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# Influence of Aerobic Exercise Training on Cardiac Troponin of University Students in Nnewi South Eastern Nigeria

**Saheed Opeyemi Usman[1*], Samuel Chukwuemeka Meludu[2], Chudi Emmanuel Dioka[1], Jude Anaelechi Onuegbu[1], Japhet M. Olisekodiaka[1], Ifeoma Onuorah[1], Chikaodili Nwando Obi-Ezeani[1], Chidiadi M. Njoku[1] and Christian E. Onah[1]**

*[1]Department of Chemical Pathology, Faculty of Medicine, Nnamdi Azikiwe University, Nnewi, Nigeria.*
*[2]Department of Human Biochemistry, Faculty of Basic Medical Sciences, Nnamdi Azikiwe University, Nnewi, Nigeria.*

***Authors' contributions***

*This work was carried out in collaboration between all authors. Authors SOU, SCM and CED designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors SOU, JAO, JMO, IO, CNOE, CMN and CEO managed the analyses of the study. Authors SOU, SCM, CED, IO, CNOE, CMN, CEO, JAO and JMO managed the literature searches. All authors read and approved the final manuscript.*

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## ABSTRACT

**Background:** Cardiovascular disease is a major public health problem & a leading cause of mortality in Nigeria, which has been largely attributed to the decline in physical exercise predisposing people to various forms of chronic ailments in general. The objective of this study was to determine the more preferred and compare results of the effect of moderate and vigorous exercises on cardiac troponin I before exercise, four weeks after exercise, eight weeks after

**Corresponding author: E-mail: senatorhopsy@yahoo.com;*

exercise and twelve weeks after exercise.
**Methods:** Serum concentration of cardiac troponin I of both vigorous exercise group (30 male individuals who played football for 40 minutes daily for 3 days/week) and moderate exercise group (30 male individuals who engaged in mild jogging for 30 minutes daily for 5 days/week) were determined using Enzyme Linked Immunosorbent Assay (ELISA) technique. All data were expressed as Mean ± Standard Deviation (SD) and analyzed with Analysis of Variance (ANOVA) while multiple comparisons were done using Post Hoc test. Pearson's correlation coefficient was used for correlational analysis.
**Results:** In the moderate exercise group, mean Body Mass Index (BMI) was reduced but no significance while mean serum cardiac troponin I was significantly increased at $P<0.05$ mainly 8 & 12 weeks after exercise as compared with results before exercise. In the vigorous exercise group, mean Body Mass Index (BMI) was significantly reduced while mean serum cardiac troponin I was significantly increased at $P<0.05$all through.
**Conclusion:** Physical exercise leads to transitory elevation in troponin level, though only after an extended period of physical exercise as evidenced mainly in the vigorous exercise group indicating that a moderate form of physical exercise is preferred as it either prevents or at delay the leakage of these proteins.

*Keywords: Exercise; cardiac; student; Nigeria.*

## 1. INTRODUCTION

Sedentary lifestyle is an issue of great concern because of its deleterious health implications in developed and developing countries. It is associated with limited physical activity, prolonged sitting at work, communities, long screen time, car driving, homes and public places, which have been restricted in ways that minimize human movement and muscular activities. People sit more and move less. This shift from a physically demanding life to reduced physical activities have exposed people to high risk of developing various health conditions such as obesity, hypertension, diabetes and cardiovascular diseases [1]. Physical exercise is any bodily activity that enhances or maintains physical fitness and overall health and wellness. It improves mental health, helps prevent depression and promote positive self-esteem [2].

The cardiovascular system is the part of the body that contains the heart, arteries and veins. It is responsible for pumping blood throughout the body thereby providing a rapid-transport system to distribute oxygen to the body cells and also remove carbon-dioxide from the body with other waste products [3]. Troponin I is a part of the troponin complex, which binds to actin in thin myofilaments to hold the actin-tropomyosin complex in place. Because of it, myosin cannot bind actin in relaxed muscle. Cardiac troponin I (cTnI) is a reliable marker of cardiac muscle tissue injury [4]. Extreme physical stress such as marathon and ultra-marathon races may lead to transitory elevation of troponin levels [5,6]. In a small group of adolescents, more than half of the participants developed troponin increase after basketball training [7]. The same was reported after treadmill test [8]. In 2011, a research work on the effects of intermittent exercise on cardiac troponin I, showed that three bouts of 90-minute exercise along with carbohydrate supplementation did not have any significant effect on the level of the troponin indices [9]. Another research work on the effects of exercise training on the course of cardiac troponin T & I levels, shows that there were no significant changes in cardiac troponin levels over time and concluded that there is no evidence from the study that prolonged resistance-type exercise training can modulate basal cardiac troponin levels [10]. Prolonged walk was associated significant increase in troponin I on day one, with no further increase thereafter [11].

The study was therefore carried out to determine and compare results of the effect of moderate and vigorous aerobic exercises on cardiac troponin I before exercise, two weeks after exercise, eight weeks after exercise and twelve weeks after exercise and determine the preferred form of physical exercise in terms of duration, intensity and frequency most especially required to avoid sedentary lifestyle.

## 2. METHODS

### 2.1 Study Site/ Subject Selection/Study Design

The study was conducted at Okofia playing ground on the Nnamdi Azikiwe University,

Okofia, Nnewi, Anambra State, Nigeria. Total study size of 60 subjects but 240 serum samples were used. They were divided into two groups: Group 1 (Vigorous Exercise) - This group consisted of 30 individuals who played football for 40 minutes per day (3 days/week). Group 2 (Moderate Exercise) -This group consisted of 30 individuals who engaged in mild jogging for 30 minutes daily (5 days/week). A baseline specimen was obtained from each subject before exercise. After four weeks, eight weeks and twelve weeks of respective training, fresh samples were collected from each subject.

## 2.2 Inclusion and Exclusion Criteria

Inclusion criteria for subjects were: physically healthy male individuals' ages 18-35 years, occasional or non-alcohol consumers, non-smokers, as well as, those not on drugs especially that will interfere with the parameter studied. Subjects physically unhealthy (males/ females), outside the age range, regular alcohol consumers, smokers and those on drugs that will interfere with the parameter studied, were all excluded.

## 2.3 Sample size

Sample size calculation was done using 95% confidence interval, 0.05 precision and prevalence rate. There seem to be no data available as regards the proportion of Anambra State residents that participate in various forms of physical exercise, but, high physical activity levels assessed in Ibadan, Western Nigeria, reported 1.7% [12]. The formula for sample size when population is more than 1000 is:

$$n = Z^2PQ/d^2 \quad [13].$$

$$n = Z^2PQ/d^2$$

Where:

- n = sample size,
- d = degree of precision (taken as 0.05),
- Z = standard normal deviation at 95% confidence interval which is 1.96,
- P = proportion of the target population (estimated at 1.7% which is 1.7/100 = 0.017),
- Q = alternate proportion (1-P) which is 1-0.017= 0.983
- n = $(1.96)^2$ (0.017)(0.983)/$(0.05)^2$ = 26

## 2.4 Sample Collection, Storage and Analysis

A 5 ml fasting blood sample was aseptically collected into plain sample containers from each of the participating individuals by venipuncture on each of the three occasions sample was withdrawn between 7.30am and 10am. Blood samples were centrifuged at 4000 Revolution per Minute (RPM) for 10 minutes and the serum of each sample was extracted into fresh plain bottle for analysis. Serum samples were analyzed promptly after centrifugation while those not analyzed immediately analyzed were stored at -20 degree Celsius until analysis few days later. Serum troponin I was analyzed by Enzyme Linked Immunosorbent Assay (ELISA) technique.

## 2.5 Principle of Enzyme Linked Immunosorbent Assay (ELISA)

The antigens or antibodies present in patient's sample are allowed to stick to a polyvinyl plate and then plate is washed to separate antigens or antibodies from remaining sample components. To this plate, a corresponding second antigen or antibody is added to get fixed to the already adhered first antigen in the plate. A tagged enzyme is added, then, a suitable substrate is added, the enzyme reacts with the substrate to produce a colour. This colour produced is measurable as a function of antigens or antibodies present in the given sample.

## 2.6 Ethical Consideration

Ethical approval was obtained from the Ethical Research Committee of the Nnamdi Azikiwe University Teaching Hospital (NAUTH), Nnewi, Anambra State, Nigeria.

## 2.7 Statistical Analysis

Data was statistically analyzed using Statistical Package for the Social Sciences (SPSS) for windows version 23.0 software. Data were expressed as Mean ± Standard Deviation (SD). Statistical analysis of the data before exercise, four weeks after exercise, eight weeks after exercise and twelve weeks after exercise was performed by Analysis of Variance (ANOVA) while multiple comparisons were done using Post Hoc test. Significance was fixed at $P < 0.05$ and highly significant if $P < 0.01$. Pearson's correlation coefficient was used for correlational analysis of the test.

## 3. RESULTS

### 3.1 Physical and Biochemical Parameters

The mean age for subjects in moderate exercise group was 23.13 ± 2.11 years while mean age for subjects in vigorous exercise group was 22.63 ± 1.67 years, with the mean age of both groups not significantly different. The mean Body Mass Index (BMI) was not significantly different throughout in the moderate exercise group while the mean Body Mass Index (BMI) significantly reduced 12 weeks after exercise as compared with the result before exercise in the vigorous exercise group. In the moderate exercise group, the mean serum concentration of Troponin I increased significantly (P<0.05) 8 weeks & 12 weeks after exercise as compared with the result before exercise as well as 12 weeks after exercise as compared with the results 4 weeks & 8weeks after exercise while in the vigorous exercise group, the mean serum concentration of Troponin I significantly increased (P<0.05) all through the study from 4 weeks post exercise, 8 weeks post exercise and 12 week post exercise (Tables 1 & 2).

**Table 1. Comparison of BMI & Troponin I results for moderate exercise group before exercise, 4-weeks after exercise, 8-weeks after exercise and 12-weeks after exercise**

| Groups | Parameters | |
|---|---|---|
| | BMI (kg/m²) | TROP I (µg/L) |
| Before exercise | 22.31 ± 1.91 | 0.013 ± 0.01 |
| 4 weeks after exercise | 21.81 ± 1.79 | 0.015 ± 0.01 |
| 8 weeks after exercise | 21.68 ± 1.67 | 0.017 ± 0.01 |
| 12 weeks after exercise | 21.16 ± 1.65 | 0.020 ± 0.01 |
| F-value | 2.182 | 14.223 |
| P-value | 0.094 | 0.001* |
| POST HOC | | |
| a/b | 1.000 | 0.849 |
| a/c | 0.992 | 0.009* |
| a/d | 0.074 | 0.001* |
| b/c | 1.000 | 0.458 |
| b/d | 0.928 | 0.001* |
| c/d | 1.000 | 0.025* |

*KEY: a – before exercise, b – 4 weeks after exercise, c – 8 weeks after exercise, d – 12 weeks after exercise*
*BMI – Body Mass Index, Trop I – Troponin I*
** = Results compared are significantly different at P-value < 0.05 (P < 0.05).*

**Table 2. Comparison of bmi & troponin i results for vigorous exercise group before exercise, 4-weeks after exercise, 8-weeks after exercise and 12-weeks after exercise**

| Groups | Parameters | |
|---|---|---|
| | BMI (kg/m²) | TROP I (µg/L) |
| Before exercise | 22.67 ± 1.80 | 0.011 ± 0.01 |
| 4 weeks after exercise | 22.08 ± 1.67 | 0.014 ± 0.01 |
| 8 weeks after exercise | 21.75 ± 1.71 | 0.017 ± 0.01 |
| 12 weeks after exercise | 21.18 ± 1.58 | 0.021 ± 0.01 |
| F-value | 4.108 | 69.032 |
| P-value | 0.008* | 0.001* |
| POST HOC | | |
| a/b | 1.000 | 0.009* |
| a/c | 0.216 | 0.001* |
| a/d | 0.005* | 0.001* |
| b/c | 1.000 | 0.001* |
| b/d | 0.249 | 0.001* |
| c/d | 1.000 | 0.001* |

*KEY: a – before exercise, b – 4 weeks after exercise, c – 8 weeks after exercise, d – 12 weeks after exercise*
*BMI – Body Mass Index, Trop I – Troponin I,*
** = Results compared are significantly different at P-value < 0.05 (P < 0.05).*

## 4. DISCUSSION

The mean age and body mass index (BMI) of both moderate and vigorous exercise groups were not significantly different before exercise, 4 weeks after exercise, 8 weeks after exercise or 12 weeks after exercise. In the moderate exercise group, the mean serum concentration of Troponin I increased significantly (P<0.05) 8 weeks & 12 weeks after exercise as compared with the result before exercise as well as 12 weeks after exercise as compared with the results 4 weeks & 8 weeks after exercise. In the vigorous exercise group, the mean serum concentration of Troponin I significantly increased (P<0.05) all through the study. This research outcome is not in agreement with some previous studies that showed three bouts of 90-minute exercise did not have any significant effect on the level of the troponin indices [9], another showed that there were no significant changes in cardiac troponin levels over time after exercise training, indicating that the results of the study do not support the idea that cardiac troponin levels might be modifiable through exercise, thus disproving the fact that higher physical activity levels were associated with both lower basal troponin levels and lower probability of a significant increase in cardiac troponin

concentrations between consecutive visits [10] but the outcomes are similar to those of other research work including the report that showed more than half of the participants developed troponin increase after basketball training [7], the same increase in troponin I was reported after treadmill test [8], marathon and ultra-marathon races leading to transitory elevation of troponin levels [5,6]. The increases in troponin I observed in this study might be attributed to the fact that exercise-induced increases in myocardial permeability possibly facilitate the release of cytosolic cardiac troponin. The raised troponin levels indicate cardiac muscle cell injury as the enzyme is released into the blood upon injury to the heart. Thus, as cardiac troponin levels do not rise in the presence of skeletal damage without cardiac myocyte damage, the implication is that this rise in troponin levels can be attributed to cardiac muscle cell injury [14,15]. Perhaps exercise training has been reported to be a successful and powerful strategy to prevent future cardiovascular disease or at the least reduce progression and/or development of cardiovascular problems, paradoxically exercise is also associated with an increased risk of acute cardiac events indicated by elevated cardiac troponin which often occur more rapidly after physical activities showing that troponin rise after physical exercise comes from cytosol and not from the thin filaments in the contractile apparatus. The increases may also be attributed to the fact that the research was carried out in young people who are expected to respond to exercise training and demonstrate higher cardiovascular plasticity especially when the exercise training extend for certain lengthened period.

## 5. CONCLUSION

Physical exercise leads to transitory elevation in troponin level, though only after an extended period of physical exercise as evidenced mainly in the vigorous exercise group indicating that a moderate form of physical exercise is preferred as it either prevents or at delay the leakage of these proteins. Thus, the findings of this study show that the moderate exercise of 30minutes per day five times a week is preferable for the body as it better enhances the biochemical parameters in the body.

## CONSENT

All authors declare that 'written informed consent was obtained from the subjects and other approved parties for publication of this paper and accompanying images.

## ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee (the ethical review committee of the Nnamdi Azikiwe University Teaching Hospital, Nnewi, Nigeria) and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki." ethical standards laid down in the 1964 Declaration of Helsinki.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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