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Effect of Aquatic Exercises on Glycemic Control in Elderly Patients with Type-2 Diabetes Mellitus

Siva Jyothi N[1], Senthil Selvam P[2], Yatheendra Kumar G[3], Anna Grace[4]

[1]Research Scholar, School of Physiotherapy, VELS University, Chennai. & Associate Professor, Department of cardio and pulmonary Physiotherapy, Durgabai Deshmukh College of Physiotherapy, DDMS (AMS), Hyderabad, Telangana, India.
[2]Principal, School of Physiotherapy, VELS University, Chennai.
[3]Vice Principal, Susruta Institute of Physical Medicine and Rehabilitation, Hyderabad, Telangana, India
[4]Master of Physiotherapy, Durgabai Deshmukh College of Physiotherapy, DDMS (AMS), Hyderabad.

Corresponding Author: Siva Jyothi N

ABSTRACT

The incidence and prevalence of diabetes are increasing, with rapid growth in the aging population. The purpose of this study is to find out the effectiveness of aquatic exercises on glycemic control in elderly patients with type 2 diabetes mellitus.30 subjects who met the inclusion criteria were randomly divided into two groups; Group A (n=15) were under hypo glycemic drugs and aquatic training in Hubbard tank for upper extremity and lower extremity. Group B (n=15) patients have no exercise training during this study, except they are relied upon medications for diabetes. HbA1C was measured pre and post treatment. Statistical analysis was tested with t test at 95% level of significance ($p<0.05$). The results suggest that there is a significant difference between posttest values of both groups in HbA1C, which indicates that group A is more significant than group B.

Keywords: Diabetes mellitus; HbA1c; Hydrotherapy; Older adults

INTRODUCTION

Diabetes mellitus (DM) is a condition that is characterized by chronic hyperglycemia and impaired metabolism of carbohydrates, lipids, and proteins which is due to the insufficient secretion of insulin / or insulin action either completely or partially. There are two primary forms of diabetes, insulin-dependent diabetes mellitus (type 1 diabetes mellitus, T1DM) and non-insulin-dependent diabetes mellitus (type 2 diabetes mellitus, T2DM). T2DM is the most common form of DM, which accounts for 90% to 95% of all diabetic patients and is expected to increase to 439 million by 2030. [1] Type 2 diabetes (2DM) is associated with being overweight, obesity, and a sedentary lifestyle. [2]

India is speedily reaching the position of possible epidemic of more than 62 million diagnosed diabetics presently. In 2000, India (31.7 million) ranked the topmost position in the world with high number of people having diabetes mellitus with china (20.8 million) and United States (17.7 million) in second and third position respectively. [3]

According to Wild et al. the diabetes rate will get doubled worldwide from 171 million in 2000 to 3606 million by the year 2030 with the greatest rise in the number in India. [4] It is estimated that by 2030, 79.4 million people may get affected with diabetes in India, while china (42.3 million) and United States (30.3 million) will also have a large number of individuals affected by diabetes. [3]

Diabetes mellitus (DM) is a condition which has a diffused biochemical, morphological that may trigger the complications that have an impact on the neural, cardiovascular, kidneys and also on

other organs and tissues like skin, liver, collagen, and elastic fibers. It is indeed a multi-system disorder that affect many organs of the body. [5]

Symptoms of high blood sugar level (hyperglycemia) include frequent urination (polyuria), increased thirst (polydipsia), weight loss, occasionally with excessive eating (polyphagia), and blurring of vision. In chronic hyperglycemia there will be growth impairment and the individual are more prone to infections. Patients with diabetes are at more risk of developing the atherosclerotic plaques of cardio vascular system, peripheral vascular system and also the diseases of cerebrovascular system. Hypertension and abnormalities of lipoprotein metabolism are often found in people with diabetes (American diabetes Association 2008). [6]

Many of the international institutes have suggested that the physical activity plays a vital role as a non-pharmacological intervention in the treatment of T2DM.

A combination of aerobic exercise and resistance exercise (combined exercise) has been recommended by the European Society of Cardiology, American College of Sports Medicine, Belgian Physical Therapy Association, and Exercise and Sports Science Australia. [7]

Aquatic immersion has profound biological effects, extending across essentially all homeostatic systems, and these therapies are beneficial in the management of patients with musculoskeletal problems, cardiovascular diseases, rheumatic disease, and other conditions. [2] From the perspectives of physics and physiology, aquatic environments are beneficial in the management of a variety of musculoskeletal, neurological, and cardiopulmonary pathologies due to the advantages of hydrostatic forces (buoyancy) and drag resistances unique to the water medium. [8] Aquatic exercise has been recommended during pregnancy due to it having less impact on articulation, and its ability to increase amniotic fluid diuresis and decrease edema, blood pressure and back pain. [9] The training performed in water may minimize some of the risks of exercise such as joint tendon injuries or trauma in sedentary patients with 2DM who are unaccustomed to exercise and wish to initiate a training program. [2]

The present study aimed to find out the effect of aquatic exercises on the glycemic control in elderly patients with type 2 diabetes mellitus patients.

MATERIALS AND METHODS

PROCEDURE

This experimental study was conducted on 30 participants in an outpatient department of Durgabai Deshmukh College of Physiotherapy and Durgabai Deshmukh Hospital and Research Center, Hyderabad after obtaining approval from institutional ethical committee. The informed consent was taken from all the participants of the study. The subjects were randomly selected according to inclusion(Age ≥ 50 years ,Both male and female, moderate diabetic mellitus (HbA1c 7.0-8.9), motivated and cooperative, known diabetes 6-7 years , and exclusion criteria(peripheral artery disease, chronic pulmonary disease, severe epilepsy and trauma, participant with recent serious cardiac surgery, musculoskeletal condition ,neurological condition, ulcer, pressure sore, diabetic neuropathy, allergy, patient with uncontrolled diabetes (HbA1c 9-13.5) and randomly divided into 2 groups such as Group A(Experimental Group) and Group B(Control Group) consisting of 15 subjects each. A brief explanation about treatment session was explained to all subjects. The duration of treatment session is 50 min/day; frequency of session is 3 days/week. The pre and post values of Hba1c were recorded at the end of 12 weeks of treatment.

GROUP A were under hypoglycemic drugs and aquatic training in Hubbard tank for upper extremity with use of motor provided turbulence, and lower extremity were trained with hip cycling in the Hubbard tank.

GROUP B patients have no exercise training during this study, except that they are relied upon medications for diabetes.

GROUP A (Experimental study)

Aquatic training in Hubbard tank: A warm up period along with stretching for about 10 minutes. Warm up include Neck Rotations-clockwise and anti-clock wise, shoulder rolls, shoulder rotations- clock wise and anti-clock wise, trunk twist, leg swings, ankle toe movements, general stretching of muscles of back, hamstrings, quadriceps, Gastrosoleus.

Before starting exercises in Hubbard tank a clear explanation and instructions were given to the patients. The Hydraulic lift suspends the stretcher, which then rotates or slides on a tract to transport the patient over the tank then lower the stretcher into the tank. Then, position the patient in supine lying on a stretcher designed specifically in water. To ensure safety with these transfers, two people should assist the patient, lower the stretcher just to the water line so that patient can become accustomed to the feeling of the water. Immerse the patient to the depth necessary, keeping the head elevated fastened the stretcher securely. Place the agitator in the appropriate position and turn them on. Patients were instructed to perform active movements of both upper extremities against the motor provided turbulence, 10 repetitions each for 3 sets for 15 minutes (Shoulder and elbow flexion, Shoulder and elbow extension, Shoulder abduction and adduction, Shoulder internal rotation, Shoulder external rotation). Patients are instructed to lie in a half sitting position and cycle paddling is done on a hip cycler in a Hubbard tank for 15 minutes. Cool down for 10 minutes.

GROUP B: (CONTROL GROUP)

The patients in control group will have no exercise training during the study. They are relied on upon their prescribed medications and the activities of daily living.

STATISTICAL ANALYSIS AND RESULTS

Statistical analysis was performed by using SPSS statistical software (version [64 bit] 20). The scores are analyzed using statistical tests. Mean, standard deviation of all the values were calculated. The observed differences were tested with the t at 95% level of significance.

Statistically the Inter group results are compared by Independent t test; Intra group results are compared by Paired t test.

Table 1: comparison of mean scores of Group A and Group B

	Group	N	Mean	Std. Deviation	Std. Error Mean
Pre	Group A	15	7.6933	.25765	.06652
	Group B	15	7.6267	.21536	.05561
Post	Group A	15	6.3467	.13558	.03501
	Group B	15	7.4333	.19881	.05133

This table is calculating the Mean, Standard Deviation, Standard error for HbAlc Levels in Group A and Group B.

Table 2: comparison of Pre and Posttest values of group A

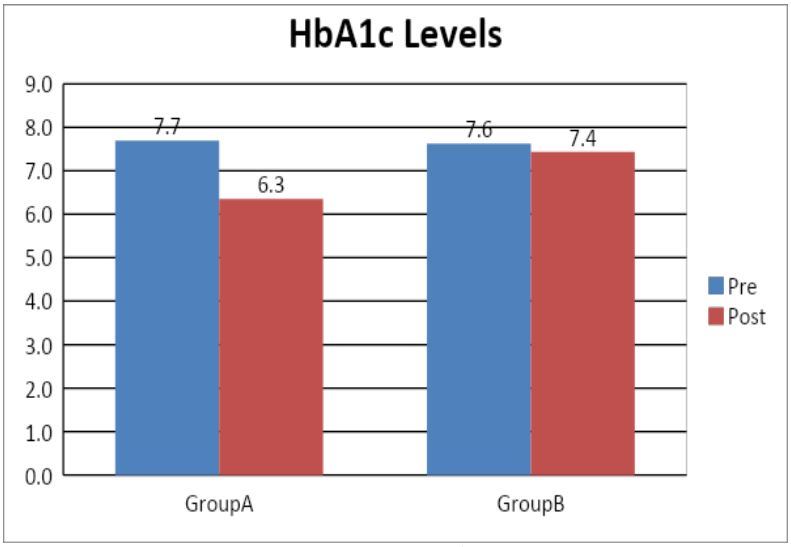
		Paired Differences			T	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean			
Pair 1	Pre - Post	1.34667	.34198	.08830	15.251	14	.000

As can be seen from the output, a significant difference exists between Pre and post of group A. Since T value is 15.251 and its p-value 0.000 is less than 0.05.

Table 3: comparison of Pre and Posttest values of group B

		Paired Differences			t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean			
Pair 1	Pre - Post	.19333	.08837	.02282	8.473	14	.000

As can be seen from the output, a significant difference exists between Pre and post of group B since T value is 8.473 and its p-value 0.000 is less than 0.05.



Graph 1: Showing Hb A1C values of Group A vs Group B

Graph 1 indicates that in comparison of both groups, there is significant reduction in Group A than Group B.

Table 4: comparison of pre and posttest values between groups

Groups			t-test for Equality of Means				
			T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Pre		Group A vs Group B	.769	28	.448	.06667	.08670
Post		Group A vs Group B	-17.490	28	.000	-1.08667	.06213

As can be seen from the output, no significant difference exists between Pre of group A and Group B. Since T value is .769 and its p-value .448 is Greater than 0.05.

As can be seen from the output, a significant difference exists between Post of group A and Group B. Since T value is -17.49 and its p-value 0.000 is less than 0.05.

DISCUSSION

The present study was therefore designed to implement supervised aquatic training program to see whether there is reduction in HbA1c values. The HbA1c test (also called glycosylated hemoglobin level) is a laboratory blood test which measures the average blood glucose concentration over the previous weeks and gives an indication of long-term blood glucose control.

The results of the study show that there is a significant reduction in HbA1c values in the Group A after 12 weeks of aquatic training with a mean of 6.347 compared to group B with a mean value of 7.43. Similar results were obtained in the study conducted by A. Nuttamonwarakul in 2012 after 12 weeks of aqua aerobic training HbA1c values were reduced significantly in aqua exercise group from the base line value mean ± SD (7.7±1.1) to 6.6±0.7 in comparison to the non-exercise group. [10]

Delevatti, Rodrigo S., et al in 2016 conducted a study on the effect of aerobic training in water and on dry land and concluded that the glucose control is similar in both the environments in type 2 diabetic patients with a mean difference of 0.42 in aerobic aquatic training group compared to dry land group mean difference of 0.35. [11]

The results of the present study are correlated with the study conducted by Conners, Ryan T., et al. in 2014 stated that underwater treadmill training helps in reducing the HbA1c levels in the type 2 diabetes mellitus patients from 6.7 to 6.0 after 8 weeks of underwater treadmill training. [12]

Lynnette M. Jones et al in 2009 conducted a study on the water-based circuit intervention in reducing fasting insulin and lowering post-load glucose levels to within the normal range(<7.8 m mol =l) in the IGT group. [13]

Sigal et al. reported that a single performance of aerobic exercise and resistance exercise would improve glycemic control in patients with type 2 diabetes, with combined exercise providing the greatest improvement. [14]

Ji-Hye Park etal in 2015 stated that Exercise can rapidly increase the expression of GLUT4 (glucose transporter type 4), the sugar transporter in skeletal muscles, thus increasing the activity of AMPK (adenosine monophosphate-activated protein kinase) in these muscles. Although patients with type 2 diabetes have a defect in insulin signal transmission in the skeletal muscles, the exercise-induced activation of AMPK in these muscles can achieve normal action, and the oxidation of fatty acids and glucose absorption will be accelerated. [15]

Zar Chi Thent in 2013 from study concluded that exercise has a positive role in maintaining the glycemic level, increasing the insulin sensitivity and also improving cardiovascular risk factors with regard to T2DM [16]

Cider Åsa et al in 2012 role of aquatic exercises on exercise performance in Patients with heart failure and T2DM.He stated that there is a significant improvement in physical performance in the training group compared with the control group. No significant change is seen in the isometric and isotonic strength of knee extensors or isotonic endurance, neither in handgrip strength or endurance. [17]

In Group B medications helps to decrease the amount of glucose that is released by the liver, slowing down the absorption of glucose from the small intestine and also helps the body to use its own available insulin more efficiently.

Aquatic exercise enables a combination of aerobic and resistance exercises and is especially suitable for patients with advanced age, obesity, peripheral neuropathy, orthopedic problems, or other comorbidity that hampers exercises on land. Due to the buoyancy effect in water weight bearing activities are much more effortless to perform in water. [17]

Aquatic exercises are shown to increase muscle mass and enhance blood flow in the muscle along with a reduction in body fat that helps to contribute to glucose tolerance in elderly patients with T2DM. [18] Aquatic exercise training represents a possible alternative for training of patients with particular injuries or complications that impair the adequate progression of a training program performed on dry-land. [19]

Limitations and Recommendations

Study can be conducted by taking a large sample size. The long term follow up results are not taken into consideration in this study. Further recommendations can done on strength training in elderly patients with type 2 diabetes. Study can be conducted by taking different levels of body immersions. Further studies can be done taking other parameters like BMI, VO2 max, lipid profiles.

CONCLUSION

The experimental group who performed the aquatic exercise training showed excellent reduction in Hba1c levels. The improvement in outcome measure provided us a valuable information that aquatic exercise training is proven to be a significant and effective approach in improving glycemic control in elderly patients with type 2 diabetes mellitus.

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