International Journal of Clinical Trials
Onuegbu JA et al. Int J Clin Trials. 2015 May;2(2):47-50
http://www.ijclinicaltrials.com
pISSN 2349-3240 | eISSN 2349-3259
DOI: 10.5455/2349-3259.ijct20150505

Research Article

Effect of moderate and vigorous physical exercises on serum immunoglobulins G and M of healthy male individuals in Anambra State

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Received: 18 February 2015
Accepted: 12 March 2015

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ABSTRACT

Background: Alterations in immunoglobulin levels have been implicated in physical exercises, of varying intensity and frequency. This has been largely attributed to decline in physical exercise thus predisposing many to various chronic ailments. The objective of this study was to determine and compare results of the effect of moderate and vigorous exercises on Immunoglobulin G (IgG) and Immunoglobulin M (IgM) before exercise, two weeks after exercise and four weeks after exercise.
Methods: Serum concentration of IgG and IgM of both vigorous exercise group (50 male individuals who played football for 2 hours daily for 5 days/week) and moderate exercise group (50 male individuals who played football for 30 minutes daily for 3 days/week) were determined using Enzyme Linked Immunosorbent Assay (ELISA) method. 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 BMI was reduced while IgG was increased but not significantly at $P<0.05$ all through. Mean serum IgM was increased significantly at $P<0.05$ mostly 4 weeks after exercise as compared with the results before exercise. In the vigorous exercise group, mean BMI was decreased while mean serum IgG was increased but not significantly at $P<0.05$. Mean serum IgM was significantly increased all through at $P<0.05$.
Conclusions: Vigorous physical exercise can substantially increase fitness, but, moderate physical exercise, when performed frequently and over an extended period, produces enhanced immune response.

Keywords: Physical exercise, ELISA, Immunoglobulin G, Immunoglobulin M

INTRODUCTION

Physical exercise is any bodily activity that enhances or maintains physical fitness and overall health and wellness. It improves mental health and helps prevent depression.[1] Controversy exists on the specific form of exercise, as well as the intensity, duration, and training intervals of the specific form of exercise chosen as a Lifestyle intervention regimen. Moderate and vigorous exercises generally relate to aerobic forms of exercise.[2] The most effective way to participate in a well-rounded physical exercise program is by following a simple short acronym called FITT (Frequency, Intensity, Time, and Type). The FITT principle includes how many times a week one should exercise (frequency), how intense the

workout should be (intensity), how long the workout is (time), and what modality to use (type of exercise).[3]

Immunity is the defense mechanism or resistance of a host against a foreign body.[4] The immune system includes chemicals and proteins in the blood, such as antibodies, complement proteins, and interferon.[5] Immunoglobulins also called antibodies are glycoprotein molecules that are produced by plasma cells in response to an immunogen and which function as antibodies.[6,7] Immunoglobulin G (IgG) is an antibody isotype synthesized and secreted by plasma B cells. It is the most abundant antibody isotype found in the circulation.[8] Immunoglobulin M (IgM), is a basic antibody that is produced by B cells. It is by far the physically largest antibody in the human circulatory system. It is the first antibody to appear in response to initial exposure to antigen.[9] Strenuous exercise is associated with tissue damage. This activates the innate immune system and local inflammation. Interaction between innate and adaptive immunity is essential for maintaining health, suggesting that the adaptive immune system may also be altered by exercise.[7] A study on the effects of training time on serum immunoglobulin alterations, cortisol, and testosterone responses in male athlete students, showed that there were not any significant differences between the amounts of serum immunoglobulins of both groups in pre-test and post-test.[10] Also, another study on the influence of ultra-endurance exercise on immunoglobulin isotypes and subclasses reported that the serum immunoglobulins were significantly altered after the race.[11] Moreover, a study on the influence of selected exercise on serum immunoglobulins A, M and G in semi-endurance elite runners reported that long and intensive exercises weaken the immune system, while moderate and short drills strengthened this system.[12] A previous study also on the effects of acute and chronic exercise on immunoglobulins showed that acute moderate exercise, such as a 45-minute bout of walking has been associated with a transient rise in serum immunoglobulin levels despite no change in plasma volume.[13] The objective of this study was therefore to determine and compare results of the effect of moderate and vigorous exercises on Immunoglobulin G (IgG) and Immunoglobulin M (IgM) before exercise, two weeks after exercise and four weeks after exercise.

METHODS

Study site/ subject selection/study design

The study was conducted at Amawbia training ground, Amudo football training ground and Okpuno football training ground, all in Awka metropolis, Anambra State, Nigeria. Total study size of 100 subjects but 300 samples/specimens was used (males). They were divided into two groups: Group 1 (Vigorous Exercise) - This group consisted of 50 individuals (males) who trained for football playing for 2 hours daily (5 days/week). Group 2 (Moderate Exercise) -This group consisted of 50 individuals (males) who trained for football playing for 30minutes (3 days/ week). A baseline specimen was obtained from each subject before exercise. After two weeks and four weeks of respective training, fresh samples were collected from each subject.

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 parameters to be studied (e.g. lipid-lowering drugs).

Subjects physically unhealthy (males/females), outside the age range, regular alcohol consumers, smokers and those on drugs especially those that will interfere with the parameters to be studied, were all excluded.

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 3.2%.[14] the formula for sample size when population is more than 1000 is:

$\mathbf{n = Z^2PQ/d^2}$.[15]

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 3.2% which is 3.2/100 = 0.032), Q = alternate proportion (1-P) which is 1-0.032= 0.968

$$n = \frac{(1.96)^2(0.032)(0.968)}{(0.05)^2} = 48$$

Sample collection, storage and analysis

A 5ml 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 Immunoglobulin G and M levels were analyzed by Enzyme Linked Immunosorbent Assay (ELISA) technique.

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.

Statistical analysis

Data was statistically analyzed using Statistical Package for the Social Sciences (SPSS) for windows version 20.0 software. All data were expressed as Mean ± Standard Deviation (SD). Statistical analysis of the data before exercise, two weeks after exercise and four 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.

RESULTS

Physical and biochemical parameters

The mean age for subjects in moderate exercise group was 21.74 years while mean age for subjects in vigorous exercise group was 21.44 years, with the mean age of both groups not significantly different. The mean body mass index (BMI) of both moderate and vigorous exercise groups was reduced but not significantly different before exercise, 2 weeks after exercise or 4 weeks after exercise (Tables 1, 2).

Table 1: Comparison of BMI, IgG & IgM results for moderate exercise group before exercise, 2-weeks after exercise and 4-weeks after exercise.

Groups	Parameters		
	BMI ($kg/m^{2)}$	IgG (g/L)	IgM (g/L)
Before exercise	22.88 ± 0.84	10.45 ± 2.03	0.82 ± 0.18
2 weeks After exercise	22.87 ± 0.85	10.65 ± 1.96	0.89 ± 0.18
4 weeks after exercise	22.69 ± 0.86	10.69 ± 1.96	0.94 ± 0.16
F-value	0.821	0.211	5.740
P-value	0.442	0.810	0.004*
Post HOC			
a/b	1.000	1.000	0.144
a/c	0.752	1.000	0.003*
b/c	0.873	1.000	0.514

In the moderate exercise group, the mean concentration of IgG was increased but not significantly at $P<0.05$ while that of IgM was significantly increased, mostly 4 weeks after exercise as compared with the results before exercise. In the vigorous exercise group, the mean concentration of IgG was increased but not significantly at $P<0.05$ while that of IgM was significantly increased all through (Tables 1, 2).

Table 2: Comparison of BMI, IgG and IgM results for vigorous exercise group before exercise, 2-weeks after exercise and 4- weeks after exercise.

Groups	Parameters		
	BMI ($kg/m^{2)}$	IgG (g/L)	IgM (g/L)
Before exercise	22.71 ± 1.20	11.15 ± 1.94	0.89 ± 0.18
2 weeks After exercise	22.54 ± 1.23	11.65 ± 1.92	0.98 ± 0.20
4 weeks after exercise	22.22 ± 1.29	11.72 ± 1.88	1.18 ± 0.17
F-value	2.008	1.298	32.272
P-value	0.138	0.276	0.001*
Post HOC			
a/b	1.000	0.591	0.044*
a/c	0.150	0.425	0.001*
b/c	0.606	1.000	0.001*

KEY:
*a- before exercise, b-2 weeks after exercise, c- 4 weeks after exercise, * = Results compared are significantly different at P-value < 0.05 (P < 0.05).*

DISCUSSION

The mean age and body mass index (BMI) of both moderate and vigorous exercise groups were not significantly different before exercise, 2 weeks after exercise or 4 weeks after exercise. In the moderate exercise group, the mean concentration of IgG was increased but not significantly at $P<0.05$ while that of IgM was significantly increased, mostly 4 weeks after exercise as compared with the results before exercise. In the vigorous exercise group, the mean concentration of IgG was increased but not significantly at $P<0.05$ while that of IgM was significantly increased all through. This study is consistent with a study on the influence of ultra-endurance exercise on immunoglobulin isotypes and subclasses, which reported that, the serum immunoglobulins were significantly altered after the race.[11] It is also in concordance with a previous study also on the effects of acute and chronic exercise on immunoglobulins showed that acute moderate exercise, such as a 45-minute bout of walking has been associated with a transient rise in serum immunoglobulin levels.[13] The study is in agreement with another study on the influence of selected exercise on serum immunoglobulins

A, M and G in semi-endurance elite runners where their findings indicated that long and intensive exercises weaken the immune system, while moderate and short drills strengthened this system.[12] However, it is not in agreement with a study on the effects of training time on serum immunoglobulin in male athlete students, which showed that there were not any significant differences between the amounts of serum immunoglobulins of both groups in pre-test and post-test.[10] Generally in exercise immunology, an increase in immunoglobulin concentration has usually been interpreted to represent enhanced immunity, and a decrease is usually interpreted as immunosuppression. The alteration in the concentration of IgM, the first antibody (immunoglobulin) class produced in an immune response, as well as that of IgG, in both moderate and vigorous exercise groups, could be as a result of the antigen stimulation through greater-than-normal quantities of microorganisms especially airborne microbes entering the body through both increased ventilation rates or increased lungs ventilation and breakdown of natural mucosal immunity by drying of airway secretions, during the exercise. Therefore, the findings in both exercise groups may imply that, the physical exercise performed strengthened the immune system thus, protecting against foreign antigens, although, caution may be advised especially regarding the vigorous exercise group, as the immune system may be suppressed if exercise is extended for a too long period.

CONCLUSION

Vigorous physical exercise can substantially increase fitness, but, moderate physical exercise, when performed frequently and over an extended period, produces enhanced immune response.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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DOI: 10.5455/2349-3259. ijct20150505
Cite this article as: Onuegbu JA, Usman SO, Meludu SC, Olisekodiaka JM. Effect of moderate and vigorous physical exercises on serum immunoglobulins G and M of healthy male individuals in Anambra State. Int J Clin Trials 2015;2:47-50.