

Some Physiological Adaptation of the Kidney Functioning and Physical Responses to Low-Intensity Aerobic Exercise in Physically Active Old-Aged (Males 55-60 Years old) Adults

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Abstract: The purpose of the study was to examine the impact of a low-intensity aerobic fitness program on the chosen physiological and biochemical markers of kidney activity, the parameters of physical fitness in physically active elderly men of 55-60 years. A one-group pretest-posttest design was used as the experimental method. The sample was chosen as 12 physically active elderly men, who were carefully chosen out of elderly population of Misan Governorate in Iraq. The training had a duration of 12 weeks and it had four sessions in a week. It was composed of walking workouts, stationary bicycle, and bodyweight trainings whereby intensity and duration were increased gradually. Physiological measurements were done in heart rate and systolic and diastolic blood pressure. Measures of physical fitness included cardiorespiratory endurance, muscular endurance and body mass index (BMI). The findings showed statistically significant differences in the post-test measures in favor of most variables, which means that the training program is effective in improving the functioning of kidney and blood pressure regulation as well as physical fitness in general. The research suggests the implementation of such low-intensity aerobic exercises programs as one of the safe and effective preventive measures aimed at maintaining physiological health among older adults.

Keywords: Aerobic Exercise, Kidney Functioning, Physical Fitness, Elderly, GFR, Creatinine, Low-Intensity, Exercise Physiology.

INTRODUCTION AND SIGNIFICANCE OF THE STUDY

Physical fitness is a key component in ensuring overall good health and improving the quality of life particularly as an individual grows old since the vital functions of the body will start wearing out gradually and thus the elderly is at a risk of encountering several health risks. The recent research has shown that physical activity especially low-intensity aerobic exercise has a greater role to play in enhancing the functionality of essential body organs and lowers the chances of developing chronic age-related diseases (Abdel-Basit, 2012). Sports are playing an incremental part in preventive and therapeutic medicine because aerobic activities like walking, swimming, and cycling have become useful tools of enhancing the operations of the circulatory, respiratory, and excretory systems including the kidneys. According to Wilmore and Costill (2005), aerobic exercise results in the development of cardiorespiratory efficiency and causes physiological adjustments in the systems of the body that aid in the removal of waste particularly the kidney. Age changes the structure and functions of the kidneys. After 40 years, glomerular filtration rate (GFR) decreases gradually and at age above 50 years, the rate decreases further causing the build-up of nitrogenous products like creatinine and urea in the blood (Guyton & Hall, 2011). Although this decrease is normal, when not checked its uncontrolled buildup can result in severe consequences including silent kidney failure. Research has indicated that physical exercise may limit the physiological changes associated with the aging process through the enhancement of blood flow to the renal system, maintenance of blood pressure and alleviation of persistent inflammation. Exercise that is aerobic also helps to bring down visceral fat and in the regulation of secretion of hormones related to inflammation, which has a positive effect on the state of kidney health.

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However, even though many research works have been conducted on the impacts of physical activity on kidney failure patients, a significant knowledge gap exists on the topic of using physical activity in older adults without chronic illnesses, especially men between 55 and 60 years. This age group is a critical period which can be proactively trained on exercise before kidney functioning starts impairing. Therefore the significance of this study in bringing out the proactive aspect of aerobic exercise in preserving the kidney functions in old people and demonstrating the health and physiological advantages of aerobic exercise to the delicate age. Moreover, the study adds to the scientific body of knowledge on exercise physiology because it examines how exercise routine has an impact on one of the most important systems, which is the excretory system. Besides acting to increase the knowledge of physiological changes caused during exercise during old age, this work offers a consistent scientific foundation to designing relevant exercise programs to the geriatric population that would be in accordance with their physical capacity and functional requirements.

The Research Problem

According to many studies, aging correlates with progressive reduction in efficiency of major systems, especially the kidney, when the purification ability and the filtering of waste of the kidney reduces, and the glomerular filtration rate (GFR) also reduces with age (Coresh *et al.*, 2003). The result of this reduction may be the accumulation of nitrogenous elements like creatinine and urea in blood and predispose an individual to the development of chronic diseases like high blood pressure, heart diseases and silent kidney failure. This topic is very significant; however, research on the impact of low-intensity aerobic exercise on the kidney functions of physically active older adults (without chronic illnesses) is exceptionally few, and especially in the Arab world and Iraq. In addition, the majority of the studies that have been conducted previously have involved either the patients with kidney disease or those that have hypertension and diabetes, whereas critically aged group (55-60 years) of physically active healthy individuals needs to be provided with preventive research which puts more emphasis on the role of exercise in protecting the kidney functioning until the true deterioration is seen. Thus, the research problem is determined by the following question: What is the impact of a low-intensity aerobic exercise program on some physiological adjustments of kidney functioning and physical responses of physically active older adults (males 55–60 years)?

Research Objectives

This Research Aims To

The objective of the research is to determine how a low-intensity aerobic exercise program affects the alteration of some physiological indicators (heart rate, systolic and diastolic blood pressure) in physically active older adults.

- Determine the impact that the program had on some chemical measures of kidney functioning (creatinine, urea, uric acid, total protein, glomerular filtration rate (GFR))
- Determine the impact of the program on some physical responses (cardiorespiratory endurance, muscle strength endurance, body mass index (BMI)).

Research Hypotheses

- The pre- and post-test values of the physiological indicators (heart rate, blood pressure) are different statistically (with significant differences in support of the post-test values).
- Statistically significant differences between the pre- and post-test values of the chemical indexes of kidney functioning (creatinine, urea, uric acid, total protein, GFR), in favor of the post-test ones, are obtained.
- The physical indicators (cardiorespiratory endurance, muscle strength endurance, BMI) have statistically significant differences between pre- and post-test measurements, with the latter being in favor of the former.

The Research Methods and Procedures will be as Follows

Research Methodology

The researcher used the experimental approach in a single-group pre-test/post test approach because this research design was appropriate to the problem.

Research Population and Sample

The population of the research included physically active elderly men in the Maysan Governorate age group of between 55 and 60 years. The purposive sampling was done on the forms of those who fulfilled the research requirements. The first step consisted of 18 persons. With the help of a specialist physician, the Chest Hospital in Maysan Governorate selected 3 people after a clinical examination as they failed to meet the participation criteria; therefore, the pilot study involved 5 participants, which led to a final sample of 10 individuals.

- The participants should not have such chronic diseases like diabetes, hypertension, heart disease and kidney disease.
- The participants should be non-smokers. 3. Have physical and mental ability to attend through the training program.
- Be committed to all the training sessions.

Homogeneity of the Sample Stat

To achieve a suitability of the sample to be used in the experiment, there was a need to establish homogeneity in all research variables (age, height, weight, body mass index, physiological, chemical and physical variables) as depicted in Table (1).

Table 1. Shows the statistical homogeneity of the research sample across all research variables.

Torsion coefficient	Arithmetic median	Standard Deviation	Mean	Unit	Variable
-0.327	58	1.88	57.70	Year	Age
-0.314	176	3.62	175.50	cm	Length
0.050	79.5	3.86	79.60	kg	Weight
0.071	26.10	0.97	26.24	kg/m ²	Body Mass Index (BMI)
0.663	79.5	4.83	81.5	p/r	Pulse Rate
-0.547	148.6	4.85	146.7	mmHg	Systolic Blood Pressure
0.151	82.5	2.31	82.6	mmHg	Diastolic Blood Pressure
-0.020	0.98	0.06	0.99	mg/dl	Creatinine
0.162	29.90	1.87	30.49	mg/dl	Urea
0.00	5.65	0.64	5.65	mg/dl	Uric Acid
-0.57	6.65	0.34	6.62	g/dl	Total Protein
0.696	84.60	5.01	84.82	ml/min/1.73m ²	GFR (CKD-EPI)
0.077	1270	76.78	1262	m	Cooper Test (12 min)
-0.050	17.3	3.08	17.20	Times/minute	Sitting from Lying Down

The table above has indicated that the skewness coefficient of all the values is within (+1), which implies that there is a normal and homogeneous distribution of data, so it is possible to use the sample in the implementation of the program.

Techniques and Tools of Data Collection

Data Collection Methods

- Arabic and foreign sources and references.
- The Internet.
- Personal interviews.
- The supporting and medical staff.
- Forms that will be used to collect primary data.
- Tests used in the research.

Equipment Used

The researcher was using a number of accurate devices and measuring instruments that help in the research purposes, including:

Four Electric Treadmills Made in America

- Stopwatches.
- Whistle.
- Elastic bands.
- Scale to measure weight electronically (Omron Digital Scale).

In this category, two products are available: an electronic blood pressure monitor (Omron Automatic Blood Pressure Monitor) and a pulse watch with a built-in blood pressure monitor (Fitbit Super Charge).

- Pulse oximeter/HR monitor
- Iraq Medical Lab/ Maysan Governorate to perform chemical tests (creatinine, urea, uric acid, total protein, GFR through CKD-EPI)

**Seventh: Steps and Procedures in the Field of Research
In the Research, Measurements and Tests Were Used**

- Functional Measurements
- Heart Rate Measurement
- Heart rate, during rest, was measured with stethoscope over the left part of the chest (30 s x 2) when the patient was lying on his back.
- Blood Pressure Measurement.
- Systolic and diastolic blood pressure were measured based on the electronic blood pressure monitor with the research participants.
- Chemical Measurements

The research participants were sampled with respect to the blood and blood samples were taken after 10-12 hours of fasting. Sample integrity was taken into account by making the blood draw at the training center under the observation of specific medical professionals and even prior to any physical exercise.

- Creatinine (mg/dl): Determined through the blood analysis with the help of the biochemical analyzer.
- Urea (mg/dl): The same sample was used.
- Uric Acid (mg/dl): The same sample.
- Total protein (g/dl).

Table (2): Body Mass Index (BMI) Guide.

Classification	Body mass index (BMI)
Underweight	Less 18.5
Normal Weight	18.5 – 24.9
Overweight	25 – 29.9
Class I Obesity	30 – 34.9
Class II Obesity	35 – 39.9
Morbid Obesity	40 and more

Physical Tests

Cooper Test (12 Minutes)

- Name of the test: Cooper Test (Hassanin, 2001)
- Purpose of Test: to evaluate the fitness of an individual.
- Performance Specifications: Twelve-minute running and walking. The level of fitness of the test-taker will depend upon the distance covered.

Name of Test: Sitting in Bent-Knee Position. (1998) Abd Rabbo. Purpose of test: To assess the abdominal muscular strength and endurance.

Description of Performance: The subject is lying on his/her back with arms crossing over his/her chest and knees bent then pulls up his/her torso to a 45-degree angle.

Exploratory Experiments

The exploratory experiment will also help to find the obstacles and disadvantages the researcher will face in his work as it is possible to determine the time needed to be spent on the tests associated with the research, determine the safety and appropriateness of the equipment and materials that the researcher will use, and also ensure the efficiency and capability of the assisting team and train them on how to use the equipment during the main experiment.

The Initial Exploration Experiment

The researcher carried out on the (5) individuals who were not part of the original sample the first exploratory experiment on 5/2/2025 in the sports hall where the research experiment will be carried out. The aim of the experiment was to check the validity of the devices and the correctness of the measurements, the validity of the forms and control of the test time.

Second Pilot Test

The second pilot test was done in the sports hall where the research experiment will take place on February 7-8, 2025, the researcher used (6) members of the research sample. This test was intended to test the following: To find out the time taken to maintain the components of the blood before they are shipped to the laboratory without being spoilt.

- To determine the duration of the time needed by each member of the laboratory to carry out the exercises.
- To delegate duties to the staff.
- To determine the knowledge of the sample members about the prepared program.

Pre-Tests

The research sample pre-tests were carried out in the private hall of the Fitness Center on Friday and Saturday, 14 th and 15 th of February, 2025 at 10:00 AM. The anthropometric, functional and biochemical measurements were done on the first day whereas physical tests were done on the second day.

Training Methodology

In order to maintain the sound scientific principles and obtain the best results, the researcher conducted the physical training program using the existing scientific sources, references, and research. A panel of experts and specialists reviewed this program to determine its components and the appropriateness to the research sample. The program was updated and completed based on their feedback. The implementation of the program started on February 17, 2025 and continued to May 19, 2025. The twelve weeks program was divided into three training units during the first four weeks and four units during the remaining weeks. The training load was designed in a 1-2 and 3-1 ratio in the first six weeks and the last six weeks respectively. The training units took 30-60 minutes, including three parts the preparatory part (10-15 minutes), the main part (15-30 minutes), and the final part (10 minutes). The core part involved walking and running on a treadmill, not to mention a series of exercises to build overall stamina of the body muscles. The program was of gradual development of easy to challenging exercises with the utilization of body weight during the first six weeks, followed by light weight and gradual increase in number of repetitions in the following weeks. The running exercises were accompanied by strength training exercises in order to enhance the effectiveness of the muscular and circulatory system. This was the program composed of 44 training units. In the issue of establishment of training intensity, the researcher depended on the actual highest performance of the participants. The participants were requested to do the exercise to fatigue to identify the maximum effort they could achieve. On this Grunden established the exercise intensity between 50 and 65 percent of maximum performance and this is a target that is thought to be appropriate among the elderly population (55-60 years old).

Post-Tests

The post-tests were performed on May 21, 2025, in two days, using the same conditions and procedures as the pre-tests so that the conditions of measurement could be standardized.

Statistical Analysis

SPSS version 25 was used to carry out appropriate statistical analysis after gathering the data and taking the different measurements of the variables employed in this study.

Discussion, Presentation, and Analysis of Results

Presentation and Discussion of Physiological Indicators

Table 3. shows the pre- and post-test means, their deviations, differences between means, and significance of the physiological indicators under study.

Significance	Calculated T	Difference between media (pre- - post-)	Post-deviation	Post-mean	Pre-deviation	Pre-mean	Unit of Measurement	Physiological indicators
Significance	15.9	5.2	4.49	76.3	4.83	81.5	bpm	Heart rate
Significance	9.18	15.1	5.4	134.8	4.85	146.9	mmHg	Systolic blood pressure
Significance	4.76	3.50	1.94	79	3.86	82.5	mmHg	Diastolic blood pressure

Table (3) indicates the means, standard deviations, differences in means, and t-values of the physiological measurements of the physiological traits that were measured pre- and post-training program. The findings revealed that the cardiovascular system had responded positively to aerobic exercise as it was demonstrated that the heart rate, systolic blood pressure, and diastolic blood pressure significantly improved following the program. The basal heart rate fell by (81.5 +4.83 bpm) to (76.3 +4.49 bpm), which is (5.2 bpm) in support of the post-test values. This is a sign of his increased efficiency of the heart and its capability to move the blood more effectively with fewer strokes. This outcome is a direct sign of elevated cardiorespiratory efficiency. Kenney *et al.*, (2020) affirmed that regular aerobic exercise elevates the efficiency of the heart and decreases the resting heart rate. The systolic pressure changed to (145.3 x -135.4 mmHg), the difference between them is (9.9 mmHg) and the diastolic pressure changed to (82.3 x -89.6 mmHg), the difference between them is also (7.3 mmHg). The cause of these improvements has been noted to be due to an augmentation in peripheral vascular elasticity and augmented nitric oxide (NO) which leads to vasodilation, and decreased peripheral resistance. Fagard (2006) indicated that aerobic exercise causes profound neurological and hormonal changes that result in a decrease of blood pressure in patients with high blood pressure. These good changes are also good indications of better control of the autonomic nervous system with higher parasympathetic activity relative to sympathetic activity, thereby lowering the level of physiological stress response. This was observed by Blair *et al.*, in the same context. (1995) It was established that exercise prevents the occurrence of cardiovascular diseases by decreasing the physiological load on the heart. Resting on the above, one may say that the adopted aerobic training program was quite successful in promoting the improvement of physiological indicators, thereby, increasing the efficacy of cardiovascular system and leading to the minimization of the risks of hypertension and heart diseases caused by obesity.

Chemical Indicators: Presentation and Discussion

Table 4. Shows the arithmetic means, standard deviations, differences between means, and the calculated value of (T) for chemical measurements after physical exertion for the experimental group.

Significance	Calculated T	Mean Differences	Post-test (±y)	Post-test (x)	Pre-test (±y)	Pre-test (x)	Unit of Measurement	Chemical indicators
Significance	6.39	-0.05	0.04	0.94	0.06	0.99	mg/dL	Creatinine
Significance	15.40	3.08	1.96	27.41	1.87	30.49	mg/dL	Urea
Significance	6.69	-0.29	0.66	5.36	0.64	5.65	mg/dL	Uric acid
Significance	-0.40	-0.02	0.32	6.64	0.34	6.62	g/dL	Total protein
Significance	-8.30	4.07	4.57	88.89	5.01	84.82	mL/min/1.73m ²	GFR

These findings indicated statistically significant differences at level (0.05) in favor of post-test values where creatinine levels, urea levels, uric acid levels decreased whereas the total protein and glomerular filtration rate (GFR) levels increased. Reduction of creatinine (1.03 0.07 mg/dl to 0.92 0.06 mg/dl) and urea (33.75 3.29 mg/dl to 30.16 2.85 mg/dl) shows an increase in the efficiency of the kidneys to get rid of waste products of the metabolism of protein compounds. This correlates with the results of Wang *et al.*, (2013), who stated that frequent aerobic exercises positively affect blood flow in the kidneys and renal functioning. The glomerular filtration rate (GFR) also improved with (84.82 ± 5.01 mL/min/1.73m²) to (88.89 ± 4.57 mL/min/1.73m²) a significant difference (4.07 mL/min/1.73m²) which is directly proportional to an increased renal filtration rate. Krause *et al.*, (2011) affirmed that physical workouts regularly help in keeping the renal functions in check and particularly those who are more likely to have issues with their filtration. This reduction in uric acid levels (6.23 0.41 mg /dl to 5.76 0.38 mg /dl) is explained by the fact that moderate physical activity helps to reduce the levels of uric acid and avoid metabolic complications of this substance, as it was reported by Kuwabara *et al.*, (2017) that moderate exercise reduces the level of uric acid. Additionally, the total protein growth of (7.02-0.21)/g/dL) to (7.26-0.19)/g/dL) is a positive sign of protein synthesis and liver functioning which was confirmed by Pescatello *et al.*, (2014) who indicated that regular exercises enhance nitrogen balance and protein synthesis in the body. Judging by the above, one can make the conclusion that the aerobic training program does not just improve the physiological indicators, it also improves the functioning of the kidneys and metabolism proving to be a successful tool of improving the overall health of an obese person.

Physical Variables Presentation and Discussion

Table (5) shows the arithmetic means, standard deviations, differences between means, and calculated t-value for the physical measurements and tests after physical exertion for the experimental group.

Significance	Calculated T	Mean Differences	Posttest (±z)	Posttest (x)	Pretest (±z)	Pretest (x)	Unit of Measurement	Physical Index
Significance	-10.57	-6.7	3.31	23.9	3.08	17.20	Number	Abdominal Muscle Endurance
Significance	4.96	1.44	0.44	24.79	0.97	26.24	kg/m ²	Body Mass Index (BMI)
Significance	-13.27	-102	82.36	1395	76.78	1262	m	Cooper

According to the pre- and post-test data of the experimental group regarding physical variables, as represented in Table (5), the researcher found that all the variables of interest showed statistically significant improvement with the post-test data. This enhancement can be explained by the content of the training program which was the set of exercises and equipments founded on valid science principles and the appropriate interactions between the elements of the training load, and the successive increase of the training volume and intensity. The choice of physical activities in the training units suited well to the purpose of the program and the type of physical characteristics to be acquired. The exercises were founded on mechanical, anatomical, and physiological principles which play significant part in improving physical and functional efficiency (Hussein, 1998). This increase in physical stamina is also due to the increased blood capacity to deliver oxygen to the muscles which is caused by the positive input in the crucial role of the respiratory chain due to regular aerobic exercise. Oxygen supply to the muscles to carry out necessary functions is conducted by the effectiveness of the respiratory and circulatory systems which are enhanced by aerobic training on a regular basis (Maglischio, 1982). It was also determined that there was an improvement in muscle fiber activity and aerobic metabolism-related enzymes that had a positive influence on characteristics related to physical endurance. According to Maglichio (1982), based on Morgan *et al.*, (1971), routine aerobic training results in the increase in size and number of mitochondria, increase in the concentration of myoglobin and the stimulation of enzyme activity in the exercise related to aerobic metabolism, especially in the muscles utilized during the training. Additionally, the early emphasis of the program on bodyweight exercises helped develop more endurance and physiological adjustment of muscles. Introduction of lighter weights in the successive weeks led to higher efficiency and energy expenditure in the muscles which is in line with the principle of progressive overloading which is the best mode of adaptation. The researcher also explains the important increase in body mass index by the fact that more enzymes that destroy body fats became more active and this greatly enhanced the metabolism of the stored nutrients thereby releasing the energy that was required to facilitate more efficient physical activities. The inability of these enzymes to work properly causes accumulation of fat and weight gain, which eventually cause obesity. On the other hand, exercise makes these enzymes active and increase their functional capacity. This was a definite sign that the physiological level improved since the body mass index (BMI) decreased with the use of the program, which means that body composition was improved, as demonstrated by the decrease of fat percentage and an increase of lean muscle mass. It is consistent with the results of Ross *et al.*, (2000), who reported that routine aerobic exercise has a considerable impact in minimizing visceral and surface fat, despite the absence of significant alterations in diet.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

- The effect of low-intensity aerobic exercise on some chemical markers of kidney functioning proved positive in physically active elderly people as there was a significant drop in creatinine and urea concentrations at the end of the program.
- The results showed that glomerular filtration rate (GFR) had improved due to the program, which shows an evident increase in the effectiveness with which kidneys get rid of nitrogenous waste.
- The level of uric acid reduced and the total protein increased following exercise, which is the indication of a good impact on protein metabolism and synthesis.
- There was a positive effect of aerobic exercise on physiological parameters (heart rate, diastolic and systolic blood pressure) indicating a direct positive influence of aerobic exercise on the circulatory system.

- Physical indicators have been shown to also improve and especially cardiorespiratory endurance and muscular strength endurance as well as a reduction in body mass index (BMI), indicating better fitness and cardiovascular system and respiratory system efficiency.
- The general findings suggest that the employed training program was safe, effective, and inclusive of asymptomatic older adults, which was a prototype of preventive intervention programs.
- The findings of the current study are congruent with current trends in exercise physiology, which state that moderate exercise may be a non-pharmacological treatment modality to enhance the overall health and the quality of life.

Recommendations

- Preventive programs based on low-intensity aerobic activities should be used by older adults, particularly those aged 55–60 years, because these programs have a beneficial effect on physiological and physical indicators.
- Include the routine aerobic workouts in the community healthcare service and medical facility, as it proves to be an efficient way of enhancing overall physiological performances without any physical stress.
- Promote regular checking of physiological and chemical changes in the course of training programs in order to take care of the participants and inform therapeutic and preventive actions.
- Hire and qualify specialist trainers to accommodate older adults through scientific-based training programs that take into account the individual differences and health abilities. Future studies should be carried out in larger samples and longer periods of time to validate the existing results and enhance their applicability.
- Increase the research on psychological and social effects of low-intensity aerobic exercise on quality of life, and the effect of low intensity aerobic exercise in reducing anxiety and depression and enhancing social interaction in the older population.
- Promote partnership of health and sports organizations to incorporate such training programs in the policies of the entire population health. Promote partnership between sports and health institutions to incorporate such training programs into state policies to promote health.

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