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A Six-Month Comparison of High-Intensity Interval Training and Moderate-Intensity Continuous Training on Blood Cell and Plasma Markers in Sedentary adult Office Workers

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Abstract

Introduction

: Sedentary office work is associated with metabolic resistance and adverse hematological profiles. While High-Intensity Interval Training (HIIT) is noted for time-efficiency, its long-term impact on blood morphology remains under-researched compared to Moderate-Intensity Continuous Training (MICT). This study compared the 6-month effects of HIIT vs. MICT on key hematological markers in sedentary office workers.

Methods

Forty-two participants (ages 20–39) were randomized into MICT (n = 21; 60–75% HRmax) or HIIT (n = 21; 80–90% HRmax) groups. Training was performed three days a week for 24 weeks. Venous blood was analyzed at baseline and post-intervention using paired and independent t-tests for within-group changes and independent t-tests for between-group comparisons ($p < 0.05$).

Results

No significant between-group differences were observed post-intervention ($p > 0.05$). However, within-group analysis showed MICT significantly increased PLT, HGB, RBC, and HCT ($p < 0.05$). In contrast, the HIIT group showed significant increases only in PLT and HGB, while RBC and HCT remained stable, which is insignificant (HCT: $p = 0.072$; RBC: $p = 0.097$; $p > 0.05$). Notably, HIIT resulted in a significant reduction in WBC count ($p < 0.05$), suggesting a superior anti-inflammatory effect.

Conclusion

Both modalities modulate immune and oxygen-transport markers. MICT appears superior for comprehensive erythropoietic adaptations, potentially aiding fatigue reduction. Conversely, HIIT may offer greater systemic anti-inflammatory benefits. Workplace wellness programs should consider MICT to specifically target improvements in aerobic capacity and blood health.

INTRODUCTION

Hematological indices, including red blood cells (RBCs), white blood cells (WBCs), and platelets (PLTs), serve as critical biomarkers for systemic homeostasis and cardiovascular health(Isaac, Abah, Akpan, & Ekaette, 2013). In addition to transporting oxygen and nutrients to peripheral tissues, the cellular composition of blood reflects the body's inflammatory status and metabolic efficiency (Berne, Levy, Koeppen, & Stanton, 2008) (Günay, Edgerton, & Jaeger, 2008). In sedentary populations, alterations in these markers, often characterized by shifts in plasma volume and cellular concentration, can serve as early indicators of increased cardiovascular risk.

The global prevalence of cardiovascular diseases (CVD) and non-communicable metabolic disorders has accelerated across all age demographics, largely driven by the contemporary rise in sedentary behavior (Go et al., 2014; Jaacks et al., 2019). In occupational settings, such as among university and office-based employees, prolonged sitting has emerged as a primary independent risk factor for cardiovascular morbidity (Faghy, Duncan,

Pringle, Meharry, & Roscoe, 2022). Traditionally, this risk is attributed to dyslipidemia—characterized by elevated triglycerides (TG), increased low-density lipoprotein cholesterol (LDL-C), and diminished high-density lipoprotein cholesterol (HDL-C) (Austin, King, Vranizan, Newman, & Krauss, 1988; Fisher et al., 2015). However, the physiological impact of physical inactivity extends beyond lipid profiles to encompass systemic metabolic and hematological dysfunction (Han, Lawlor, & Kimm, 2010; Jeppesen, Hein, Suadicani, & Gyntelberg, 1998). Technological advancements have largely eliminated incidental physical activity, fostering a state of chronic energy surplus where metabolic expenditure fails to match caloric intake, promoting adiposity and systemic inflammation (Almatsier, 2001; DM & Stella, 2015). Critically, sedentary lifestyles are increasingly linked to pro-thrombotic states and altered blood rheology. Abnormalities in the concentration and function of erythrocytes, leukocytes, and platelets can facilitate thrombus formation and heighten susceptibility to chronic inflammatory conditions(Yuniarto & Sutapa, 2018). Despite the established link between inactivity and these hematological markers, there remains a need to identify which exercise modalitiesHIIT or MICT most effectively mitigate these specific risks in the modern office environment.

Physical exercise is a potent stimulus for hematological adaptation, typically characterized by expansions in plasma volume and total hemoglobin mass (Uzun, 2016) (Åstrand, 2003). However, the magnitude of these adaptations is highly contingent upon the 'dose' of exercisespecifically the interaction between intensity, duration, and frequency(İbiş, Hazar, & Gökdemir, 2010) (Cengiz & Çinar, 2014). While the benefits of Moderate-Intensity Continuous Training (MICT) are well-established, High-Intensity Interval Training (HIIT) has emerged as a time-efficient alternative that may offer superior improvements in cardiorespiratory fitness and visceral adiposity in clinical populations (Guirado et al., 2012) (Guadalupe-Grau et al., 2017) (Maillard, Pereira, & Boisseau, 2018; Roy et al., 2018). Despite the documented efficacy of HIIT in improving metabolic markers in populations with type 2 diabetes and obesity, its comparative impact on hematological morphology remains a subject of academic debate (Costigan, Eather, Plotnikoff, Taaffe, & Lubans, 2015; Hannan et al., 2018). Previous studies on exercise-induced hematological shifts have yielded equivocal results: while some evidence suggests significant increases in key markers like red blood cell (RBC) indices and platelet counts, other investigations report negligible changes(Ceylan, İrez, & Saygın, 2014; Duzova et al., 2016; Gnanou et al., 2014; Kantyka, Herman, Roczniok, & Kuba, 2015; Koushki, Mollanovruzib, & Rashidlamirc, 2013) (Çakmakçı, 2009; Spiropoulos & Trakada, 2003).

Sedentary adult office workers represent a unique clinical demographic characterized by 'occupational sitting.' Emerging research suggests that prolonged sitting creates a state of metabolic inflexibility that may not be fully countered by short bouts of activity. Specifically, this population often exhibits 'subclinical' hematological shifts such as elevated WBC (a marker of low-grade inflammation) and altered HCT that precede the onset of CVD. There is a critical need to determine if high-intensity stimulus is required to 'break' this sedentary-induced physiological state. While HIIT is recognized for its time-efficiency, current literature is heavily skewed toward short-term interventions (4–12 weeks). The long-term hematological adaptation to HIIT versus MICT over 6 months remains a significant knowledge gap. It is unclear if the rapid cellular changes observed in short-term HIIT studies are sustained, or if MICT provides a more stable, long-term improvement in oxygen-carrying capacity (RBC and HGB) in office-bound adults.

Consequently, this study aimed to evaluate the longitudinal (six-month) effects of High-Intensity Interval Training (HIIT) versus Moderate-Intensity Continuous Training (MICT) on the hematological profiles of sedentary office workers. It was hypothesized that HIIT would induce a more pronounced reduction in systemic inflammatory markers, specifically, White Blood Cell (WBC) counts, due to the higher physiological stress of the intervals. Conversely, we predicted that MICT would demonstrate superior adaptations in red blood cell indices (RBC, HGB,

and HCT), reflecting a more stable enhancement of oxygen-carrying capacity resulting from sustained aerobic volume.

MATERIALS AND METHODS

Study design

This study employed a six-month, prospective, parallel-group randomized controlled trial (RCT) design to evaluate the comparative efficacy of High-Intensity Interval Training (HIIT) and Moderate-Intensity Continuous Training (MICT). The experimental protocol was conducted in strict accordance with the Declaration of Helsinki and received formal approval from the Institutional Research Ethics Committee (IRERC) of the Sports Academy (Protocol No. IRERC.08.2024–13.04.2025/04 April 2024). This longitudinal framework was selected to ensure sufficient time for chronic hematological adaptations to manifest.

Randomization and Participant Flow

Participants (N = 42) were randomly allocated to either the High-Intensity Interval Training (HIIT, n = 21) or Moderate-Intensity Continuous Training (MICT, n = 21) group using a 1:1 allocation ratio. Randomization was achieved via a computer-generated random sequence to minimize selection bias. To maintain rigorous allocation concealment, group assignments were sequentially numbered and were unsealed by an independent researcher only upon the completion of baseline assessments. As detailed in the CONSORT flow diagram (Fig. 1), ten participants (five from each cohort) withdrew before completion due to personal reasons or non-protocol-related injuries. Consequently, the final analysis was conducted on 32 participants (n = 16 per group). Data were analyzed using an intent-to-treat (ITT) approach to preserve the benefits of randomization and account for attrition.

Physical measurement

Anthropometric measurements were performed following standardized clinical protocols. Height was measured to the nearest 0.25 cm using a calibrated digital stadiometer (Scale 5005; ScaleTronix Inc., Wheaton, IL). Body mass was assessed using a high-precision medical scale, with measurements recorded to the nearest 0.1 kg. To ensure data accuracy and minimize diurnal variation, participants were weighed in the morning following an overnight fast (post-voiding) and were instructed to wear minimal, light clothing without footwear. All physical assessments were conducted by the same researcher to reduce inter-rater variability.

Blood Cell and Plasma Markers measurement

To maintain systemic homeostasis and minimize acute metabolic interference, participants were instructed to observe a strict overnight fast (no caloric intake after 22:00) before each testing session. Venous blood collection was standardized between 09:00 and 10:00 to account for circadian fluctuations in hematological indices. A comprehensive panel of key hematological and plasma markers was evaluated, including total White Blood Cell (WBC) count, Platelet (PLT) count, Red Blood Cell (RBC) count, Hemoglobin (HGB) concentration, and Hematocrit (HCT) percentage. All parameters were quantified using an automated five-part differential hematology analyzer (URIT-5160, 5-DIFF; URIT Medical Electronic Co., Ltd.). The device was calibrated according to the manufacturer's specifications to ensure analytical precision and intra-assay reliability throughout the six-month intervention.

Exercise intervention:

All participants were familiar with the exercise testing protocol by going through a preliminary exercise test. To ensure the physiological fidelity of the intervention, heart rate (HR) was monitored during all workouts for both groups using a portable pulsimeter (Polar). Participants wore an elastic strap secured around the chest, which transmitted data to a receiver worn on the wrist. The monitor was activated throughout the 60-minute MICT sessions and the HIIT intervals to ensure compliance with the prescribed intensity zones of 50–75% MHR and 80–90% MHR, respectively. Target heart rates for each subject were calculated individually using the following formula: Target HR = [(MHR – RHR) times Desired Intensity%] + RHR. Where: MHR (Maximum Heart Rate) was estimated as (220 – age), and RHR (Resting Heart Rate) was measured after 10 minutes of seated rest (Goldberg, Elliot, & Kuehl, 1988). Before the 6-month intervention, all participants underwent a one-week familiarization period to learn proper exercise technique. To ensure progressive overload, training volume was adjusted every 4 weeks by increasing the number of repetitions or decreasing the rest intervals, ensuring that heart rate remained within the target 80–90% (HIIT) or 50–75% (MICT) zones as cardiovascular fitness improved.

Moderate intensity continuous training (MICT)

Participants in the MICT group underwent a supervised 24-week aerobic exercise intervention, performed three days per week. Each 60-minute session was structured into three distinct phases: a 10-minute standardized warm-up, 40 minutes of continuous aerobic conditioning, and a 10-minute active cool-down. The primary conditioning phase utilized a multi-modal approach, including treadmill walking/running, rope jumping, and aerobic gym exercises. Exercise intensity was strictly monitored using the percentage of Maximal Heart Rate (%HRmax), with participants maintaining a target zone of 50–75% HRmax. Treadmill protocols commenced with a standardized entry speed of 1.5 km/h at 0% inclination, with subsequent adjustments made to ensure subjects remained within their designated heart rate zones. Adherence was verified through heart rate monitors to ensure physiological consistency across the six-month intervention period.

High intensity interval training (HIIT)

The HIIT intervention was designed as a time-efficient, high-intensity protocol performed three days per week for 24 weeks. Each session targeted a physiological intensity of 80–90% of Maximal Heart Rate (HRmax), verified through continuous heart rate monitoring. The protocol utilized a circuit-based approach consisting of explosive movements, including running on the spot, jumping jacks, squat jumps, and split lunges. Participants performed three sets of one-minute high-intensity work intervals, interspersed with one-minute passive or low-intensity recovery periods (1:1 work-to-rest ratio). To account for the ceiling effect of improved cardiorespiratory fitness over the six months, exercise progression was managed through a systematic increase in movement tempo and a gradual reduction in recovery intervals. This ensured that the metabolic demand remained within the 80–90% HR threshold throughout the study. Detailed training parameters and longitudinal progression for both cohorts are summarized in Fig. 2.

Procedure of Data Collection:

To enhance participant compliance and minimize test-related anxiety, all subjects attended a pre-intervention familiarization session to become acclimated to the laboratory environment and experimental equipment. All

diagnostic procedures were conducted by a multidisciplinary team of qualified professionals, including physicians, nurses, and exercise physiologists within clinical facilities adhering to the American College of Sports Medicine (ACSM) standards(Pescatello, 2014). Following the recruitment phase, participants underwent comprehensive baseline assessments of hematological profiles, specifically targeting red blood cell (RBC) count, white blood cell (WBC) count, hematocrit (HCT), platelet (PLT) count, and hemoglobin (HGB) concentration. To ensure intra-examiner reliability and eliminate procedural variance, the identical team of evaluators performed all measurements at baseline and post-intervention (6 months), following a standardized sequence. Furthermore, a double-blinding strategy was implemented: the technical staff responsible for blood analysis remained blinded to the participants' group allocations, and the personnel conducting the physiological evaluations were entirely independent of the team managing the exercise interventions. This separation of duties was strictly maintained to mitigate potential observer bias.

Nutritional Standardization and Dietary Monitoring

To isolate the physiological effects of the exercise interventions, participants were required to maintain their habitual dietary patterns throughout the 24-week study period. Nutritional standardization was enforced by instructing subjects to avoid excessive intake of lipid-dense (fried) foods and refined carbohydrates, which are known to acutely influence metabolic and hematological markers. Dietary adherence and stability were monitored longitudinally using 3-day food records (comprising two non-consecutive weekdays and one weekend day) collected at monthly intervals. These records were systematically reviewed by the research team to identify and mitigate significant nutritional deviations. Furthermore, to ensure the validity of the post-intervention hematological data, participants provided verbal and written confirmation of a strict 12-hour overnight fast before each morning venipuncture session at baseline and the six-month follow-up. This protocol was implemented to minimize the confounding influence of postprandial lipemia and glucose fluctuations on plasma markers.

Blood Sample Analysis:

Hematological assessments were conducted at baseline and following the 24-week intervention. To ensure pre-analytical standardization, participants were required to observe a 12-hour overnight fast and abstain from strenuous physical activity for 48 hours prior to testing. Dietary control was maintained by instructing subjects to adhere to their habitual nutritional patterns while specifically avoiding high-glycemic and lipid-dense (fried) foods throughout the six-month study period. Venous blood samples (2 mL) were obtained via venipuncture from the antecubital vein by a certified laboratory professional using sterile, single-use syringes. The collected samples were immediately transferred into evacuated tubes containing EDTA anticoagulant and labeled for identification. All samples were transported to an accredited clinical laboratory (Laboratório UÁLIA – Análises Clínicas) and analyzed within two hours of collection to avoid the confounding effects of cryopreservation. Hematological parameters were quantified using an automated five-part differential hematology analyzer (URIT-5160, 5-DIFF), following established internal quality control protocols. Baseline and post-intervention data were recorded and systematically compared to evaluate longitudinal shifts.

Statistical Analysis:

Data analysis was performed using IBM SPSS Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics, expressed as mean ± standard deviation (M ± SD), were utilized to summarize participant demographics and baseline characteristics. The normality of data distribution was rigorously assessed using the Shapiro-Wilk test, while Levene’s test was employed to verify the homogeneity of variance across groups. To evaluate primary outcomes, a two-tailed paired-sample t-test was utilized to determine significant within-group

changes from baseline to post-intervention (6 months). Between-group comparisons of post-intervention hematological markers were conducted using an independent-sample t-test, with baseline values serving as covariates where appropriate. The magnitude of the treatment effect was quantified using partial eta-squared (ηp2), with thresholds defined as small (< 0.01), moderate (0.06–0.14), and large (> 0.14) (Richardson, 2011). Statistical significance for all analyses was set at a threshold of $p < 0.05$ (95% confidence interval).

RESULTS

Participant Baseline Characteristics

At baseline, there were no significant differences between groups regarding demographic or key Blood Cell and Plasma Markers ($p > 0.05$). The MICT group had a mean age of 30.19 ± 3.88 years, a body mass of 72.0 ± 4.19 kg, and a stature of 169.19 ± 3.71 cm. Similarly, the HIIT group presented a mean age of 31.13 ± 4.19 years, a body mass of 71.5 ± 5.47 kg, and a stature of 170.63 ± 3.99 cm.

Within-group comparisons of hematological Variables

Regarding the secondary outcomes, the six-month intervention resulted in significant within-group changes across several hematological markers for both the MICT and HIIT groups (Table 1). Paired-sample t-tests revealed significant reductions in WBC count for MICT (7.88 ± 0.95 to 7.59 ± 0.75 10^9/L, $p = 0.002$) and HIIT (7.69 ± 1.28 to 7.34 ± 0.96 10^9/L, $p = 0.002$). In terms of oxygen-transport markers, the MICT group showed significant increases in HCT (46.66 ± 3.26% to 47.26 ± 2.95%, $p < 0.001$), HGB (14.94 ± 0.99 to 15.51 ± 0.69 g/dl, $p < 0.001$), and RBC count (4.51 ± 0.97 to 4.79 ± 0.78 10^12/L, $p = 0.018$); conversely, while the HIIT group showed a significant increase in HGB (14.89 ± 0.83 to 14.99 ± 0.78g/dl, $p = 0.008$), changes in HCT ($p = 0.072$) and RBC ($p = 0.097$) did not reach statistical significance. Finally, both groups demonstrated significant increases in PLT count, with MICT rising from 232.37 ± 23.63 to 236.06 ± 21.54 10^9/L ($p = 0.001$) and HIIT rising from 240.31 ± 23.32 to 243.00 ± 20.67 10^9/L ($p = 0.009$).

Table 1
Within-group comparisons of hematological Variables

Variables	(MICT = 16)					(HIIT = 16)			
	M ± SD		T	df	p-value*	M ± SD	t	df	p-value*
$WBC(10^9/L)$	PRE	7.88 ± 0.95	3.86	15	0.002*	7.69 ± 1.28	3.79	15	0.002*
	POST		-4.47	15	0.000*		1.93	15	0.072
HCT (%)	PRE	7.59 ± 0.75	-4.00	15	0.001*	7.34 ± 0.97	-3.02	15	0.009*
$PLT(10^9/L)$	POST	46.66 ± 3.26	-5.09	15	0.000*	47.92 ± 3.04	-3.03	15	0.008*
	PRE		-2.66	15	0.018*		1.77	15	0.097
HGB (g/dl)	POST	47.26 ± 2.95				47.82 ± 2.92			
$RBC(10^{12}/L)$	PRE	232.37 ± 23.63				240.31 ± 23.32			
	POST	236.06 ± 21.54				243.00 ± 20.67			
	PRE	14.94 ± 0.99				14.89 ± 0.83			
	POST	15.51 ± 0.69				14.99 ± 0.78			
		4.51 ± 0.97				4.86 ± 0.63			
		4.79 ± 0.78				4.85 ± 0.62			

*Note:*Denotes significant within-group change (p < 0.05).*

Data presented as M ± SD for continuous variables. Abbreviations: M: mean, SD: standard deviation, df: degree of freedom, MICT: moderate intensity continuous training group, HIIT: high intensity interval training group, WBC: white blood cell, HCT: moderate hematocrit, PLT: platelet, HGB: hemoglobin, RBC: red blood cell

The line graph illustrates the physiological shifts from baseline to post-exercise (Fig. 3), highlighting that while both protocols shared consistent trends in decreasing white blood cell (WBC) counts and increasing platelet (PLT) levels, the Moderate Intensity Continuous Training (MICT) group demonstrated broader significant improvements across all measured markers, including increases in oxygen-carrying components like hematocrit (HCT), hemoglobin (HGB), and red blood cells (RBC). In contrast, the High Intensity Interval Training (HIIT) group showed significant changes only in WBC, PLT, and HGB, with its impacts on HCT and RBC failing to reach statistical significance, as indicated by the flatter lines and lack of markers in those specific panels. These divergent results suggest that while certain hematological responses may be independent of training intensity, MICT appears to elicit a more comprehensive stimulus for erythropoietic markers.

Between-group Comparisons of Hematological Markers

To evaluate the comparative efficacy of the two interventions, independent sample t-tests were conducted on the change scores (Δ) from baseline to six months (Table 2). The analysis revealed no statistically significant differences between the MICT and HIIT groups for any hematological parameters at the six-month follow-up ($p > 0.05$). Specifically, the mean change in WBC count did not differ significantly between groups ($p = 0.426$), nor did

the changes in HCT (p = 0.811), PLT (p = 0.356), and RBC (p = 0.826). Although the MICT group showed a numerically higher increase in HGB compared to the HIIT group, this difference did not reach statistical significance (p = 0.057). Effect size calculations via partial eta squared (np^2) indicated a large effect for HGB (np^2= 0.116) and medium effects for WBC (np^2= 0.021), HGB [alternate marker] (np^2= 0.058), and PLT (np^2= 0.029). Small effect sizes were observed for RBC (np^2= 0.002) and HCT (np^2= 0.002).

Table 2 Between-group Comparisons of Hematological Markers

Variables	**Pre-exercise**			**Post-exercise**					**95% CI**	
		M±SD	**p-value**		**M±SD**	**T**	**(Δ)**	**p-value**	Lower	Upper
HCT (%)	MICT	7.88±0.95	0.644	MICT	7.59±0.75	0.807	-0.29	0.426	-.37	0.87
	HIIT	7.69±1.28		HIIT	7.34±0.96		-0.35			
HGB (g/dl)	MICT	46.66±3.26	0.267	MICT	47.25±2.94	-0.241	+0.59	0.811	-2.36	1.86
	HIIT	47.92±3.04		HIIT	47.50±2.91		-0.42			
	MICT	232.3±23.6	0.347	MICT	236.0±21.5	-0.938	+3.70	0.356	-22.23	8.23
	HIIT	240.3±23.3		HIIT	243.0±20.6		+2.70			
	MICT	14.94±0.99	0.879	MICT	15.51±0.69	1.98	+0.57	0.057	-0.016	1.05
	HIIT	14.89±0.83		HIIT	14.99±0.78		+0.10			
	MICT	4.51±0.97	0.247	MICT	4.79±0.78	-0.222	+0.28	0.826	-0.56	0.45
	HIIT	4.86±0.63		HIIT	4.85±0.62		-0.01			

Note, *p-value represents the between-group comparison of mean change scores using the Independent Samples t-test.Abbreviations: M: mean, SD: standard deviation, df: degree of freedom, CI: confidence interval, MICT: moderate intensity continuous training group, HIIT: high intensity interval training group, WBC: white blood cell, HCT: hematocrit, PLT: platelet, HGB, hemoglobin, RBC, red blood cell, ηp2:partial eta squared,, (Δ) Mean Change

Figure 4, *Between-group Comparisons of Hematological Markers bar chart*

Between-group comparisons of hematological markers have been visualized in a grouped bar chart with error bars representing the Standard Deviation (SD) (Fig. 4). The graph illustrates the divergent and shared effects of Moderate Intensity Continuous Training (MICT) and High Intensity Interval Training (HIIT) across five hematological markers from pre- to post-exercise. While both protocols resulted in a slight decrease in white blood cell (WBC) counts and a shared upward trend in platelet (PLT) levels, their impacts on oxygen-carrying components differed notably: MICT led to visible increases in hemoglobin (HGB) and red blood cell (RBC) counts alongside a marginal

rise in hematocrit (HCT), whereas the HIIT group remained relatively stable across these variables, showing only a marginal decrease in HCT.

DISCUSSION

The primary objective of this study was to compare the long-term effects of HIIT and MICT on hematological profiles in sedentary office workers. Our findings demonstrate that six months of structured exercise, regardless of intensity, facilitates significant adaptations in blood cell markers. While both modalities effectively modulated white blood cell (WBC) counts and hemoglobin (HGB), the lack of significant between-group differences suggests that total training volume over six months may be a more critical driver of hematological adaptation than exercise intensity alone. These results partially support our hypothesis, confirming that regular exercise improves blood health, though the anticipated superiority of HIIT was not statistically observed (Bobeuf, Labonté, Khalil, & Dionne, 2009).

A critical finding was the significant increase in RBC, HGB, and HCT within the MICT group, contrasted by a non-significant decrease in RBC and HCT in the HIIT group. The MICT results align with established physiological mechanisms where aerobic exercise stimulates the release of erythropoietin (EPO) in response to increased oxygen demand, thereby promoting erythropoiesis (Laughlin et al., 2012; Pasricha, Low, Thompson, Farrell, & De-Regil, 2014). This adaptation enhances the blood's oxygen-carrying capacity, a vital benefit for sedentary individuals.

In contrast, the non-significant decline in RBC parameters within the HIIT cohort warrants critical interpretation. This may be attributed to "sports anemia," a phenomenon where a rapid expansion of plasma volume aimed at improving thermoregulation and stroke volume outpaces red cell production, resulting in a dilution effect (Bobeuf et al., 2009).

Other studies indicate that a program of regular physical activity, with intensity between 60–85% of the maximal heart rate, increased hemoglobin and hematocrit levels in older women. These results suggest that MICT training increases the transport of oxygen to tissues (PÉREZ, MONROY DE PEÑA, DÍAZ, & FLÓREZ MANRIQUE, 2003). MICT exercise results in increased HGB, HCT, and RBC mass in women with rheumatoid arthritis (Banz et al., 2003). Aerobic Exercise, like jogging, can increase the total HGB and red blood cell mass, which increases oxygen transport capability, so that with structured exercise, the hemoglobin level in the blood, which functions to bind oxygen in the blood and relax it throughout the body, will also increase (Jannah, 2020). After 6 months of anaerobic training (HIIT), results showed no change in hematocrit, or red blood cell count, of older men, which are all implicated in blood viscosity (Bobeuf et al., 2009) (Halson, Lancaster, Jeukendrup, & Gleeson, 2003). Furthermore, the mechanical stress and high core temperatures associated with HIIT can trigger foot-strike hemolysis or oxidative stress, leading to the premature destruction of older erythrocytes. The lack of nutritional supplementation (iron and protein) in our study may have further limited the HIIT group's ability to compensate for this turnover, as high-intensity exertion places a higher demand on metabolic substrates.

Both HIIT and MICT protocols led to a significant reduction in total WBC counts, which serves as a proxy for systemic inflammation. Sedentary office workers are frequently characterized by chronic low-grade inflammation due to prolonged physical inactivity. The reduction in WBC suggests that long-term exercise induces a shift in the inflammatory environment, possibly by reducing pro-inflammatory cytokines and improving endothelial function (Johannsen et al., 2012). While the HIIT group showed a numerically greater reduction, the lack of between-group significance suggests that for previously sedentary adults, simply reaching the threshold of regular physical activity

is sufficient to achieve an anti-inflammatory effect. The significant increase in PLT counts across both groups reflects an adaptive response to exercise-induced stress and the mobilization of platelets from the spleen and bone marrow. While acute spikes in platelets can increase coagulation risk, long-term moderate increases are often balanced by improved platelet function and fibrinolytic activity (El-Lithy, El-Mazny, Sabbour, & El-Deeb, 2015) (Çiçek, 2018). For office workers at risk of cardiovascular disease, these adaptations represent a stabilization of the hematological system in response to regular physical stress.

The 6-month duration of this study allowed for the observation of chronic adaptations rather than the transient fluctuations typical of shorter interventions. The findings contradict studies suggesting that MICT leads to decreases in HGB (Çiçek, 2018). Instead, demonstrating that for sedentary office workers, MICT provides a more consistent stimulus for increasing red cell mass. This suggests that MICT may be a more "conservative" and effective approach for improving oxygen transport, while HIIT serves as a time-efficient alternative for inflammatory control, provided that nutritional recovery is managed.

The observed improvements in hematological markers within the MICT group are consistent with several clinical investigations. For instance, supervised aerobic training has been shown to significantly elevate HGB in specialized populations, such as patients with type-1 diabetes, whereas high-resistance or anaerobic-focused protocols often result in non-significant reductions (Ramalho et al., 2006). This supports our observation that moderate-intensity continuous exercise provides a steady stimulus for increasing hemoglobin mass, likely through sustained erythropoietic activity. Similarly, our results align with findings from 8- to 16-week aerobic programs that reported significant increases in RBC, HGB, and HCT (Imran et al., 2023; Sazvar, Mohammadi, Nazem, & Farahpour, 2013) (Heidari, Kargarfard, & Jali, 2011), suggesting that the physiological "ceiling" for these adaptations is not reached in the short term, but rather continues to consolidate over 6 months. The divergent response observed in our HIIT group, characterized by an insignificant decrease in RBC and HCT, contrasts with some acute studies where blood markers rise immediately post-exercise (Belviranli, Okudan, & Kabak, 2017). However, this discrepancy is easily explained by the timing of the analysis. While acute HIIT causes transient hemoconcentration due to plasma volume shifts, chronic high-intensity training often leads to a stabilized or slightly hemodiluted state as an adaptation to thermal stress and increased cardiac output(Bobeuf et al., 2009).

Our findings contradict those of studies reporting superior hematological gains in HIIT over MICT (Karakoç, Akalan, Alemdaroğlu, & Arslan, 2012). This contradiction may stem from the specific sedentary nature of our office worker cohort; those with lower baseline fitness may be more susceptible to the mechanical hemolysis or "sports anemia" associated with high-intensity exertion when compared to the athletes or younger subjects often featured in contradictory literature (Koç, Özen, Abanoz, & Pulur, 2018). Furthermore, the significant increase in PLT values across our 6-month intervention echoes the findings of Çiçek (2018), who noted similar increases in sedentary women following 16 weeks of exercise. While some studies on shorter durations (8 weeks) observed platelet decreases, our longer-duration study suggests that a 6-month threshold may induce a more robust mobilization of platelets. Ultimately, while our study contradicts investigations that found no change in hematological parameters following 12 to 16 weeks of training (Murray-Kolb et al., 2001);(Çiçek, 2018). It highlights that for sedentary office workers, a 6-month duration is a critical factor in manifesting significant improvements in oxygen-transport capacity, particularly within the MICT group.

Our finding that MICT had a more significant impact on red cell markers than HIIT is supported by the theory of plasma volume expansion. Continuous, moderate exercise typically creates a longer duration of thermal stress and increased blood flow, which triggers the body to increase both plasma volume and, eventually, red cell mass. While

HIIT is highly effective for cardiovascular power, the shorter "burst" nature may not always provide the sustained stimulus required for significant RBC increases in some populations (Aguree & Gernand, 2019). The significant decrease in White Blood Cells (WBC) in both groups post-exercise is a common observation in the "open window" theory of exercise immunology. Immediately following intense or prolonged exercise, immune cells often migrate out of the blood and into the peripheral tissues (like the lungs or muscles) to begin the repair process(Yano, Kremenik, Uchida, & Oyanagi, 2018). The significant increase in Platelets in both groups is a classic finding. Exercise typically causes a transient "thickening" of the blood (hemoconcentration) due to fluid loss (sweat) and the release of platelets from the spleen. This is a natural defense mechanism that prepares the body for potential injury.

Limitations of the study

The limitation of the current study is the lack of control over participants' psychological stress levels, which can influence hematological and inflammatory markers in office workers. And the study focused specifically on sedentary office workers; therefore, the results may not be generalizable to other populations with different occupational physical demands. These factors suggest that while both HIIT and MICT are effective, the lack of a 'superior' protocol in our results might be due to individual variability in response to exercise intensity.

CONCLUSIONS

In conclusion, the present study demonstrates that six months of either High-Intensity Interval Training (HIIT) or Moderate-Intensity Continuous Training (MICT) effectively modulates hematological profiles in sedentary adult office workers. While both modalities significantly reduced white blood cell (WBC) counts and increased hemoglobin (HGB) and platelet (PLT) levels over time, no statistically significant differences were observed between the two protocols regarding the magnitude of these changes. Although MICT showed a trend toward greater increases in red blood cell (RBC) count and hematocrit (HCT) compared to HIIT, and HIIT showed a numerically greater reduction in WBC, these between-group variations did not reach statistical significance. These findings suggest that both high-intensity and moderate-intensity exercises are viable strategies for improving blood cell markers and reducing chronic low-grade inflammation in sedentary populations. Clinicians and office workers may therefore choose between these modalities based on personal preference and time availability to improve cardiovascular health and mitigate the risks associated with a sedentary lifestyle.

Declarations

Conflict of interest

Regarding this work, the authors disclose no conflicts of interest.

Institutional Review Board Statement

The study was conducted in accordance with the principles outlined in the Declaration of Helsinki and was approved by the Sports Academy research board and ethics committee (No. IRERC.08.2024–13.04.2025/04 April 2024).

Informed Consent Statement: Written informed consent was obtained from all participants of sedentary adult office workers.

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Author Contribution

Conceptualization, A.T.B. and H.G.; methodology, A.T.B. and A.S.; software, A.T.B.; validation, A.T.B., H.G., A.S., and E.K.; formal analysis, A.T.B. and E.K.; investigation, A.T.B., H.G., and A.S.; resources, A.T.B. and E.K.; data curation, A.T.B. and A.S.; writing original draft preparation, A.T.B.; writing review and editing, A.T.B., H.G., A.S., and E.K.; visualization, A.T.B. and H.G.; supervision, H.G. and E.K.; project administration, A.T.B. and H.G.; funding acquisition, A.T.B. and E.K. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement:

The data provided in this work are accessible upon request from the corresponding author.

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Figures

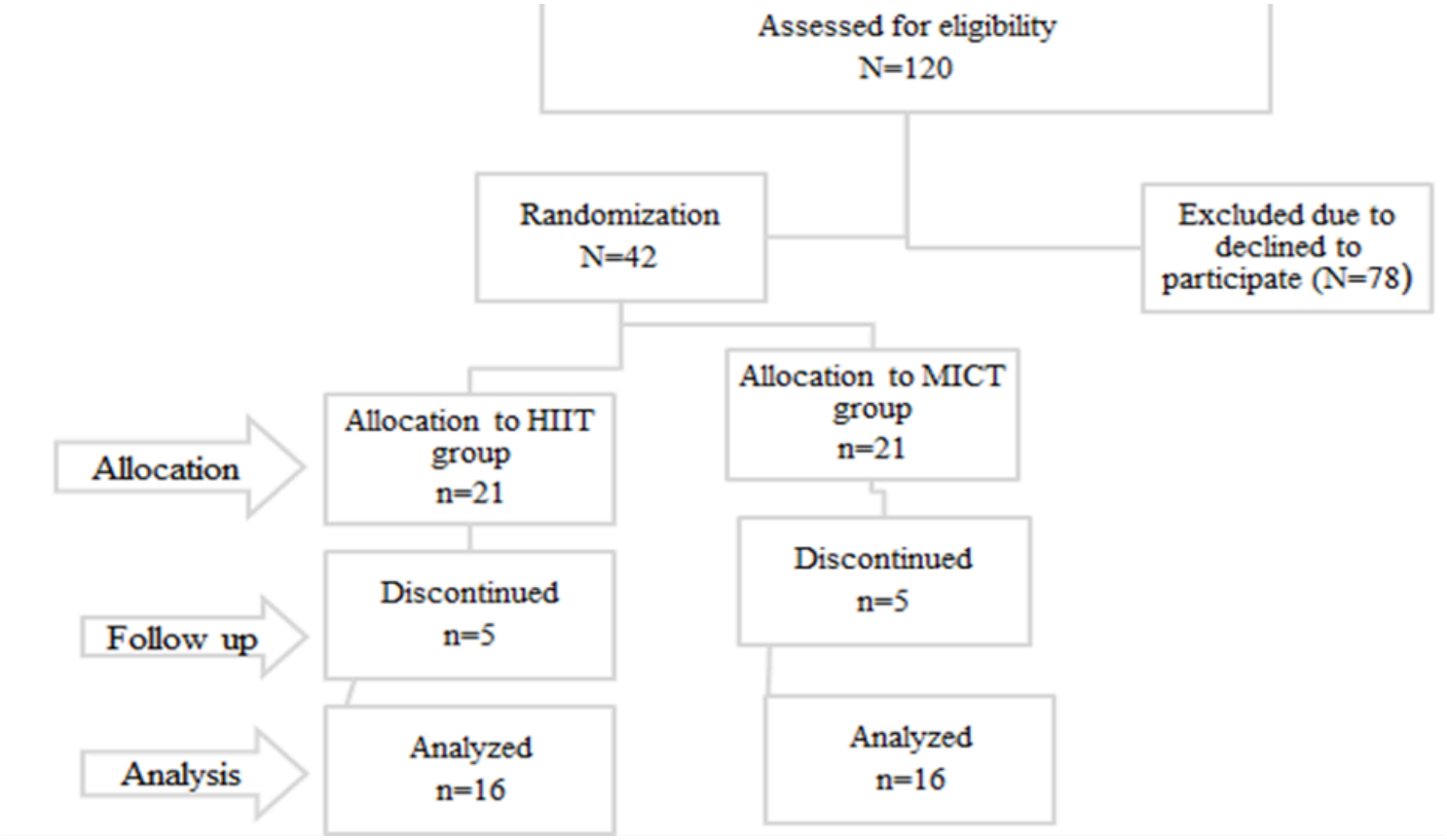


Figure 1

participant CONSORT flow diagram

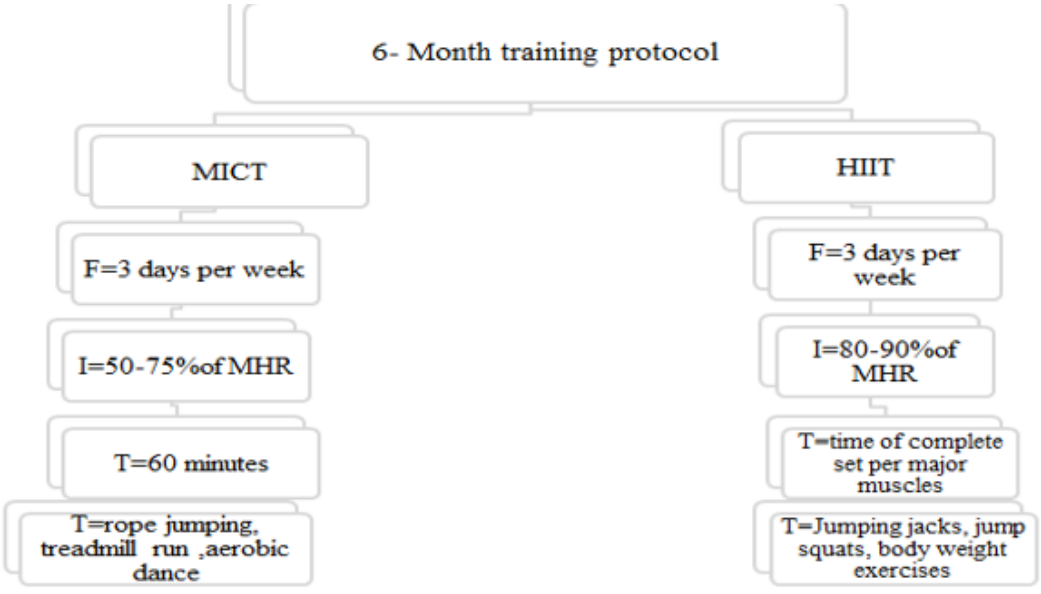


Figure 2

training protocol

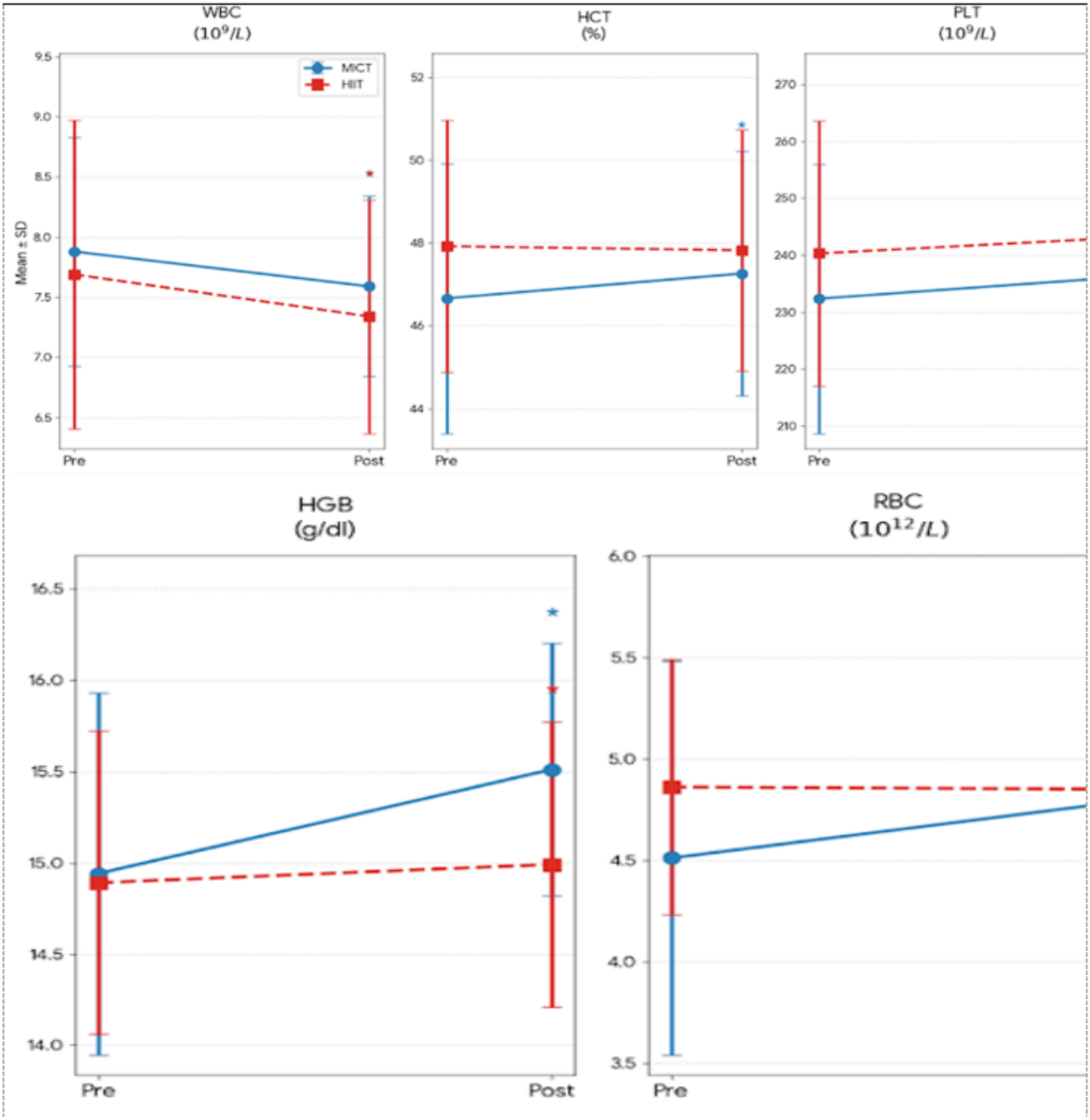


Figure 3

within-group comparisons (Pre vs. Post) line graph presentation

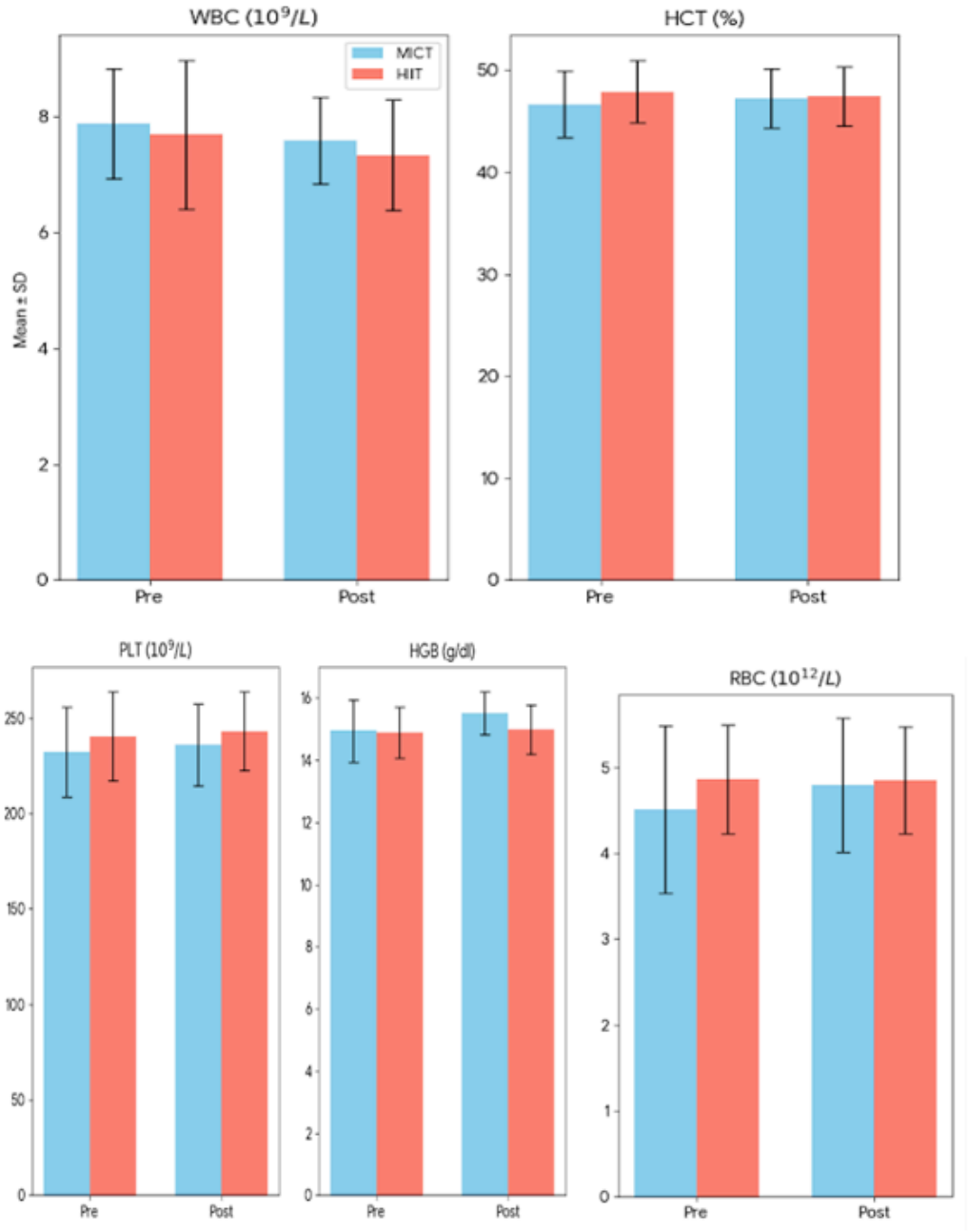


Figure 4

Between-group Comparisons of Hematological Markers bar chart