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Effect of Exercise Program on Immunity System of Male Geriatrics with Immunodeficiency Disorders

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Abstract

Background: Immunodeficiency is a major cause of illness, especially in people of Old age.

Aim of Study: The study was conducted to evaluate the effect of exercise program on immunity system of male geriatrics with immunodeficiency disorder.

Material and Methods: Forty male patients with immunodeficiency disorders participated in the study, between 60 and 70 years old. They were divided randomly and equally into two groups: 20 patients group (A), in which patients received the regular medications plus the exercise program; and 20 patients in group (B), in which patients received just the regular medications.

The exercise program contained aerobic, flexibility, strengthening and endurance exercises for 50-60min, three times per week, for 3 month assessment of patients in each group for immunty level (WBCs and lymphocytes), before and after treatment.

Results: There was a significant increase in WBCs count, lymphocytes count and 6MWT post treatment in group (A) and group (B) compared with that pre treatment (p>0.001). The percent of increase in WBCs count, lymphocytes count and 6MWT in the study group was 147.45%, 293.83% and 40.68% respectively, and that for control group was 95.83%, 257.14% and 25.36% respectively.

Conclusion: Exercises are effective in increasing immunity level in male patients with immunodeficiency disorders.

Key Words: *Geriatrics – Immunodeficiency – Exercise.*

Introduction

THE immune system is a network of cells and tissues responsible for the defense against pathogenic microorganisms, and for eliminating neoplastic tissues and other foreign substances, such as toxic materials and transplants [1]. It is the human defence system, the overall purpose of which is to recognize and respond to a wide variety of pathogens or injury [2].

When the immune system is less active than normal this is immunodeficiency, Causes of this deficiency have been classified in either primary or secondary [3]. Secondary immunodeficiencies are far more common than primary immunodeficiencies, it result from a variety of factors that can affect a host with an intrinsically normal immune system, These deficiencies of immunity are clinically manifested by an increased frequency or unusual complications of common infections and occasionally by the occurrence of recurrent infections [3].

The immune system is influenced acutely, and to a lesser extent chronically, by exercise, physical exercise training may improve a number of immune system parameters [4].

When people exercise regularly, there are a number of things that benefit the body. Heart gets stronger and is able to pump more blood throughout the body. Lungs get better equipped at handling oxygen and dishing it out to the rest of the body. Muscles also get stronger as they use them more often. Immune system is no different. And that will help keep people healthier than they would be if they didn't exercise.

The positive effects of physical exercise in reducing the risk of all-cause mortality and improving the lifespan have been extensively documented. Chronic physical exercise offers protection against chronic diseases, dementia and cognitive decline, among other diseases. Regular exercise training

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also protects against bacteria and viruses infections and enhance immune responses to pathogens and vaccines. This makes the physical exercise a valuable tool to prevent infectious diseases, such as COVID-19, or non-infectious ones, such as obesity. The impact of physical exercise on tissue homeostasis provokes an adaptive response which depends on the type, duration and intensity of the stimuli. The beneficial consequences of exercise on the health outcomes involve the modulation of the immune system. The regular practice of moderate intensity physical exercise directs the immune response to an anti-inflammatory status, that is believed to be the main desired mechanism to improve the health out-comes [5].

Regular exercise reduces the risk of chronic metabolic and cardiorespiratory diseases, because exercise exerts anti-inflammatory effects. The anti-inflammatory effects of regular exercise may be mediated via both a reduction in visceral fat mass (with a subsequent decreased release of adipokines) and the induction of an anti-inflammatory environment with each bout of exercise. Various mechanisms may contribute to the generation of this anti-inflammatory environment, including: Increased release of cortisol and adrenaline from the adrenal glands; increased production and release of myokines from working skeletal muscle; with subsequent inhibition of down stream pro-inflammatory cytokine production; inhibition of adipose tissue infiltration by monocytes and macrophages; phenotypic switching of macrophages within adipose tissue; a reduction in the circulating numbers of pro-inflammatory monocytes; and an increase in the circulating numbers of TReg cells [6].

Immunity is gen-erally well maintained up until age 50; Regular exercise training of a moderate intensity is believed to exert beneficial effects on immune function. Therefore, the effects of regular exercise training on immune function has typically been studied in older adults, although many more studies are examining the effects of moderate exercise training in obese and diseased patients, including those living with cancer and HIV. Moreover, the exercise mode (i.e., aerobic, resistance, or combinations) most likely to exert the greatest influence on immunity is debatable, but is likely dependent on the subject/patient group and any underlying disease [7].

Aim of study:

To evaluate the effect of exercise program on immunity system of male geriatrics with immunodeficiency disorder.

Material and Methods

Design of the study:

The study was a pretest-posttest research design.

Participant:

Participants were recruited from outpatient clinic of Ashmoun hospital, Egypt. The clinical application Of exercise group were conducted in Ashmoun Hospital, In the period between April to July 2021. The study was approved by the Ethical Committee for Human Re-search at Faculty of Physical Therapy, Cairo University, Egypt. (Reference number P.T. REC/0 12/002 605). Participants were invited to join the study and signed the written consent form prior to participation. Forty patients diagnosed with immunodeficiency disorders, were enrolled to the study if they met the inclusion criteria of WBC less than 4.5 $x10^9$/L and Lymphocytes less than 1 $x10^9$/L [8], being between the age of 60 to 70 years, their BMI 30Kg/m^2, medically stable (vital signs are stable within normal limits: Blood pressure, pulse, temperature, and respiration).

Patients were Excluded if they are Uncooperative, had Psychological disorders, Cognition impairments, any musculoskeletal diseases prevent exercise program, patients receive medications which affect immunity.

Sample size and randomization:

Forty patients were randomly distributed between two groups, the group who taking their standard medications in addition to the exercises program (Group A=20), or the one who only take the standard medications (Group B=20), using a computer generated random blocks and concealed allocation was done by the use of sealed opaque envelopes. A randomization generated by an author not involved in data collection.

Instrumentation:

A- *For evaluation:*

- Fatigue severity scale (FSS) questionnaire [9].
- 6 MWT [10].
- Pulse Oxi meter, to measure pulse rate for each patient during the session.
- Weight and height scale, to measure weight and height to determine BMI.
- Blood analyzer, to measure WBC and lymphocytes (Sysmex-KX-21N-Hematology-Analyzer).
- Unstretchable tape measurement.
- Counter.
- Traffic cones.

B- *For treatment:*

Study group (A):

The patient performing the exercises using:

- Electrical treadmill With adjustable speed and safe mood.
- Free weights.
- Cycle ergometer.

Control group (B):

Only medical treatment.

Procedure:

Each patient was interviewed and the goal of the study was explained, the patient that agreed to participate in the study was asked to fill a consent form. Detailed history was taken from each patient. Pain intensity, lumbar range of motion and functional disability were assessed for each patient before and at the end of treatment sessions. Procedure: Each patient was interviewed and the goal of the study was explained, the patient that agreed to participate in the study was asked to fill a consent form. Detailed history was taken from each patient. Pain intensity, lumbar range of motion and functional disability were assessed for each patient before and at the end of treatment sessions.

A- *Evaluation procedures:*

Evaluate fatigue intensity using the FSS which is made up of 9 statements that are evaluated by the person taking the test. A 7-step, Likert scale is used to rate each response with higher numbers representing stronger agreement by the respondent.

The score of the scale is generated by calculating the average response to the questions.

Instructions:

Consider the past week when answering questions.

Choose only one answer for each question:

1 = Strongly Disagree; 7 = Strongly Agree. FSS is a valid and reliable tool to measure fatigue severity.

- Calculate maximum Heart rate for each patient from equation:

$$MHR = 208 – (0.7 \times age)$$ **[11]**

- Calculate each patient target heart rate, from Karvonen formula:

$$THR = Resting\ HR + ((0.6 \text{ to } 0.85)\ [maximum\ HR\text{-}resting\ HR])$$ **[12]**

- Determine each patient suitable resistance intensity from the ten repetition maximum test.
- Measure weight and height to determine BMI.
- Measure WBC and lymphocytes.
- Ddo the 6MWT to assese a patient's functional capacity.

The subject walked around a series of traffic cones, which were placed (every 3 meters) to mark off a circular walking area of about 40 feet in diameter that was measured before the test.

Subjects were instructed to attempt to walk for 6 minutes, covering as much ground as possible at a work effort that allowed the person to talk without becoming short of breath.

The tester walked alongside the subject, and timed the walk with a stop watch. Subjects were not prompted by the tester because previous studies have found that encouragement provided by the tester affects performance, with patients receiving encouragement walking greater distances than those who do not.

The subject was permitted to stop and rest, but was instructed to resume wal 6 minutes, the subject was instructed to stop walking, a marker was placed on the ground, and the distance walked during the last lap was measured by a rolling tape measure.

The total distance was derived by multiplying the number of laps by the circumference of the walking circle, and adding the distance covered on the last lap.

B- *Treatment procedure:*

Study group (group A):

This group received exercise program which was performed in three phases: Warming up phase, main exercise phase and cool down phase.

1- Warming-up: Comprised of 10 minutes of walking in place, backward and sideways, Heel presses and toe touches to the front and sides at progressively Then, subjects performed continuous movement through a normal range of motion, and dynamic stretch **[13]**.

2- Main exercise -phase: Aerobic, resistance, and endurance exercise for 40 minutes, Comprised of:

- 10 minutes walking on the treadmill.
- 10 minutes on the cycle ergometer.
- 20 minutes of strengthening and endurance exercises for: Shoulder flexion, extension, abduction and adduction, shoulder horizontal abduction and adduction. Elbow flexion and extension Hip flexion,

extension, abduction, and adduction Knee flexion, and extension **[14]**.

3- *Cooling down:* Comprised of 10 minutes of walking in place, backward and sideways, Heel presses and toe touches to the front and sides at progressively Then, subjects performed continuous movement through a normal range of motion, and dynamic stretch **[15]**.

Statistical analysis:

Descriptive statistics and unpaired *t*-test were conducted for comparison of subject characteristics between groups. Normal distribution of data was checked using the Shapiro-Wilk test. Levene's test for homogeneity of variances was conducted to test the homogeneity between groups. Unpaired *t*-test was conducted to compare the mean values of WBCs count, lymphocytes count and 6MWT between the study and control groups. Paired *t*-test was conducted for comparison between pre and post treatment in each group. The level of significance for all statistical tests was set at $p<0.05$. All statistical analysis was conducted through the statistical package for social studies (SPSS) version 25 for windows (IBM SPSS, Chicago, IL, USA).

Results

Subject characteristics:

Table (1) showed the subject characteristics of the study and control groups. There was no significant difference between groups in age, weight, height and BMI ($p>0.05$).

Effect of treatment on WBCs count, lymphocytes count and 6MWT:

- Within group comparison:

There was a significant increase in WBCs count, lymphocytes count and 6MWT post treatment in the study and control groups compared with that pre treatment ($p>0.001$). The percent of increase in WBCs count, lymphocytes count and 6MWT in the study group was 147.45%, 293.83% and 40.68% respectively, and that for control group was 95.83%, 257.14% and 25.36% respectively (Table 2).

- Between groups comparison:

There was no significant difference between groups pre-treatment ($p>0.05$). Comparison between groups post treatment revealed a significant increase in WBCs count, lymphocytes count and 6MWT of the study group compared with that of the control group ($p<0.01$) (Table 2).

Table (1): Subject characteristics.

	Group A Mean ± SD	Group B Mean ± SD	*p*-value
Age (years)	62.73±2	63.05±2.48	0.66
Weight (kg)	71.36±4.37	70.36±3.35	0.43
Height (cm)	168.84±5.15	167.36±4.43	0.35
BMI (kg/m^2)	25.01±0.46	25.11±0.4	0.49

SD: Standard deviation.
p-value: Level of significance.

Table (2): Mean WBCs count, lymphocytes count and 6MWT pre and post treatment of the study and control groups.

	Study group Mean ± SD	Control group Mean ± SD	MD	*t*-value	*p*-value
WBCs count (x10^9/L):					
Pre treatment	2.74±0.82	2.64±0.68	0.1	0.41	0.68
Post treatment	6.78±1.15	5.17±0.79	1.61	5.01	0.0001
MD	–4.04	–2.53			
% of change	147.45	95.83			
t-value	–11.8	–19.27			
	p=0.001	*p*=0.001			
Lymphocytes count (x10^9/L):					
Pre treatment	0.81±0.13	0.77±0.14	0.04	1.01	0.31
Post treatment	3.19±0.33	2.75±0.56	0.44	2.87	0.007
MD	–2.38	–1.98			
% of change	293.83	257.14			
t-value	–30.87	–18.19			
	p=0.001	*p*=0.001			
6MWT (m):					
Pre treatment	499.47±37.18	475.26±50.37	24.21	1.68	0.1
Post treatment	702.63±38.12	595.78±49.36	106.85	7.47	0.001
MD	–203.16	–120.52			
% of change	40.68	25.36			
t-value	–118.18	–22.63			
	p=0.001	*p*=0.001			

SD: Standard deviation. MD: Mean difference. *p*-value: Probability value.

Discussion

The results of this study for both group showed statistically significant difference in increasing immunity, but exercises program group showed more significant improvement in mean difference.

The results of this study coincided with Spielmann et al., **[16]**, who discussed that aging is associated with many discernable changes in the normal functioning of the immune system that are likely to contribute to poorer vaccine responses and the increased incidence of infection and malignancy seen in the elderly. Regular exercise has been associated with enhanced vaccination responses, lower numbers of exhausted/senescent T-cells, increased T-cell proliferation, lower circulatory levels of inflammatory cytokines, increased neutrophil phagocytic activity, lowered inflammatory response to bacterial challenge, greater NK-cell cytotoxic activity and longer leukocyte telomere lengths in aging humans, all of which indicate that habitual exercise is capable of regulating the immune system and delaying the onset of immunosenescence.

The results of the present study also agreed with the Findings of sellami et al., **[17]** review, which has synthesized and discussed the current evidence for the role of exercise interventions in influencing lymphocytes activity in older subjects. The most marked changes occur in the general proliferation of immune cells (i.e., the cell proliferative capability and involution of tissues and organs). This is important because advanced age induces decreased proliferative response.

Many studies show the positive effect of exercise on the immune system such as elevation in T-cell proliferative capacity, increased neutrophil function, and NK cell cytotoxic activity.

Also, Kenny et al., **[18]** reported that When people exercise regularly, exercise can boost people immune system by providing a boost to the cells in body that are assigned to attack bacteria. These cells appear to work more slowly in people who don't exercise than in those that do. As a result, if people exercise, their immune system is better equipped to handle bacteria that could cause them to become sick. Though this boost only lasts for a few hours after they exercise, it's often enough to help keep them healthier than they would be if they didn't exercise.

Da Luz Scheffer & Latini **[5]** agreed about the positive effects of physical exercise in reducing the risk of all-cause mortality and improving the lifespan have been extensively documented. Chronic physical exercise offers protection against chronic non-communicable diseases, dementia and cognitive decline, among other diseases. Regular exercise training also protects against bacteria and viruses infections and enhance immune responses to pathogens and vaccines. This makes the physical exercise a valuable tool to prevent infectious diseases, such, or non-infectious ones.

Exercise is a powerful behavioral intervention that is being used in earnest to improve immune and health outcomes in the elderly and the obese, as well as patients living with cancer and chronic viral infections such as HIV. While studies focused on the immune response to acute exercise are mostly descriptive, the effects of single exercise bouts on immunity may also have clinical implications. Moreover, acute exercise has already proven to be a simpleand economical method to improve vaccine responses, and the implementation of such methods in “at-risk” populations such as the elderly couldhave important implications for public health. Simpson et al., **[19]**.

This contention is also supported by the majority of animal studies, which mostly report improved immune responses and outcomes to viral infections and malignancies due to exercise training Importantly, many of the immune biomarkers that are positively displayed in exercising elderly are key components of the IRP, which, in turn, has been shown to predict morbidity and mortality in older humans. Hojman et al., **[20]**.

Conclusion:

From the obtained result of this study, it was concluded that there is significant correlation between exercise program and immunity system of male geriatrics with immunodeficiency disorders.

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تأثير برنامج التمارين العلاجية على الجهاز المناعى للرجال المسنين مرضى ضعف المناعة

الهدف من البحث: تقييم تأثر التمارين على الجهاز المناعى للمسنين الرجال مرضى ضعف المناعة.

مواد البحث وأساليبه: تم إجراء هذا البحث على مجموعة تتكون من ٤٠ من الرجال مرضى ضعف المناعة والذى تتراوح أعمارهم بين الـ ٦٠ والـ ٧٠ من العمر. تم تقسيمهم إلى مجموعتين، مجموعة (أ) التى تلقت علاج دوائى فقط، ومجموعة (ب) التى تلقت علاج دوائى بجانب التمارين العلاجية.

تم تقييم التغيير فى الجهاز المناعى للمرضى بقياس كل من عدد خلايا الدم البيضاء، عدد الليمفاويات، والخضوع لاختبار المشى لمدة ٦ دقائق، قبل بدء فترة تلقى العلاج وبعد انتهائها.

النتائج: أوضحت النتائج وجود علاقة طردية قوية بين ممارسة التمارين وتحسن الجهاز المناعى.

التوصيات: وفقاً للنتائج السابقة نوصى بضرورة عمل المزيد من الأبحاث فيما يخص هذا المجال لمعرفة كافة العوامل المؤثرة على تحسن الجهاز المناعى لدى مرضى ضعف المناعة وغيرهم، والاستفادة القصوى منها عند وضع برنامج علاجى لهم، للوصول إلى أفضل النتائج العلاجية.