International Journal of Enhanced Research in Medicines & Dental Care (IJERMDC),
ISSN: 2349-1590, Vol. 12 Issue 7, July-2025

Levels of Plasma Fibrinogen and Some Haematological Parameters in Subjects Exposed to Three Weeks Aerobic Exercise

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ABSTRACT

Exercise has been found to benefit human health, with aerobic exercise improving cardiovascular health via changing fibrinogen and haematological indices. Elevated plasma fibrinogen levels are associated with an increased risk of cardiovascular disease, whereas aerobic exercise has been proven to improve fibrinogen levels, indicating its importance in cardiovascular health.This pre-post study evaluated the levels of plasma fibrinogen and some haematological parameters in subjects exposed to three weeks aerobic exercise in NnamdiAzikiwe University Nnewi Campus, Nigeria.This pre-post study evaluated the levels of plasma fibrinogen and some haematological parameters in subjects exposed to three weeks aerobic exercise in NnamdiAzikiwe University Nnewi Campus, Nigeria. A total of 30 male and female participants aged 18-35 years were recruited for the study by simple random sampling. The aerobic activity comprised of skipping rope for 30 minutes four times a week for three weeks (21 days). Venous blood samples were collected at baseline (pre-exercise samples; day 0) and after exercise (post-exercise samples; day 21) to assess the levels of fibrinogen and some haematological parameters [total white blood cell count (TWBC), absolute lymphocytes count (AB LYMP), absolute granulocyte count (AB GRAN) and absolute MID cell count (AB MID)] in the subjects. Results showed the mean plasma fibrinogen (180.84±18.95 Vs. 223.46±28.51), TWBC (1.87±0.99 Vs. 4.04±1.39), absolute granulocyte count (0.41±0.21 Vs. 1.42±0.92) and absolute MID cells count (0.13±0.09 Vs. 0.54±0.32) were all statistically significantly decreased in the subjects post-exercise compared to the pre-exercise values (p = 0.001) respectively. However, the mean absolute lymphocyte count (p = 0.200) did not differ significantly when compared before and after exercise. TWBC level showed significant (p = 0.001) positive correlations with AB LYM,AB GRAN, and AB MID respectively; AB LYM Vs. AB MID (r = 0.390; p = 0.030) and AB GRAN Vs. AB MID (r = 0.690; p = 0.001).The decrease in fibrinogen levels may indicate that aerobic exercise has a cardioprotective effect. Further research with larger sample sizes is required to further understand the mechanisms underlying the current findings.

Keywords: Physical Activity, Exercise, Aerobic Exercise, Cardiovascular Health, Fibrinogen, Leucocytes, Haematological Indices.

INTRODUCTION

Any activity that is rhythmic, engages large muscular groups, and can be sustained over time is considered aerobic exercise by the American College of Sports Medicine[1]. Exercise promotes cardiovascular health and has been connected to changes in an individual's homeostatic and biochemical state[2-5]. There are numerous types of aerobic exercise, such as running, skipping, walking, sprinting, cycling, swimming, and others [6]. Aerobic exercise, a form of physical fitness, is essential for the maintenance of physical and mental health, as well as for the enhancement of performance, in both athletes and non-athletes [7]. Recent studies suggest that exercise affects an individual's haematological condition, with variations depending on the type, duration, and intensity of exercise [8, 9].

Fibrinogen is an abundant blood coagulation protein synthesized in the liver that is found in human blood plasma at quantities ranging from 1.5-4 g/L in healthy people and has a half-life of 3-5 days [10, 11]. It is digested by thrombin and

converted into insoluble fibrin, which causes blood coagulation by joining active platelets [12]. Fibrinogen is thought to be the most reliable coagulation marker for predicting the risk of cardiovascular problems [13]. It has several functions, including converting to fibrin, which is a cofactor for platelet aggregation, regulating blood rheology, and aiding leukocyte adhesion [14, 15]. Elevated plasma fibrinogen levels are linked to an increased risk of cardiovascular disease [16, 17] whereas aerobic exercise has been shown to decrease fibrinogen level highlighting its role in cardiovascular health [13].

White blood cell parameters have also been demonstrated to be impacted by exercise. According to reports, it causes an instantaneous rise in white blood cells, the size of which is primarily correlated with the length, intensity, and duration of the activity [18]. However, there are a number of ways in which the leucocyte count numbers after exercise can alter. The length of exercise, not the intensity or overall amount of activity performed, largely determines the pattern of post-exercise changes in the leucocyte count [19]. It has also been suggested that the increase in white blood cell count is likely due to a sign of leukocyte activation during exercise [20]. The rise in leukocytes following exercise can be attributed to either hormonal changes, which are probably mediated by β adrenergic receptors, or an increase in blood flow, which draws leukocytes from the marginal pool [19]. Several studies have shown elevated levels of total white blood cell count in healthy persons post aerobic exercise compared to pre-exercise levels [5, 21], while other studies found no statistically significant difference in leucocyte levels before and after aerobic exercise [19, 22, 23].

These days, behavioral and lifestyle modifications are the most often suggested means of preventing and managing cardiovascular illnesses[13]. Usually, these adjustments entail using natural or pharmaceutical supplements and increasing physical exercise [24-29]. To increase life expectancy and enhance general quality of life, physical activity and routine medical examinations are essential[13]. Therefore, this study evaluated the levels of plasma fibrinogen and some haematological parameters in subjects exposed to three weeks aerobic exercise in NnamdiAzikiwe University Nnewi Campus, Nigeria.

MATERIALS AND METHODS

Study Area
This study was conducted at College of Health Sciences, NnamdiAzikiwe University, OkofiaOtolo Nnewi Campus, Nnewi North Local Government Area of Anambra State.

Study Design And Population
This pre-post study evaluated the levels of plasma fibrinogen and some haematological parameters in subjects exposed to three weeks aerobic exercise in NnamdiAzikiwe University Nnewi Campus, Nigeria. A total of 30 participants were recruited for the study by simple random sampling. Participants included male and female NnamdiAzikiwe University students aged 18 to 35 years from the Nnewi campus.

The aerobic activity comprised of skipping rope for 30 minutes four times a week for three weeks (21 days). There are several methods for skipping rope, including the basic or easy jump technique. This technique entails jumping over the rope with both feet slightly separated. It is done independently.

Samples were collected at baseline (pre-exercise samples; day 0) and after exercise (post-exercise samples; day 21) to assess the levels of fibrinogenand some haematological parameters [total white blood cell count (TWBC), absolute lymphocytes count (AB LYMP), absolute granulocyte count (AB GRAN) and absolute MID cell count (AB MID)] in the subjects. Participants gave informed consent before the study commenced.

Inclusion Criteria
Participants in the study were up to the age of 18 years and had no pathological conditions such as cardiovascular or renal disease. They were also non-smokers, had no history of bleeding issues, and were not pregnant.

Exclusion Criteria
This study excluded subjects below the age of 18, those with any pathological conditions, smokers and pregnant women.

Ethical Consideration
Ethical approval was sought and obtained from the ethics committee of Faculty of Health Sciences and Technology, NnamdiAzikiwe University, Nnewi Campus, before the commencement of the study.

Informed Consent
Informed consent of all the participating Subjects was sought and obtained.

Sample Collection
Before and after exercise, each individual provided four milliliters (4 ml) of venous blood. 2 ml of each was dispensed into a well-labeled Ethylenediaminetetraacetic acid (EDTA) container for full blood count estimation, and the remaining 2 ml of venous blood was dispensed into a well-labeled sodium citrate anticoagulant container for fibrinogen levels determination.

LABORATORY METHODS

Full blood count (FBC) estimation
The total white blood cell count (TWBC), absolute lymphocytes count (AB LYMP), absolute granulocyte count (AB GRAN) and absolute MID cell count (AB MID)] were determined using a three part Biobase hematology analyzer (BK-6190, China) by following the manufacturer's instructions.

Determining Fibrinogen Level
The test was performed using the Clauss method, in which 9 parts of whole blood were combined with 1 part of trisodium citrate anticoagulant and centrifuged at 2500g for 15 minutes to produce sodium citrated plasma. The sodium citrated plasma was diluted 1:10 with imidazol buffer, and 100 microliters of the diluted plasma was incubated at 37 degrees Celsius. Then, 50 microliters of bovine thrombin were added to the incubated plasma, and the timer was started immediately. The clotting time was observed and recorded. The fibrinogen level was measured in mg/dl using a log-log calibration curve, the MASTER CURVE, which was included with the fibrinogen kit.

Statistical Analysis
The SPSS statistical tool, version 26.0, was used to analyze the data collected for this study. Paired t-test was used to compare the data acquired in the subjects before and after exercise while the relationship between the various parameters was examined using Pearson's correlation coefficient. Statistical significance was set at $p<0.05$.

RESULTS

The mean fibrinogen (180.84±18.95 Vs. 223.46±28.51; p = 0.001), TWBC (1.87±0.99 Vs. 4.04±1.39; p = 0.001), absolute granulocyte count (0.41±0.21 Vs. 1.42±0.92; p = 0.001) and absolute MID cells count (0.13±0.09 Vs. 0.54±0.32; p = 0.001) were all statistically significantly decreased in the subjects post-exercise compared to the pre-exercise values respectively. However, the mean absolute lymphocyte count (p = 0.200) did not differ significantly when compared before and after exercise (Table 1).

There were significant positive correlations between the levels of TWBC Vs. AB LYM (r = 0.690; p = 0.001) and TWBC Vs. AB GRAN (r = 0.470; p = 0.010) while the rest of the parameters were not significantly correlated in the pre-exercise subjects (p>0.05). See table 2.

There were significant positive correlations between the levels of TWBC Vs. AB LYM (r = 0.622; p = 0.001), TWBC Vs. AB GRAN (r = 0.634; p = 0.001), TWBC Vs. AB MID (r = 0.509; 0.001), AB LYM Vs. AB MID (r = 0.390; p = 0.030) and AB GRAN Vs. AB MID (r = 0.690; p = 0.001) respectively while TWBC Vs. Fibrinogen (p= 0.362) was not significantly correlated in the post-exercise subjects (p>0.05). See table 3.

Table 1: Levels Of Fibrinogen And Some Haematological Indices In The Subjects Before And After 3 Weeks Aerobic Exercise (Mean± SD, N = 30)

Variables	Pre-exercise	Post-exercise	t-value	p-value
Fibrinogen (mg/dl)	223.46±28.51	180.84±18.95	6.810	0.001*
TWBC (10^9/l)	4.04±1.39	1.87±0.99	6.940	0.001*
AB LYMP (10^9/l)	2.04±1.22	1.71±0.75	1.272	0.200
AB GRAN (10^9/l)	1.42±0.92	0.41±0.21	6.577	0.001*
AB MID (10^9/l)	0.54±0.32	0.13±0.09	6.594	0.001*

*Statistically significant at p <0.05

Key:
TWBC = Total white blood cell count
AB LYMP = Absolute lymphocytes count
AB GRAN = Absolute granulocytes count
AB MID = Absolute MID cells count

Table 2: Levels of Association Between Parameters Studied in the Pre-Exercise Subjects

Variables	r-value	p-value
TWBC Vs. AB LYM	0.690	0.001
TWBC Vs. AB GRAN	0.470	0.010
AB MID Vs. TWBC	0.330	0.070
TWBC Vs. Fibrinogen	- 0.190	0.300

*Statistically significant at p <0.05

Key:
TWBC = Total white blood cell count
AB LYMP = Absolute lymphocytes count
AB GRAN = Absolute granulocytes count
AB MID = Absolute MID cells count

Table 3: Levels of Association Between Parameters Studied in the Post-Exercise Subjects

Variables	r-value	p-value
TWBC Vs. AB LYM	0.622	0.001
TWBC Vs. AB GRAN	0.634	0.001
TWBC Vs. AB MID	0.509	0.001
TWBC Vs. Fibrinogen	0.180	0.362
AB LYM Vs. AB MID	0.390	0.030
AB GRAN Vs. AB MID	0.690	0.001

*Statistically significant at p <0.05

Key:
TWBC = Total white blood cell count
AB LYMP = Absolute lymphocytes count
AB GRAN = Absolute granulocytes count
AB MID = Absolute MID cells count

DISCUSSION

The present study found significant decrease in the mean fibrinogen level in the subjects post exercise compared to pre-exercise value. Previous studies have shown that aerobic exercise can reduce fibrinogen levels [30,31]. Babaei*et al.* [13] showed an 8-week aerobic exercise program, with or without *C. dactylon* extract supplementation, significantly improved the fibrinogen plasma level, blood viscosity, plasma viscosity, and hematocrit in sedentary men. Tayebi*et al.* [32] noted that plasma fibrinogen decreased by 12% after six sessions of 45-second high-intensity interval training (HIIT), by 8% after 30-second HIIT, and by 5% after 15-second HIIT which is consistent with the current finding. Furthermore, Eslami*et al.* [33] revealed in a meta-analysis study that the chronic response of fibrinogen to exercises is significantly reductive in healthy individuals, which is related to aerobic exercise and high-intensity interval training.Aerobic exercise can reduce fibrinogen levels by regulating catecholamine levels and boosting blood supply to muscles [34].

Aside this, other plausible explanations for this is that aerobic exercise can reduce fibrinogen levels by increasing HDL and decreasing LDL, while also lowering stress and fat percentage [35], or by modulating inflammatory processes [36].Fibrinogen is a significant independent risk factor for atherosclerosis and heart attacks, therefore a decrease in its concentration may imply a lower risk of atherosclerosis[13]. However, other studies were invariance with our finding [37]. Elevated plasma fibrinogen levels may exacerbate arteriosclerosis by enhancing blood viscosity, increasing platelet interaction with the arterial wall, and altering blood coagulation via nonrheological processes[32]. It may also have a direct effect on the vessel wall, which may have an adverse effect on the progression of arteriosclerosis [38].

Our investigation found significant decreases in the mean total white blood cell count, as well as in the leucocyte differential, which included the absolute granulocyte count and absolute MID cell count, but no significant changes in the mean absolute lymphocyte count. The finding of decreased leucocyte counts in the subjects post-exercise in this study aligns with Akarah[39] that observed significantly decreased WBC counts in students after aerobic exercisessuggesting that the decrease may be an indication that the immune system is compromised as result of the exercise undertaken by the students.Leucocytes are part of the immune system of the body as it protects against pathogenic microorganisms and other foreign materials entering the body as well as infections and damaged cells that are capable of disturbing the normal function of the body [40]. On the other hand, some other similar studies found either significant increases in leucocytes counts [5] or no significant differences in the mean WBC counts after aerobic exercises [19, 22, 23] which is not in keeping with the present results.Aside these, a previous study [41], showed that immediately after exercise a reduction in the absolute lymphocyte count was observed in runners, whereas there was an increase in the number of monocytes and neutrophils which is in contrast with the findings of this study.This differences in the patterns of results by different authors in different studies may be attributable to differences in exercise durations and intensity.

There were significant positive correlations between the levels of TWBC Vs. AB LYM and TWBC Vs. AB GRAN in the pre-exercise subjects. This shows that a linear relationship exists between these biomarkers in this individuals before exercise and hence as one increases, so does the other and vice versa. TWBC levels were also favorably connected with AB LYM, AB GRAN, and AB MID, as well as AB LYM vs. AB MID and AB GRAN vs. AB MID in the participants after exercise.This means that an increase in TWBC after exercise will result in an increase in absolute lymphocyte counts, absolute granulocyte counts, and absolute mid cell counts, with an increase in absolute lymphocyte counts leading to an increase in absolute mid cell count, and an increase in absolute granulocyte counts leading to an increase in absolute mid cell count, and vice versa.

CONCLUSION

This study found significant decreases in plasma fibrinogen, total white blood cell counts, absolute granulocyte and mid cell counts, but no change in absolute lymphocyte count following aerobic activity. The decrease in fibrinogen levels may indicate that aerobic exercise has a cardioprotective effect. Further research with larger sample sizes is required to further understand the mechanisms underlying the current findings.

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