THE EFFECT OF HYDROALCOHOLIC EXTRACT OF RED SKIN PISTACHIO AND AEROBIC EXERCISE ON MOTOR ACTIVITY OF STREPTOZOTOCIN-DIABETIC MALE RATS

Sajad Abdi Gorabi[1], Hasan Mohammadzadeh[1] and Mohammad Rostampour[2]

Urmia University, Urmia, Iran
Guilan University of Medical Sciences, Rasht, Iran

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Abstract
Studies have identified the role of sports activities and medicinal plants individually on motor activity, but the problem that has recently affected our minds is the study of the effects of diabetes on motor activity and the complementary role of aerobic exercises and red skin pistachios because it has active biological compounds to cope with this destructive effect. Therefore, the purpose of this study was to investigate the effect of combined aerobic exercise and consumption of hydroalcoholic extract of pistachio red skin on motor activity in male rats with diabetic streptozotocin. For this purpose, in this experimental study, Wistar male rats weighing 250-280 g were used in 5 groups with equal number of 15 ones in each group. The rats were diabetic with single-dose STZ (50 mg kg) and test protocol was applied for 8 weeks. Results were compared by one-way ANOVA and Tukey's complementary test. The results showed a significant difference between the groups (P <0.01). Intra-group comparisons showed no significant difference between the STZ group and the diabetic saline group. On the other hand, comparison of diabetic group with effective dose and aerobic exercise with non-diabetic group and STZ group and diabetic recipient of saline showed a significant difference (P <0.01). Also, there was a significant difference between the diabetic group of effective dose and aerobic training and the diabetic group of aerobic training with non diabetic and diabetic group receiving effective dose (P <0.05). In general, the findings of this study showed that hydroalcoholic extract of pistachio red skin and aerobic training, as well as aerobic exercise, could improve motor behavior in diabetic rats with streptozotocin.

Key words: *pistachio red skin, aerobic exercise, motor activity, streptozotocin, rat.*

Introduction

Diabetes desease with a history of several thousand years has never been so extensive in history. At the beginning of the third decades, the total number of people with diabetes was 171 million, while according to estimates in the year 2030 this figure would reach 366 million (1). One of the most important factors in creating this situation is the people's desire for urbanization, air pollution, water, noise, consumption of artificial and industrial origin instead of natural and non-fodder foods, mental and psychological stresses caused by social and environmental disorders and competitions, an undesirable economic and especially contemporary lifestyle with little physical activity and distance from spirituality (2). Diabetes is one of the most common metabolic disturbances associated with multiple complications in various organs.

Several neurological complications of diabetes occur in the central and peripheral nervous system (3.4). And in diabetics, memory and learning, the ability to solve problems, the speed of exercise, mental and complex physical movements, inference, and understanding of the person concerned about issues are harmed (5). A lot of research has been done on the treatment of diabetes using medicinal herbs (6). Pistachio is one of the most widely used herbs in traditional medicine. The pistachio pistacia vera and the Anacardiaceae family have a parenchymal and fiber plant, in which there is water, gluten, protein, fat, minerals, vitamins, colorful compounds and terpenes. This plant also contains flavonoids (7). The effect of physical activity is important on preventing diabetes. Physical inactivity can increase the risk of diabetes. Communities with adequate physical activity have a lower incidence of diabetes (8). The numerous effects of exercise, especially its regular type, are also useful on metabolic processes with increased insulin sensitivity, glucose tolerance and weight loss, have a clear effect on cardiovascular health by reducing blood pressure and reducing triglycerides from diabetes mellitus syndrome, in treatment (9).

Exercise on treadmill is an important factor in improving cognitive function (10). Some research suggest that people with moderate physical activity are at lower risk of developing mental illness than those with low mobility, indicating that physical activity has mental and physical benefits (11-13). But some studies did not show this effect. For example, Millau et al. (2008) studied the effect of 2 weeks of intense physical activity and 8 weeks of long-term physical activity on treadmill and daily stress (due to physical activity with stress) on different types of memory in rats. The results showed that stress and physical activity (severe or prolonged) did not affect spatial acquisition and retention.

In addition, Barnes et al. (1991) observed that exercise does not affect the spatial memory of rats; in humans, no beneficial effects of physical activity on cognitive functions have been observed (14, 15). Additionally, sporadic effects in both humans and rats are observed, which is probably due to the used protocol and the intensity and duration of exercise (16). On the other hand, it seems that there is a relationship between cognitive and motor function, so that any disturbance in cognitive factors affects motor functions and causes disturbance in motor function, on the contrary, it is likely to high physical capabilities affect cognitive function (17-19). Therefore, there is ambiguity about the effect of running on the treadmill on memory and learning about motor activity. Azadeh et al (2017) reported that pistachio skin can be used as a cheap and accessible source of active bioactive compounds. All extracts obtained from two cultivars pistachio in Ian (Quchi and O'hadi) and four acetone, methanol, ethanol and water with two methods of using ultrasound and soaking were shown to have a strong antioxidant property as DPPH, so that in anti Oxidation of the extracts method was much stronger than the standard gallic acid and ascorbic acid (20).

Exercise alone can prevent many complications of diabetes but it is surprising that this unique therapeutic approach is less popular (21). So the present study has investigated the effect of hydroalcoholic extract of pistachio red skin and aerobic exercise on motor activity of streptozotocin-diabetic male rats (21).

Materials and methods

Subjects
In this experimental study, Wistar male rats weighing 250-280 gr with equal number (n = 15) were used at Guilan University of Medical Sciences at a temperature of 22 ± 2 ° and in 12-hour darkness cycle (the start of lighting at 9:00 and the start of the darkness at 21:00). In each cage 4 ones were kept with standard water and food.

All behavioral tests were carried out from 10:00 to 14:00.

Their place of storage was cleaned twice a day, and during this time they were checked for their sugars, and if they had reached the fetal border, they were injected with insulin.

Experiments were performed in 6 groups as follows:
• Sham group: A group that got a diabetic but did not receive a drug.
• STZ group receiving Streptozotocin
• Saline recipient group: Normal saline receptor as solvent STZ
• The group receiving the effective dose of pineapple juice hydroalcoholic extract
• A group with aerobic exercises
• An effective dose group of pomegranate juice and aerobic exercise hydroalcoholic extract

Diabetic animals
After controlling and recording the weight, blood glucose of all animals was measured by intravenous administration of the mouse using a glucometer (Accu Check) and without fasting the serum glucose level was less than 200 mg / dl. Then, they were diabetic (50 mg / kg diabetic) after 24 hours of starvation with an intraperitoneal injection of Streptozotocin (STZ) (22).

For injection, streptozotocin was dissolved in a cold saline physiological solution of 1 ml / kg; Infusion was performed at 8:00 and in fasting condition. Three days (72 hours) after streptozotocin injection, blood glucose was monitored in diabetic groups. The criterion for diabetic rats was considered to be above 250 mg / dL. Therefore, rats with a blood glucose level above 250 mg / dl were excluded from the study (22-24).

Effective dust review method
Among the various doses of RPH hydroalcoholic extract (1, 5, 10, 50, 100 and 500 mg/kg) were administered to rats by gavage for 2 months, only 10 mg/kg dose of the extract significantly increased the STLr 24 h compared to saline group ($P < 0.05$) and a significant reduction in the TDC compared to the sham and saline groups (respectively, $P < 0.01$ and $P < 0.05$). Therefore, 10 mg/kg dose of RPH extract was selected as effective dose.

Aerobic exercises
Rat treadmill was used to perform an aerobic exercise. The aerobic exercise instruction for animals was initiated by the rats who took an introductory course. During this period, recurrent short-term training sessions were used for 4 consecutive days (each training session included a 5-minute course of 10 m / min and 1 time per day).

After the introduction period, 1 day rest was given to the animals and after removal of untrained animals of main training period began. In the first week, animals ran a treadmill with a gradient of 0 and a speed of 10 m/ min for 10 minutes. In the second week after 5 minutes running at speeds of 10 m/ min, the speed was reached to 20 m/ min with the same zero gradient and running for 10 minutes at this speed (25). After treatment or practice of the different groups of animals were tested using standard devices to check motor activity. After 8 weeks of induction of diabetic rats, treadmill was used to assess motor activity.

Vehicle motor device
Special rat treadmill was used to evaluate the activity and motor behavior of rats. This device consists of a single evaluation unit consisting of a floor and two four-frame, each equipped with 16x16 cells transmitter infrared rays and 16x16 cell receiver and one control unit connected to the computer and related special software (To configure the necessary parameters and settings) that automatically and digitally analyze and record the parameters of the motor.

How to register motor activity
In order to assess motor activity, in the first step, each rat was left inside the machine 24 hours before testing for 10 minutes in order to adapt to the environment. On the second day, after placing each animal in one of the four corners of the evaluation unit (face to face), pressing the start button, the device automatically detects the movements of the animal during the set time, and records motor parameters digitally.

All experiments were carried out at 8:00 and 14:00 under laboratory fluorescence light and after the end of each experiment, the floor and the units of the evaluator unit were treated with cotton impregnated with alcohol. And also at the beginning of each experiment, the floor of the device was mildly impregnated with a slick or dull solution (to avoid the potential stimulatory effect of the remaining urine odor and previous animal feces on motor activity). In this work, bitter almond oil was used (26, 27). In all experiments, the recording time of the motor activity was regulated 10 minutes and the level 6 (10 meters per second).

Behavioral measurement of motor activity (LMA)
An additional test is the form of a non-conditional model for the production and measurement of anxiety and the determination of the anxiety and anti-anxiety properties of drugs. The device consists of two open arms (50 × 50 × 1) and two closed armholes (5.39 × 5.49 cm) and center space (10 × 10 cm) and the height of floor is 60 cm. T

he best measure for measuring anxiety is presence in the open arm. After 30 minutes of drug injection and saline, the experimental groups were examined for 5 minutes in a high-grade maze system. Each animal was used only once in a test to avoid any learning. The number of open and closed arms has been recorded. After the test was completed for each rat, the machine was cleaned with cotton.

Extraction method
The pistachio was prepared for extraction of Iranian one (Owhadi cultivars) with 13 years old trees in Damghan from Semnan province in 2013. This plant was confirmed by Dr. Davoud Bakhshi, a faculty member of Agriculture of University of Guilan, and then, according to the following method, extraction of the crust was done from red pistachio skin was done in such a way that the red pink was isolated after the raw pistachio was prepared and washed by oven at 40 ° C. To prepare the extract from the soaking method was used.

In this method, first, 50 g of dried pistachio red skin was poured into a suitable container and 250 ml of ethanol (70% ethanol and distilled water 30%) were added. The contents of the container were filled with a filter paper and a glass container in a smooth human turned out. The filtered solution was transferred to the balloon and solvent was removed in a rotary device (set at 70 ° to medium range), the concentrated liquid was dried on a flat glass and dried in an oven at 40 ° C. After that, the extract dried powder was collected softly from the glass and the resulting powder was used to prepare the doses of hydroalcoholic extract of red pistachio skin in the present study (30 and 50 mg/ kg) (28). Meanwhile, the administration of the solution was made by gavage to solubility 10 ml/ kg extract was performed in saline solvent.

Method of data analysis
The results were compared using one-way ANOVA and then Tukey's complementary test. P <0.05 was considered as a significant level.

Results

Motor activity test results:
Description of measuring motor activity in rats receiving pistachio red acne hydroalcoholic extract.

Table 1. Statistical description of the mean of motor activity measurement in rats receiving hydroalcoholic extract (s)

Index		Sham	Salin	1 mg/kg	5 mg/kg	10 mg/kg	50mg/kg	100 mg/kg	500 mg/kg
Motor Activity	Mean± Std. dev.	40±8.78	40.87±7.8	53.37±9.75	53.37±15.13	53±10.77	53±12.29	3.75±7.14	46.28±17.81

The results showed that there was no significant difference in locomotion activity in groups (figure 1).

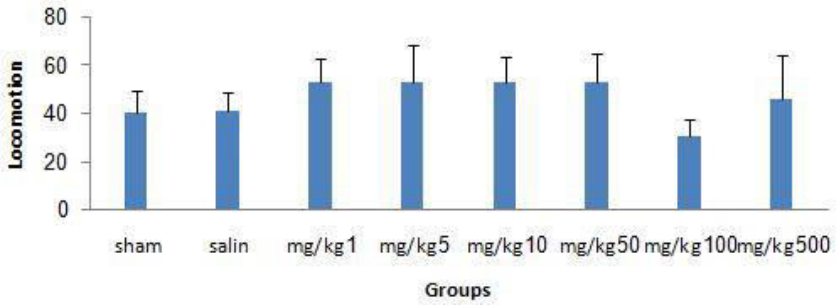

Figure 1. Comparison of Locomotion in eight groups, the information is based on mean and standard deviation.

Description of measurement of motor activity in non-diabetic rats

Table 2: Statistical description of the mean of motor activity in non-diabetic rats (s).

Index		Sham	Saline	Effective dose	Aerobic activity	Aerobic activity+ Effective dose
Motor activity	Mean±Std dev.	37.42±5.02	36±8.46	45.37±8.91	68±5.95	70±5.07

The results showed that there was a significant difference in the level of motor activity of groups (Fig. 2). There was a significant difference between the groups ($p < 0.01$). In-group comparison showed no significant difference between Sham group and saline group. On the other hand, there was a significant difference between the aerobic training group and the effective dose group, aerobic exercise with Sham group and saline receiving group ($p < 0.01$).

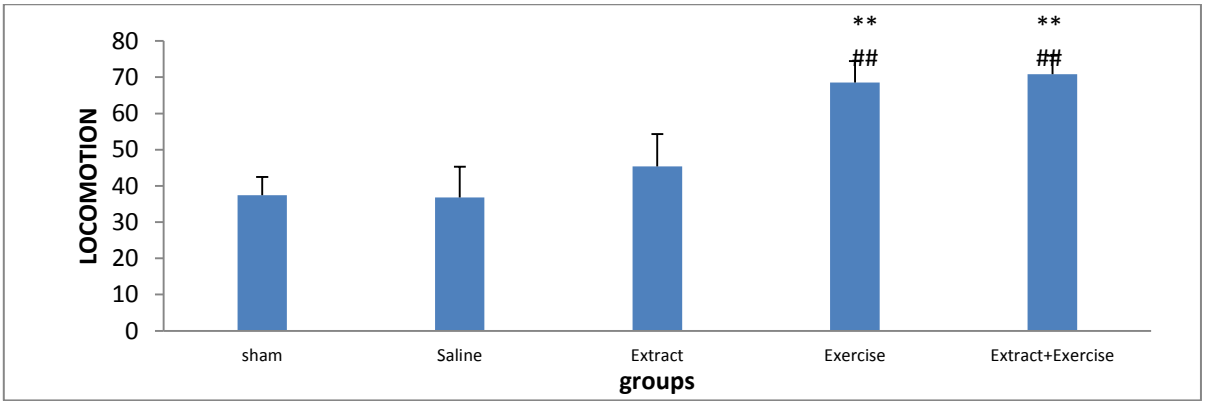

Figure 2. Comparison-Locomotion In five groups, information is presented based on mean and standard deviation.

A description of the measurement of motor activity in diabetic rats

Table 3: Statistical description of the mean of motor activity measurement in diabetic rats

Index		Control	Diabetic control	Diabetic Saline	E. D. dose	Diabetic aerobic activity	Diabetic (aerobic training+Effective dose)
Motor activity	Mean±Std dev.	37.42±5.02	36.85±8.46	32.28±3.53	40.62±8.78	70.87±5.07	76.42±5.99

The results showed that there was a significant difference in motor activity (Fig. 3). There was a significant difference between the groups ($p < 0.01$). Intra-group comparisons showed no significant difference between the STZ diabetic group and the sham diabetic group. On the other hand, there was a significant difference between the diabetic group of aerobic training and the diabetic group with an effective and diabetic dose of aerobic exercise with the Stz group and diabetic recipient saline ($p < 0.01$). On the other hand, there was a significant difference between the diabetic group of aerobic training and the diabetic group with an effective dose and diabetic aerobic exercise group with Sham group and diabetic recipient effective dose ($p < 0.05$).

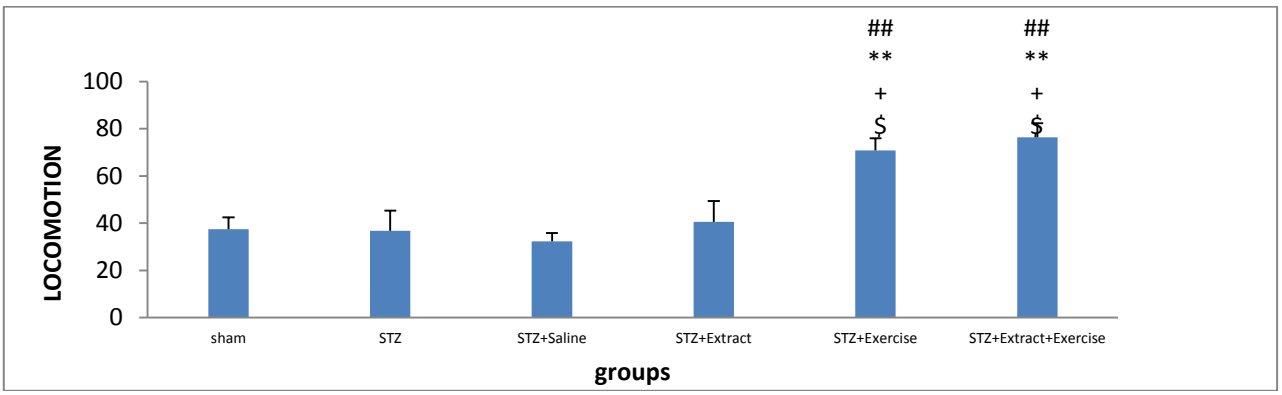

Figure 3. Comparison of Locomotion in groups of six, information is based on mean and standard deviation.

Description of the measurement of motor activity of all rats receiving hydroalcoholic extract

Table 4. Statistical description of the mean of motor activity measurement in rats receiving the hydroalcoholic extract.

Index		Sham	Saline	1 mg/kg	5 mg/kg	10 mg/kg	50 mg/kg	100 mg/kg	500 mg/kg
Motor activity	Mean±Std dev.	3.75±1.2	3.5±0.56	4±0.32	3.62±0.46	5.87±0.39	2.25±0.45	2.6±0.56	1.62±0.62

The results showed that there was a significant difference in the level of motor activity total activity (Fig. 4). There was a significant difference between the groups ($p < 0.001$). There was no significant difference between the sham group and the saline group. On the other hand, there was a significant difference between the extract group (10 mg/ kg) and the extract group (100 mg/kg) ($p < 0.01$) and also with the extract group 500 mg / kg ($p < 0.001$).

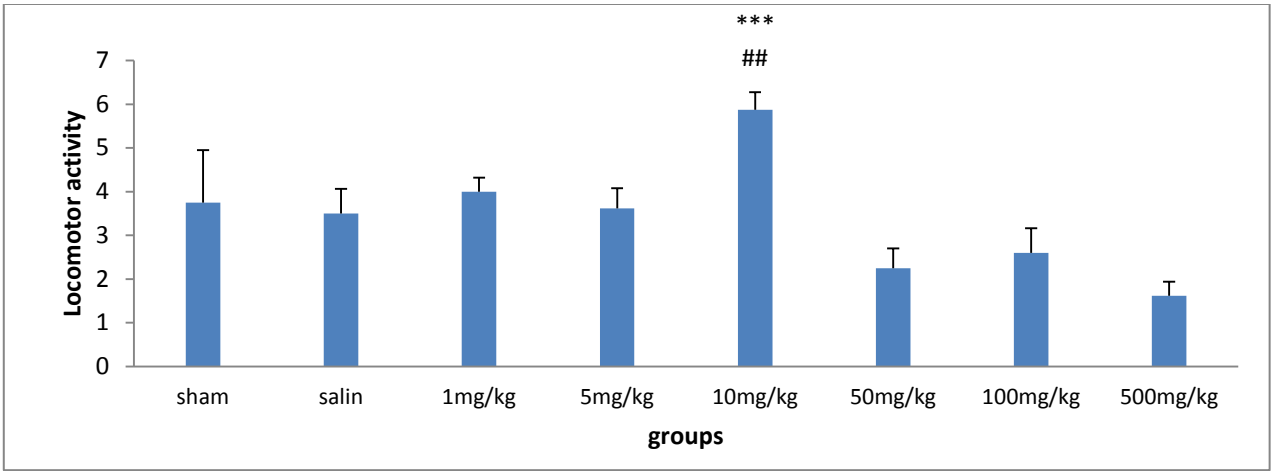

Figure 4. Comparison of motor activity total in eight groups, information is presented based on mean and standard deviation.

Description of measurement of motor activity in non-diabetic rats

Table 5. Descriptive statistics of the mean of motor activity evaluation of non-diabetic rats

Index		Sham	Saline	Effective dose	Aerobic activity	Diabetic (aerobic training+Effective dose
Motor activity	Mean±Std dev.	3.75±1.2	3.5±0.56	5.87±0.39	8.28±1.10	8.87±0.66

The results showed that there was a significant difference in the level of motor activity total activity (Fig. 5). There was a significant difference between the groups ($p < 0.001$).

Intra-group comparison showed no significant difference between sham group and diabetic group of saline.

On the other hand, there was a significant difference between the non diabetic group and the effective dose and aerobic training with the control group and saline ($p < 0.001$). Also, there was a significant difference in the non-diabetic group in the effective dose and aerobic exercise group with the aerobic training group ($p < 0.05$).

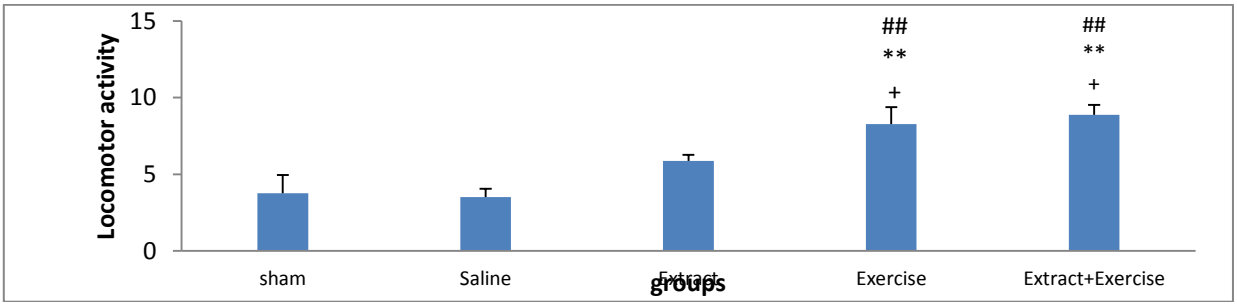

Figure 5. Comparison of Motor activity total in five groups, data are presented based on mean and standard deviation.

Description of the measurement of motor activity in diabetic rats

Table 6: Statistical description of motor activity measurement in diabetic rats

Index		Control	Diabetic control	Diabetic Saline	E. D. dose	Diabetic aerobic activity	Diabetic (aerobic training+Effective dose)
Motor activity	Mean±Std dev.	3.75±1.2	3.28±0.746	2.57±0.48	3.42±0.48	8.28±0.48	9.87±0.34

The study showed that there was a significant difference in the level of motor activity total activity (Fig. 6). There was a significant difference between the groups ($p < 0.01$). Intra-group comparisons showed no significant difference between the STZ diabetic group and the sham diabetic group.

On the other hand, there was a significant difference between the diabetic group of aerobic training and the diabetic group with an effective dose and diabetic aerobic exercise group with Stz group and diabetic recipient of saline and sham ($p < 0.001$).

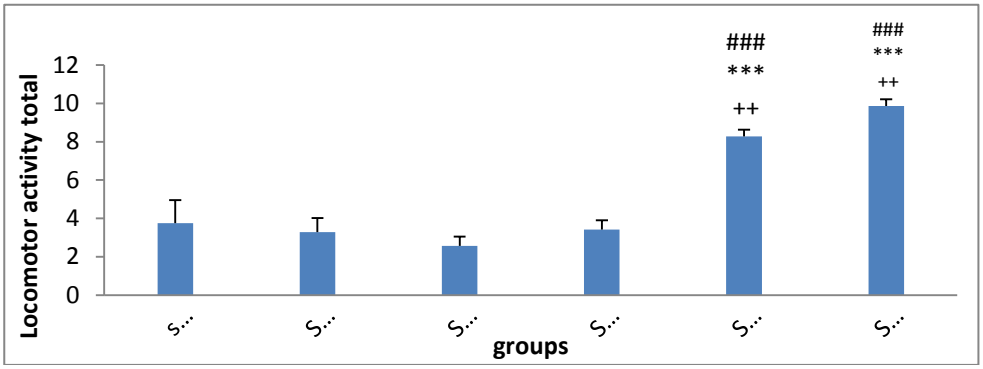

Figure 6. Comparison of motor activity total in six groups, information is presented based on mean and standard deviation.

Discussion

In the present study, the effect of hydroalcoholic extract of red pistachio skin and aerobic exercise on motor activity of non-diabetic and diabetic male rats with streptozotocin was studied. Regarding the fact that pistachios have a variety of effects in traditional medicine, and finally, the chemical drugs used in anxiety disorders have side effects. In this study, oral administration of hydroalcoholic extracts of pistachio red skin and aerobic training in diabetic rats significantly increased the motor activity for eight weeks. In fact, increasing the number of movements and standing in all the arms, increasing the angle of inclination from the slope, shows the effect of hydroalcoholic extract of pistachio red skin and aerobic exercise in preventing motor performance impairment, ability and increased muscle strength in diabetic groups With streptozotocin (18). The red skin extract of pistachios contains polyphenol compounds and has high antioxidant properties and thus has its beneficial effects (19). Laboratory analyzes and pharmacological measurements have shown that red pistachio skin contains tropenoid oil, flavonoids, salts, polysaccharides, tannins and fatty acids (20). Previous studies have shown that the compounds in the hydroalcoholic extract of pistachio red skin have anti-anxiolytic and palliative effects, while in the model of anxiety measurement, there is a decrease in motor activity that is contradictory to this research (21). The results show that injection of scopolamine may cause syncope-induced motor disturbances in the brain by inducing motor-coordination impairment in rats, and the hydroalcoholic extract of red pistachio skin with its strong antioxidant properties reduces oxidative stress and may therefore Improves motor coordination (22). Pineapple red peppermint contains polyphenolic compounds and has high antioxidant power and thus has beneficial effects (23). Laboratory analyzes and pharmacological measurements have shown that pistachio red peel contains peppermint oil, flavonoids, salts, Polysaccharides, tannins and fatty acids (24). Sports activity is thought to reduce and improve the level of plasma lipids and blood glucose, reduce oxidative stress and increase insulin sensitivity, and can improve the complications of diabetes (25). Positive changes in blood glucose are mainly due to cumulative effects of several times the reduction of blood glucose levels per exercise (26). The findings of this study showed that the physical activity of rats significantly improves, so that mice with four weeks of regular aerobic activity, on the distance indicators and the time needed to find the hidden platform in the recall phase and the duration of the queue in the exploration test performed better than mice that did not function. This indicates improved cognitive function of rats after a period of aerobic activity. Several studies have reported the desired effects of physical activity on memory (27, 28, 29). For example, Ahmadi et al. (2012) examined the effect of aerobic activity on spatial learning and motor activity of elderly rats, concluding that 8 weeks of aerobic activity improved spatial learning

and motor function of elderly rats (30). Also, based on the results of a study by Nickel et al. (2007), running three weeks improved the cognitive function of elderly mice (28). Asl et al. (2007) examined the effect of regular long-term physical activity on learning and spatial memory in young, middle-aged and elderly rats (31). In their research, spatial memory of the mice was studied through Morris water maze. The results showed that regular physical activity increased spatial learning and memory of young mice, but had no effect on middle and middle-aged rats. In another study, Albace et al. (2006) examined the effects of moderate forced exercise on treadmill on spatial memory learning in older rats, which concluded that elderly rats had 7 weeks of physical activity, They discovered the hidden platform faster than the control group in the Morris Water Maze test and swam down a shorter path to find the hidden platform (27).

However, research findings such as Faben et al. (2008) and Millau et al. (2008) contradict the present research (33, 32). It seems that factors such as the number of subjects, the age of the subject, the time and speed of running these contradictory results. For example, in a study by Millau et al. (2008), the samples included eight mice, while in the present study, each group contained 15 mice. They mentioned that perhaps the reason why the effect of physical activity on memory was not observed was that the mice were old and because of the stress threshold in the elderly, this increased the fear of the tested environment.

In addition, in the study of Millau et al. (2008), running time (45 minutes) and the duration of the training protocol (4 weeks) also differed from the present study. The hypotheses that have been suggested to explain the positive relationship between physical activity and cognitive function are: cardiovascular fitness hypothesis; cerebral circulation hypothesis; neurotrophic stimulation hypothesis; neurogenesis and synaptogenesis hypothesis; and neural efficacy hypothesis. Among these hypotheses, the cardiovascular fitness hypothesis has attracted the most attention. This hypothesis suggests that cardiovascular fitness is a physiological mediator that explains the relationship between physical activity and cognitive function improvement (34).

Meta-analysis Anguaran et al. (2008) has shown a positive correlation between cardiovascular (aerobic) and cognitive function (35). It has been observed that in animals, angiogenesis of the hippocampus, neurogenesis of the hippocampus, and synaptic ductility increase in response to cardiovascular activity. Also, higher levels of cardiovascular fitness are associated with increased hippocampal volume and also better memory function (36).

Conclusion

In general, the results of this study showed that exercise can significantly improve diabetic disorders in motor performance of rats. The study notes that exercise and red peppermint extract have protective effects against motor disorders caused by the effects of diabetes. Exercise as well as hydroalcoholic extracts of pistachio red skin have increased the antioxidant activity, especially in the pistachio red peppermint extract, which has very strong antioxidant properties and has flavonoids. As a result, aerobic exercise, as well as the combined consumption of hydroalcoholic extract of pistachio red skin and aerobic exercise, provide a modern therapeutic approach and can be considered as an effective and uncomplicated way to reduce complications from diabetes.

References

King, H., Aubert, R.E., & Herman, W.H. (1998). Global Burden of Diabetes. Prevalence, Numerical Estimates and Projections, *Diabetes Care*, *21*, 1414–1431.

Behnam, M., Piety, F., & Mousavi, M.A. (2015). The Role of Lifestyle in Diabetes Mellitus. *Journal of Science*, *5*(1), 15-24.

Artola, A., Kamal, A., Ramakers, G.M., et al. (2005). Diabetes mellitus concomitantly facilitates the induction of long-term depression and inhibits that of long-term potentiation in hippocampus. *Eur J Neurosci*, *22*, 169-178.

Kucukatay, V., Ağar, A., Gumuslu, S., & Yargiçoğlu, P. (2007). Effect of sulfur dioxide on active and passive avoidance in experimental diabetes mellitus: relation to oxidant stress and antioxidant enzymes. *Int J Neurosci*, *117*, 1091-1107.

Biessels, G.J., & Gispen, W.H. (2005). The impact of diabetes on cognition: what can be learned from rodent models? *Neurobiol Aging*, *26*(S1), 36-41.

Maleknia, S., et al. (2008). *Biochemistry Harper For College Students.* Tehran: University Press

Young, I.S., Torney, J.J., & Trimble, E.R. (1991). The effect of ascorbate supplementation on oxidative stress in thestreptozotocin diabetic rat. *Free Radical Biology and Medicine*, *8*, 752–758.

Fentem, P.H. (1994). Benefits Of Exercise In Health And Disease, *BMJ*, *308*.

Helmrich, S., Ragland, D.R., & Leung, R.W. (1991). Physical Activity and Reduced Occurrence of Non-Insulin-Dependent Diabetes Mellitus. *N Engl J Med*., *325*, 147–152.

Tanasescu, M., Leitzmann, M.F., & Rimm, E.B. (2003). Physical activity in relation to cardiovascular disease and total mortality among men with type 2 diabetes. *Circulation*, *107*, 2435–2439.

Firouzjaei, M., Jafari, M., et al. (2013). Aminoguanidine changes hippocampal expression of apoptosis related genes, imprives Passive avoidance learning and memory in Streptozotocin-induced diabetic rats. *Cell Mol Neurobiol*., *13*, 5-18.

Hasanein, P., & Shahidi, S. (2012). Preventive effect of Teucrium Polium on learning and memory deficits in diabetic rats. *Med Sci Monit*., *18*(1), 41-46.

Jabbarpour, Z., Shahidi, S., et al. (2014). Effect of tempol on the passive avoidance and novel object recognition task in diabetic rats. *Brain Res*., *101*, 51-56.

Verma, S., & Bordia, A. (1998). Antioxidant property of Saffron in man. *Indian journal of medical sciences*, *52*(5), 205-207.

Mohammed, M., & Lebron, M. (2012). Sex difference. Gondal hormones and the fear extinction network: implication for anxiety disorders. *Biology of mood and anxiety disorders*, *2*(3), 2-12.

Lister, R.Q. (2008). The use of a plus-maze to measure anxiety in the mouse. *J Psycharmacology*, *92*, 180-105.

Mesripour, A.M, Kalamian, M.H (2013). Effect of Burberry Hydrochloride on Motor Performance Impairment in Streptozotocin-Induced Diabetic Rats. *Journal of Knowledge and Wellness, 8*(4), 35-45.

Vale-Martínez, A., Guillazo-Blanch, G., et al. (2002). Morgado-Bernal I. Electrolytic and ibotenic acid lesions of the nucleus basalis magnocellularis interrupt long term retention, but not acquisition of two-way active avoidance, in rats. *Exp Brain Res*., *42*(1), 52-66.

Gomaa, A., Hashem, T., Mohamed, M., & Ashry, E. (2003). Matricaria chamomilla extract inhibits both development of morphine dependence and expression of abstinence syndrome in rats. *J Pharmacol Sci*., *92*(1), 50-55.

Zanoli, P., Avallone, R., & Baraldi, M. (2000). Behavioral characterization of the flavonoids apigenin and chrysin. *Fitoterapia*, *71*(S1), 117-123.

Rabiei, Z., Ali Babaei, Z., & Rafiyan, M. (2011). Effect of Chamomile Ethanol Extract on Coordination-Motor Disorders in Rats and Determination of Antioxidant Properties of Chamomile Plant. *Journal of Babol University of Medical Sciences*, *4*, 50-44.

Tsai, C.Y., Chan, J.Y., et al. (2012). Brain-derived neurotrophic factorameliorates brain stem cardiovascular dysregulation during experimental temporal lobestatus epilepticus. *PLoS One*, *7*(3), 33527.

Gomaa, A., Hashem, T., Mohamed, M., & Ashry, E. (2003). Matricariachamomilla extract inhibits both development of morphine dependence and expression of abstinence syndrome in rats. *J Pharmacol Sci*., *92*(1), 50-55.

Teixeira-Lemos, E., Nunes, S., Teixeira, F., & Reis, F. (2011). Regular physical exercise training assists in preventing type 2 diabetes development: focus on its antioxidant and anti-inflammatory properties. *Cardiovasc Diabetol*, *10*, 12.

Jackson, A.S., & Pollock, M.L. Generalized equations for predicting body density of men. *Br J Nutr*., *40*(3), 497-504.

Albeck, D.S., Sano, K., Prewitt, G.E., Dalton, L. (2006). Mild forced treadmill exercise enhances spatial learning in the aged rat. *Behave Brain Res*, *168*, 345-348.

Nichol, K.E., Parachikova, A.I., & Cotman, C.W. (2007). Three weeks of running wheel exposure improves cognitive performance in the aged Tg2576 mouse. *Behave Brain Res*, *184*, 124-132.

Uysal, N., Tugyan, K., Kayatekin, B.M., et al. (2005). The effects of regular aerobic exercise in adolescent period on hippocamal neuron density, apoptosis and spatial memory. *Neurosci Lett*, *383*, 241-245.

Ahmadi, N., Aslankhani, M.A., & Naghdi, N. (2012). Aerobic activity improves spatial learning and motor activity in aged rats. *Physiol Pharmacol*, *15*, 527-537.

Asl, N.A., Sheikhzade, F., Torchi, M., Roshangar, L., & Khamnei, S. Long-term regular exercise promotes memory and learning in older rats. *Pathophysiology*, *15*, 9-12.

Mello, P.B., Benetti, F., Cammarota, M., & Izquierdo, I. (2008). Effects of acute and chronic physical exercise and stress on different types of memory in rats. *An Acad Bras Cienc*, *80*, 301-309.

Fabene, P., Mariotti, R., Mora, G.N., Chakir, A., & Zancanaro, C. (2008). Forced mild physical training-induced effects on cognitive and motory behavior in old mice. *J Nutr Health Aging*, *12*, 388-390.

North, T.C., McCullagh, P., Tran, Z.V., Effect of exercise on depression. *Exerc Sport Sci Rev*, *18*, 379-415.

Angevaren, M., Aufdemkampe, G., Verhaar, H., Aleman, A., & Vanhees, L. (2008). Physical activity and enhanced fitness to improve cognitive function in older people without known cognitive impairment. *Cochrane Database Syst Rev*, *16*, 3.

Aberg, M., Pedersen, N.L., Toren, K., et al. (2009). Cardiovascular fitness is associated with cognition in young adulthood. *Proc Natl Acad Sci USA*, *106*, 20906-20911.

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Correspondence to:
Hasan Mohammadzadeh
Department of Motor Behavior, Urmia University, Iran
E-mail: h.mohammadzadeh@gmail.com