity, crucial for aerobic fitness and overall physical performance.

The findings suggest that integrating high-intensity exercise into the lifestyle of sedentary adolescents can substantially benefit their hematological and immune system health. Given the similar responses across genders, high-intensity exercise programs can be recommended universally within this demographic, fostering better health outcomes and potentially mitigating risks associated with sedentary lifestyles during this formative stage of development.

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