

Review Article

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# Molecular and Biochemical Outcomes of Exercise: A Review Study

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## Abstract

This study expressed the results of our works for about 10 years regarding exercise health effects. Physical exercise has been found to have significant effects under physiological conditions and pathologic conditions such as diabetes, Parkinson's disease, osteoporosis, and others. Molecular effects of physical exercise were shown through up-regulation of some mediators in some pathways that include HSP70, VEGF, P16; and down-regulation of some mediators in other pathways that include iNOS, P53, and estrogen receptor. These cellular variations act to make better health. Studies in osteoporosis revealed that physical exercise improves the health of bone through increasing levels of calcium and bone mineral density. Taken together, physical exercise improves the health of various body systems and organs and helps in protection and therapeutic conditions.

**Keywords:** Physical exercise; Up-regulation; Down-regulation; HSP70; VEGF; P16; P53; iNOS; Calcium

## Introduction

Physical exercise has significant health impacts more than it is thought. In this review study, this topic will be investigated in depth in view of our studies and others. In the first group of studies, a review of experimental studies is going to show how physical exercise improves the health under physiological and pathologic conditions. Al-Jarrah et al (2010) conducted a study to explore the influence of physical exercise to control levels of estrogen receptor (ER $\alpha$ ) and p16 in rats with type 1 diabetes, and endometrial hyperplasia associated with diabetes. The methodology involved induction of diabetes type 1. Four groups were randomly selected (N=10) and assigned as: sedentary control (SC), exercise control (EC), sedentary diabetic (SD), and exercised diabetic (ED). Treadmill program was applied for 4 weeks. Routine histological examination (hematoxylin and eosin) was performed to examine histological status and hyperplasia; and immunohistochemistry was applied to investigate the expression of ER $\alpha$  and p16. The results showed that hyperplasia was developed in rats in SD group (70%). No hyperplasia was observed either in rats in SC group or ED group. On molecular level, diabetic type 1 rats up-regulated

the expression of ER $\alpha$  and down-regulated the expression of p16 significantly (p<0.05) in SD group rats compared with rats in SC group. Exercise had positive impacts in reversing the adverse effects of diabetes ED group rats. As a conclusion, severe impacts of diabetes on endometrial tissue can be inhibited by aerobic exercise.

In view of growing body of literature showing the beneficial effects of physical exercise on patients with Parkinson's disease (PD), we conducted a study to explore the expression of inducible nitric oxide (iNOS) and neuronal nitric oxide (nNOS) in the brain of a chronic mouse model of PD. The second objective of this study was to investigate the effect endurance exercise on the expression of these markers. Methodology involved induction of mouse PD model using 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP) and probenecid. Forty albino mice were assigned randomly into 4 groups (N=10) in the following pattern: sedentary control (SC), exercise control (EC), sedentary PD (SPD), exercise PD (EPD). Training program using treadmill was applied for 4 weeks. At the end of the experiment, the expression of biomarkers was assessed in the striatum in all animal groups using immunohistochemical

techniques. Study findings showed that nNOS was up-regulated significantly in striatum of SPD mice compared to SC mice. Physical exercise was insignificantly able to down-regulate the expression of nNOS in EC group compared to SC group. Exercise training was significantly able to down-regulate the expression rate of nNOS in EPD compared to SPD. The expression of iNOS almost followed the same patterns of interactivity exception non-significant down regulation of iNOS in EC and EPD groups. As a conclusion, 4 weeks of exercise positively impact the expression of nNOS and iNOS in the striatum of mouse PD [1].

In another study on PD, we take into consideration some aspects such as muscle weakness and fatigue associated with this disease particularly among aged patients. The objectives of the study were to investigate the expression of iNOS in the skeletal muscles of mice with PD and to explore the effects of physical exercise on the expression of iNOS in the same muscles. PD was induced as indicated before. The results showed that PD significantly upregulated the expression of iNOS in gastrocnemius muscle in SPD group in comparison with SC group. On the other hand, in soleus muscle, there was no significant up-regulation of iNOS in SPD group compared with SC. Taken together, physical exercise attenuated the changes in iNOS expression associated with PD in skeletal muscles. We think that these findings may have significant implications in rehabilitation programs for PD [2].

In another study on PD, we explored the influence of physical exercise on the expression of HSP70 in brains of mice with induced Parkinson disease. The methods were as described before, the results showed that the expression of HSP70 was significantly down-regulated due to PD compared with control group. Exercise was significantly able to up-regulate the expression of HSP70 in EC group compared with control group. No significant up-regulation in EPD compared with PD was observed. Taken together, we think that exercise has a significant role in enhancing the health status of mice with Parkinson disease [3].

In another study, we investigated the impact of physical exercise on the renal vascular endothelial growth factor (VEGF) expression in type I diabetic rats. Diabetes was induced by streptozotocin in the rats in the two diabetic groups. Results showed that diabetes significantly up-regulated the expression of VEGF in SD compared with SC groups. Physical exercise significantly down-regulated the expression of VEGF in renal tissue in ED group compared with SD group. Taken together, physical exercise inhibited the up-regulation of VEGF associated with diabetes in renal tissue [4].

We conducted another study to explore the expression of both P53 and iNOS in cardiac muscle of rat with type 1 diabetes. The method we followed as described earlier. The study findings showed that both iNOS and P53 were up-regulated in cardiac tissue of diabetic rats. Physical exercise was able to significantly down-regulate the expression of P53, and insignificantly down-regulate the expression of iNOS. Taken together, physical exercise has the ability to lower the complications of diabetes in cardiac tissue [5].

We conducted another study to demonstrate the influence of physical exercise on the expression of VEGF in heart of diabetic heart. The methodology was described before. The results showed that type 1 diabetes significantly down-regulated the expression of VEGF in SD group compared with SC. Physical exercise significantly up-regulated the expression of VEGF in cardiac tissue in ED compared with SD. Taken together, physical exercise can improve the heart health through up-regulation of cardiac

Our present data suggest that treadmill exercise training improved diabetes-induced VEGF expression. Finally, anaerobic exercise was shown to improve the status of osteoporosis in human subjects. Reviewing literature showed that physical exercise is potentially able to delay or inhibit osteoporosis [6-10] studied the changes in bone mineral content following physical exercise for 6 months in 2 groups of postmenopausal women. One group followed aerobic exercise protocols, and the other group followed resistance exercise. Both types of exercise significantly improved levels of BMD, serum calcium (Ca), and parathyroid hormone (PTH) [11,12].

## Conclusion

The results of the present review study showed that physical exercise improves the health of various body systems and organs and helps in protection and therapeutic conditions.

## Acknowledgement

None.

## Conflict of Interest

No conflict of interest.

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