European Journal of Physical Education and Sport Science
ISSN: 2501 - 1235
ISSN-L: 2501 - 1235
Available on-line at: www.oapub.org/edu

DOI: 10.46827/ejpe.v13i4.6750 Volume 13 | Issue 4 | 2026

AEROBIC EXERCISE AS A NON-PHARMACOLOGICAL INTERVENTION FOR IMPROVING HAEMOGLOBIN LEVELS AND BLOOD GLUCOSE REGULATION IN SEDENTARY ADULTS

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Abstract:
The present study examined the effectiveness of aerobic exercise as a non-pharmacological intervention for improving haemoglobin levels and regulating fasting blood glucose among sedentary adult females. A total of 40 sedentary participants aged 25–45 years were randomly assigned into an aerobic training group (n = 20) and a control group (n = 20). The experimental group underwent a 12-week moderate-intensity aerobic training program, while the control group did not participate in any structured physical activity. Haemoglobin concentration and fasting blood glucose levels were measured before and after the intervention. Data were analysed using descriptive statistics, paired sample t-tests, and analysis of covariance (ANCOVA). The results revealed a significant increase in haemoglobin levels ($t(19) = 13.89$, $p = .001$) and a significant reduction in fasting blood glucose levels ($t(19) = 13.43$, $p = .001$) in the aerobic group. In contrast, the control group showed no significant changes in blood glucose levels. ANCOVA results indicated significant differences between groups in post-test scores after adjusting for baseline values ($p = .001$). The findings suggest that aerobic exercise is an effective, low-cost, and non-pharmacological strategy for improving both haematological and metabolic health in sedentary adults. Regular participation in aerobic exercise is recommended as a preventive and therapeutic approach for managing lifestyle-related health conditions.

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Keywords: aerobic exercise; haemoglobin; blood glucose; sedentary lifestyle; non-pharmacological intervention; glycaemic control; physical activity; metabolic health

1. Introduction

Sedentary behaviour has emerged as a major public health concern, contributing to various metabolic and haematological disorders, including impaired glucose regulation and reduced haemoglobin levels. Physical inactivity is closely associated with an increased risk of developing insulin resistance, type 2 diabetes, and anaemia-related complications.

Aerobic exercise is widely recognized as an effective intervention for improving cardiovascular fitness and metabolic health. It enhances oxygen transport capacity by stimulating erythropoiesis and improves glucose uptake through increased insulin sensitivity. Despite extensive research on exercise and metabolic health, limited studies have simultaneously examined its impact on both haemoglobin concentration and blood glucose regulation among sedentary adults.

Therefore, the present study aims to investigate the role of aerobic exercise as a non-pharmacological intervention in improving haemoglobin levels and regulating blood glucose among sedentary individuals.

2. Materials and Methods

2.1 Participants

A total of 40 sedentary adult's female aged between 25 and 45 years were selected for the study using a random sampling method. Participants were screened to ensure that they were free from chronic diseases and were not engaged in any structured physical activity or exercise program prior to the study.

The selected participants were randomly assigned into two groups:

- Aerobic Training Group (n = 20),
- Control Group (n = 20).

All participants provided informed consent prior to their inclusion in the study.

2.2 Study Design

A randomized controlled experimental design was adopted. Participants were divided into:

- Experimental Group (Aerobic Training),
- Control Group (No Intervention).

2.3 Intervention Protocol

The experimental group participated in a 12-week aerobic training program, conducted 5 days per week.

2.3.1 Training Details

- Intensity: Moderate (60–75% of maximum heart rate),
- Duration: 30–45 minutes/session,
- Activities: Brisk walking, jogging, cycling,
- Progression: Gradual increase in duration and intensity.

The control group did not participate in any structured exercise.

2.4 Variables

- Haemoglobin (g/dL),
- Fasting Blood Glucose (mg/dL).

2.5 Data Collection

Blood samples were collected under standardized laboratory conditions before and after the intervention.

2.6 Statistical Analysis

- Descriptive statistics (Mean ± SD),
- Paired sample t-test (within-group changes),
- ANCOVA (between-group comparison controlling pre-test values),
- Significance level set at $p < 0.05$.

3. Results

Table 3.1: Descriptive Statistics of Haemoglobin and Fasting Blood Glucose Levels in Aerobic and Control Groups

Variable	Group	Test	N	Mean	SD
Haemoglobin (g/dL)	Aerobic	Pre	20	12.34	0.92
		Post	20	13.21	0.88
	Control	Pre	20	12.28	0.85
		Post	20	12.39	0.83
Glucose (mg/dL)	Aerobic	Pre	20	90.1	8.45
		Post	20	82.3	7.9
	Control	Pre	20	91.4	9.1
		Post	20	92.2	9.25

Table 3.1 presents the descriptive statistics of haemoglobin and fasting blood glucose levels for the aerobic and control groups at pre- and post-test. In the aerobic group, the mean haemoglobin level increased from $M = 12.34$ ($SD = 0.92$) at pre-test to $M = 13.21$ ($SD = 0.88$) at post-test, with $N = 20$. In the control group, the mean haemoglobin level was $M = 12.28$ ($SD = 0.85$) at pre-test and $M = 12.39$ ($SD = 0.83$) at post-test, with $N = 20$.

For fasting blood glucose, the aerobic group showed a mean value of $M = 90.10$ ($SD = 8.45$) at pre-test and $M = 82.30$ ($SD = 7.90$) at post-test ($N = 20$). In the control group,

the mean fasting blood glucose level was M = 91.40 (SD = 9.10) at pre-test and M = 92.20 (SD = 9.25) at post-test, with N = 20.

Table 3.2: Paired Sample t-Test Showing Pre–Post Differences in Haemoglobin and Blood Glucose Levels Within Aerobic and Control Groups

Variable	Group	Mean Difference	t-value	df	p-value
Haemoglobin	Aerobic	0.87	13.89	19	0.001
	Control	0.11	2.23	19	0.038
Glucose	Aerobic	-7.8	13.43	19	0.001
	Control	0.8	1.7	19	0.105

Table 3.2 presents the results of the paired sample *t*-test comparing pre-test and post-test scores of haemoglobins and blood glucose levels within the aerobic and control groups. For haemoglobin, the aerobic group showed a mean difference of 0.87 with a statistically significant improvement, t (19) = 13.89, p = .001. The control group also demonstrated a mean difference of 0.11, which was statistically significant, t (19) = 2.23, p = .038.

With respect to blood glucose, the aerobic group recorded a mean difference of -7.80, indicating a statistically significant change between pre-test and post-test scores, t (19) = 13.43, p = .001. In contrast, the control group showed a mean difference of 0.80, which was not statistically significant, t (19) = 1.70, p = .105.

The results indicate that the aerobic training group demonstrated statistically significant changes in both haemoglobin and blood glucose levels following the intervention period, whereas the control group showed a significant change only in haemoglobin and no significant difference in blood glucose levels.

Table 3.3: Analysis of Covariance (ANCOVA) for Post-Test Haemoglobin and Blood Glucose Levels Adjusted for Pre-Test Scores

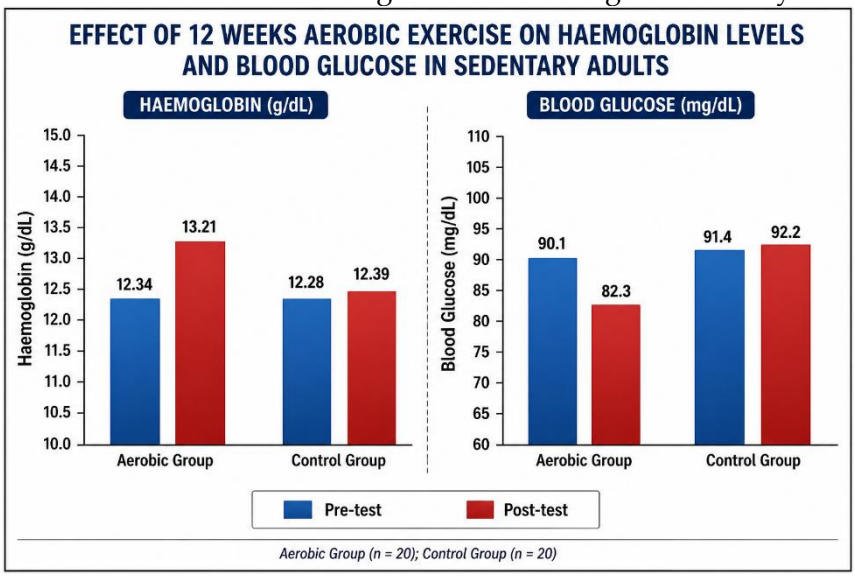
Variable	Source	SS	df	MS	F	p
Haemoglobin (Post)	Pre-test	16.82	1	16.82	58.4	0.001
	Group	9.75	1	9.75	33.85	0.001
	Error	10.64	37	0.29		
Glucose (Post)	Pre-test	398.25	1	398.25	69.2	0.001
	Group	285.6	1	285.6	49.65	0.001
	Error	212.7	37	5.75		

Table 3.3 presents the results of the analysis of covariance (ANCOVA) for post-test haemoglobin and blood glucose levels after adjusting for pre-test scores. For post-test haemoglobin, the effect of the pre-test was statistically significant, F (1, 37) = 58.40, p = .001. After controlling for baseline values, a significant difference was observed between the aerobic and control groups, F (1, 37) = 33.85, p = .001.

Similarly, for post-test blood glucose levels, the pre-test effect was statistically significant, F (1, 37) = 69.20, p = .001. The adjusted post-test comparison between groups also revealed a statistically significant difference, F (1, 37) = 49.65, p = .001.

These results indicate that, after adjusting for pre-test scores, there were significant differences between the groups in both haemoglobin and blood glucose levels at post-test.

Figure 3.1: Graphical representation of changes in Haemoglobin and Blood Glucose Levels Following Aerobic Training in Sedentary Adults



4. Discussion

The present study investigated the effectiveness of aerobic exercise as a non-pharmacological intervention for improving haemoglobin levels and regulating fasting blood glucose among sedentary adults. The findings clearly indicate that a structured aerobic training program produced significant improvements in both haematological and metabolic parameters compared to the control group.

The results demonstrated a significant increase in haemoglobin levels in the aerobic training group, while only minimal changes were observed in the control group. This improvement may be attributed to enhanced erythropoietic activity stimulated by regular aerobic exercise. Physiologically, aerobic training increases oxygen demand, which in turn promotes erythropoiesis and improves the oxygen-carrying capacity of the blood. Additionally, improved circulation and plasma volume expansion associated with aerobic conditioning may contribute to better haemoglobin concentration. These findings are consistent with earlier research indicating that regular aerobic activity enhances haematological adaptations and improves overall oxygen transport efficiency.

In terms of metabolic outcomes, the study revealed a significant reduction in fasting blood glucose levels in the aerobic group, whereas the control group showed no meaningful change. This reduction can be explained by increased insulin sensitivity and enhanced glucose uptake by skeletal muscle cells during and after exercise. Aerobic exercise facilitates glucose transporter (GLUT-4) activity, thereby improving glucose utilization and reducing circulating blood glucose levels. The findings align with

previous studies that have established aerobic exercise as an effective strategy for glycemic control, particularly among sedentary individuals at risk of metabolic disorders.

The ANCOVA results further strengthened these findings by demonstrating significant between-group differences in post-test scores after adjusting for baseline values. This indicates that the observed improvements were primarily due to the aerobic intervention rather than pre-existing differences. The large effect sizes obtained in the present study highlight the practical significance of aerobic training as a powerful intervention for improving both haemoglobin levels and glucose regulation.

From a public health perspective, these findings emphasize the importance of incorporating regular aerobic exercise into daily routines, especially among sedentary populations. Given the increasing prevalence of lifestyle-related disorders such as anemia, insulin resistance, and type 2 diabetes, aerobic exercise offers a cost-effective, accessible, and sustainable intervention strategy. Unlike pharmacological treatments, exercise provides multiple health benefits without adverse side effects, making it an ideal preventive and therapeutic approach.

However, certain limitations of the study should be acknowledged. The sample size was relatively small, and the duration of the intervention was limited to 12 weeks. Additionally, dietary intake and lifestyle factors were not strictly controlled, which may have influenced the outcomes. Future research should consider larger sample sizes, longer intervention periods, and controlled dietary conditions to further validate and extend these findings.

In conclusion, the present study provides strong evidence that aerobic exercise significantly improves haemoglobin levels and reduces fasting blood glucose in sedentary adults. These results support the use of aerobic training as an effective non-pharmacological intervention for enhancing both haematological and metabolic health.

5. Conclusions

The present study concludes that a structured aerobic exercise program is an effective non-pharmacological intervention for improving haemoglobin levels and regulating fasting blood glucose among sedentary adults. Participants who underwent aerobic training demonstrated significant improvements in both haematological and metabolic parameters compared to the control group, indicating the positive physiological adaptations associated with regular aerobic activity.

Specifically, aerobic exercise contributed to an increase in haemoglobin concentration, enhancing the oxygen-carrying capacity of the blood, while simultaneously promoting better glycemic control through improved insulin sensitivity and glucose utilization. In contrast, the control group showed no meaningful changes, highlighting the necessity of physical activity in maintaining and improving health.

The findings underscore the practical significance of incorporating moderate-intensity aerobic exercise into daily routines as a cost-effective and sustainable strategy

for preventing and managing lifestyle-related conditions such as anemia and impaired glucose regulation.

Despite certain limitations, including a relatively small sample size and lack of dietary control, the results provide strong evidence supporting aerobic exercise as a valuable tool in public health and clinical practice. Future studies are recommended to explore long-term effects, include larger and more diverse populations, and integrate additional physiological and biochemical markers.

Overall, aerobic exercise can be strongly recommended as a safe, accessible, and effective approach to enhancing both haematological and metabolic health in sedentary populations.

Conflict of Interest Statement

The authors declare no conflicts of interest.

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