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Effect of Chair Aerobics and Resistance Training on Blood Glucose Level in Diabetic Post-Menopausal Women

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Vaishnavi Amale
Krishna Institute of Medical Sciences (Deemed to be University), Krishna college of Physiotherapy, Karad, Maharashtra, India

Dr. G. Varadharajulu
Krishna Institute of Medical Sciences (Deemed to be University), Krishna college of Physiotherapy, Karad, Maharashtra, India

Keywords:
chair aerobics, fatigue, postmenopausal women, sedentary, type 2 diabetes mellitus.

Abstract

Introduction: Menopause, a crucial juncture in a woman's existence, is marked by significant physical and emotional alterations, including a reduction in oestrogen levels and consequential effects on progesterone levels. Hormonal fluctuations during menopause impact cellular insulin responsiveness, resulting in increased blood glucose levels, while oestrogen insufficiency commonly contributes to fatigue. While previous research has independently assessed the effectiveness of chair aerobics and resistance training, but their combined benefits remain unexplored in sedentary women with elevated blood glucose and fatigue levels. Therefore, the purpose of this study is to determine the combined effectiveness of chair aerobics and resistance training on blood glucose and fatigue levels in diabetic post-menopausal women.

Methods: Study involved 57 sedentary postmenopausal women with type 2 diabetes. Pre-intervention screening involved Body Mass Index (BMI) analysis, fasting blood glucose test and fatigue assessment scale. Exercise training included chair aerobics and resistance training given 3 times per week for 8 weeks. Fasting blood glucose level and fatigue levels were assessed pre- and post- intervention.

Result: The present study showed statistical significant difference in fasting blood glucose level ($p < 0.0001$) and fatigue levels ($p < 0.0001$) with improved physical functioning and energy levels.

Conclusion: After conducting the investigation, our study discovered that sedentary postmenopausal women with diabetes can significantly reduce their fasting blood glucose levels and tiredness levels by incorporation of chair aerobics and strength training. Combination of these interventions should be duly regarded as beneficial strategies in managing type 2 diabetes for glycaemic control and alleviating fatigue.

1. Introduction

As per more recent recommendations made by the World Health Organization's (WHO) "Scientific Group on Research in the Menopause," natural menopause is defined as the permanent cessation of menstruation resulting from the loss of ovarian follicular activity. [1] Natural menopause is believed to manifest following a period of uninterrupted amenorrhea lasting 12 consecutive months, without any readily apparent pathological or physiological factors accounting for this phenomenon. [2] The designation "surgical menopause" encompasses individuals who have ceased menstruating due to surgical intervention, encompassing those who have undergone bilateral oophorectomy, hysterectomy, or both procedures. [3] The normal age range for the perimenopause is 45 to 55 years old. [3] Indian women's average menopausal age spans from 40.32 to 48.84 years. [4] Distressing menopause symptoms include weight gain, irritation, anxiousness, lethargy, chilly hands and feet, hot flushes, and cold sweats. [4] During the menopausal transition women have phenotypical, metabolic, and biochemical alterations that raise their risk of type 2 Diabetes Mellitus (T2DM) [5]

Women in their middle age are more susceptible to developing type 2 diabetes when contrasted with younger women. [6] When impact of age is considered, postmenopausal women are more likely to develop type 2 diabetes (DM-II), which is crucial because it is one of the most prevalent chronic diseases in postmenopausal women. [7,8] A significant reduction in ovarian oestrogen release is one of the significant hormonal changes associated with the menopause

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transition. [9] Endogenous oestradiol levels fall as a result of oocyte depletion brought on by the permanent termination of menstruation which develops insulin resistance and induces fatigue. [5 ,10,11]. Insulin resistance is distinguished by the incapability of circulating insulin to proficiently regulate the uptake and utilization of glucose by insulin-sensitive tissues and organs. [11] Insulin resistance in postmenopausal women induces notable elevation in fasting glucose and insulin levels, signifying diminished ability of the body to efficiently regulate glucose metabolism. [12] Lower E2 concentrations were linked to a 47 percent heightened risk of type 2 diabetes during the menopausal transition, according to the Study of Women's Health Across the Nation (SWAN). [13]

Postmenopausal women are liable to develop metabolic syndrome, which causes sarcopenia, especially in those who maintain sedentary lifestyles. [14] Sarcopenia and type 2 diabetes mellitus (T2- DM) are intimately associated to each other, and muscle wasting is meticulously related to both, the metabolic syndrome (Met-S) and insulin resistance (IR). [15] The body composition changes significantly during menopause, including declination of muscle mass, rise in fat body mass, and relocation of fat from the periphery to the central part of the body and these changes are linked to problems with insulin sensitivity and glucose. [14,15,16] The escalation in visceral adiposity, which amplifies the secretion of proinflammatory cytokines, augments circulating free fatty acids, and triggers the generation of reactive oxygen species, all of which play a role to foster in to the development of insulin resistance. [5] With rising body mass index (BMI), it is closely associated with an elevated risk of type 2 diabetes, while insufficient physical activity is liked to a greater prevalence of diabetes. [7]

Attaining and sustaining adequate glycaemic control is vital in the management and aerobic physical activity is a pivotal treatment option for type 2 diabetes. [17] It is generally established that regular aerobic exercise improves glycaemic control and insulin sensitivity [13]. Aerobic exercise pertains to physical activities such as walking or jogging that encompasses sustained and repetitive movement of major muscle groups for at least 10 minutes consecutively. [18] Aerobic (endurance) exercise boosts skeletal muscle capitalization and blood flow, while concurrently increasing levels of muscular glucose transporter isoform-4 (GLUT4), hexokinase and glycogen synthase activity. [18] As a practical way to improving fatigue, regular aerobic activity with increasing intensity is recommended [19] Chair Aerobics entail engaging in aerobic workouts while seated in a chair, incorporating upper and lower extremities guided by a mentor, accompanied by music, and maintaining a seated position in a chair with proper back support. [20] Chair-based exercises have been shown to assist people retain or increase their independence and mobility, and they provide a substitute to dynamic exercises while working for those who work in a sedentary setting or live a sedentary lifestyle [20]

Resistance exercise has favorable effects on diabetes, and these findings should instigate its use due to the growing number of inactive, elderly, and obese people in industrialized countries [17] Because of the effect of enhancing insulin action, training programs that include a resistive exercise component, such as moderate intensity weight-lifting exercises, may be especially beneficial in type 2 diabetes. [21] Resistance exercise has effectively mitigated insulin resistance and improve insulin action in postmenopausal women by increasing muscle mass and improved insulin sensitivity by augmenting glucose storage, enhancing glucose clearance from the circulatory system, and minimizing the volume of insulin needed to maintain normal glucose tolerance. [22,23,24] Because skeletal muscle is the biggest bulk of insulin-sensitive tissue, increases in muscle mass have been linked to improved glycaemic control.[17] Since 2006, the American Diabetes Association's (ADA) guidelines have stated that "in the absence of contraindications, people with type 2 diabetes should be encouraged to perform resistance exercise three times a week, targeting all major muscle groups, progressing to three sets of 8–10 repetitions at a weight that cannot be lifted more than eight to ten times" [25]

Training programmes that incorporate both modalities (aerobic and resistance) may be the most beneficial because they leverage distinct mode of action, leading to optimal benefits. This shows that a combined programme may be more effective than either workout plan alone in reducing insulin resistance[24] Amalgamation of aerobic and resistance exercise increases endothelial vasodilator function, which may result in enhanced blood flow and glucose uptake in active muscle beds and surged aerobic capacity, which

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is linked to increased glucose uptake, potentially due to improved blood flow and increased tissue exposure to insulin and glucose, independent of body weight changes. [21] There are literatures describing isolated benefits of aerobic and resistance training and literatures have described about the effects of combined training (CT) or the combination of both in the same session. But not many articles have used chair aerobics and resistance training together which alter blood glucose levels and fatigue levels in postmenopausal women who are more susceptible to these risk factors. This study focuses on using both that is chair aerobics and resistance training to see the effect on the fasting blood glucose level and fatigue levels.

2. Methodology

Experimental study setting: This is a study to assess fasting blood glucose level and fatigue levels in the diabetic postmenopausal women. The study was conducted in Krishna Institute of Medical Sciences 'Deemed to be' University, Karad and an ethical clearance certificate was obtained by Institutional Ethical Committee. The objective and methodology of the study were thoroughly elucidated to the participants, ensuring a comprehensive understanding of the research. Written informed consent was obtained from the individuals who met the predetermined inclusion and exclusion criteria, signifying their voluntary agreement to participate in the study.

Inclusion criteria with postmenopausal women (greater than 12 months of amenorrhea), middle aged women (45-55years), sedentary women, Individuals that were willing to participate with established Type 2 DM for more than a year. Exclusion criteria were un-cooperative individuals, individuals with acute illness, severe hypertension, myocardial infarction, hormone replacement therapy, severe retinopathy, nephropathy and neuropathy, history of serious cerebrovascular or cardiovascular diseases.

A brief demographic data was obtained from the participants prior to the assessment. Subjects were nominated by simple random sampling method according to the inclusion criteria and exclusion criteria. Pre assessment was done by using outcome measures such as with the use of fasting blood glucose test and fatigue level which was assessed by fatigue assessment scale. Then exercise intervention was given to the patient. Post- test assessment was done by using outcome measures. The selected subjects underwent chair aerobics and resistance training for a period of 8 weeks for 3 sessions a week for 45 minutes. Before each session, participants were provided with warm up exercises consisting of Active Range of Motion (AROM) movements targeting upper limb and lower limb. To conclude the exercise session, cool down phase was implemented, incorporating stretching and relaxation techniques. The protocol for combined training was as follows:

2.1 Exercise Protocol:

	Exercises	Duration
Warm up exercises	• neck movements • shoulder and elbow rotations • elbow flexion and extension • forearm curls and wrist rotations • ankle toe movements • spine flexion and extension • spinal side rotation	These exercises will be given for 10 minutes.
Chair aerobics	• marching with arm movements • alternate hand and leg movements • alternate arm and leg raise • knee to chest • marching in standing position	These exercises will be given for 10 minutes. Commencing with low intensity exercise, progressively escalating the speed of movements and thus

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	• hamstring curls • leg swings • lunges • knee to chest in a standing position. • mini squats	intensity.
Resistance training	• bench press • leg press • leg extension • lateral pulldown • triceps pushdown • arm curl • Sit ups	These exercises will be given for 15 minutes. -initially 3 sets of 8 to 10 repetitions which were increased to 5 sets.
ool down	• Diaphragmatic breathing exercise • neck stretches • biceps stretch • triceps stretch • forearm stretches • pectoral stretch • quadriceps stretch • hamstring stretches • gastro-soleus stretch	This phase will last for 10 minutes. Stretches were sustained up to 30 seconds.

3. Result:

This study focuses on the use of chair aerobics which is low to medium intensity exercise and resistance exercise in reducing the increased fasting blood glucose level and fatigue levels. The study was executed in geographical vicinity of Karad. The result was drawn by outcome measures such as fasting blood glucose test and fatigue assessment scale. In this study total 61 subjects were screened and fulfilled the inclusion criteria as well as the exclusion criteria. Out of which 3 declined to follow the regimen and 1 terminated the treatment, remaining 57 participants were included in the study and continued the treatment protocol. Total 57 consents were taken and study was progressed accordingly.

3.1 AGE-WISE DISTRIBUTION

Table 3.1. Age wise distribution of Participants

Age Group	Mean ± SD	Number of individuals	Percentage
1. 45-50 yrs	48.8 ± 1.289	21	37%
2. 51-60 yrs	53 ± 1.638	36	63%

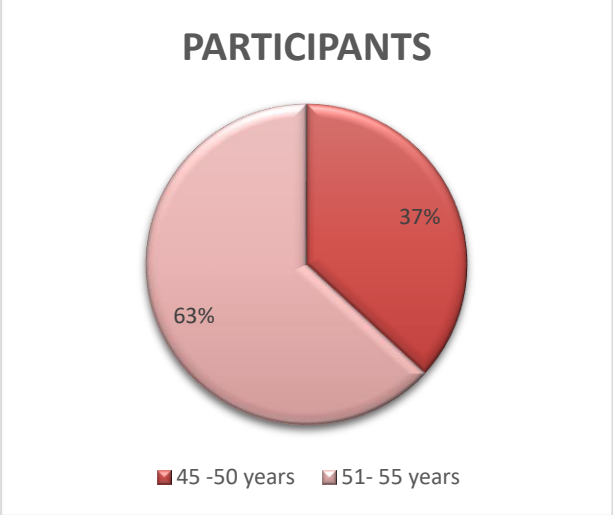

Figure 3.1. Age wise distribution of participants

Interpretation: From the above table and figure maximum number of participants i.e., 36 participants belonged to age group of 51 -60 years and 21 participants belonged to age group of 45- 50 years.

3.2 BODY-MASS INDEX (BMI)

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Body mass index	Mean	Sd	P- value
Pre test	28.6	2.122	0.0196
Post test	27.9	2.213	0.0178

Table 3.2. BMI analysis

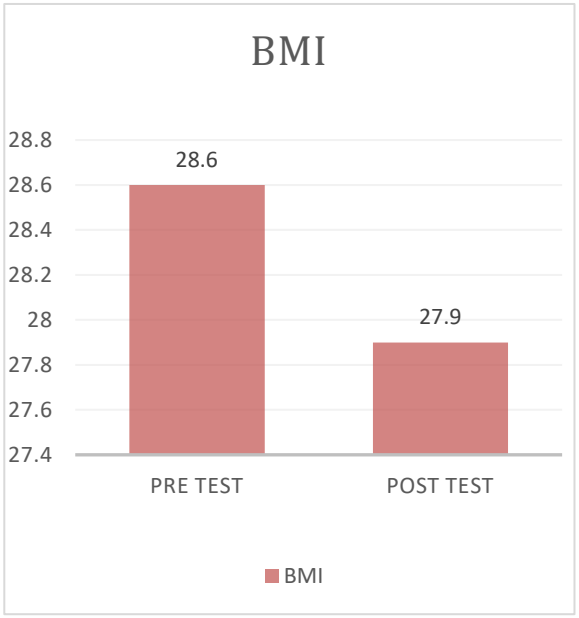

Figure .3.2 BMI analysis

Interpretation*: Table no. 3.2 and Figure no. 3.2 shows the Body Mass Index (BMI) analysis. It could be interpretated from the data that there is no significant change in the BMI values post intervention.*

3.3 FASTING BLOOD GLUCOSE LEVELS ANALYSIS

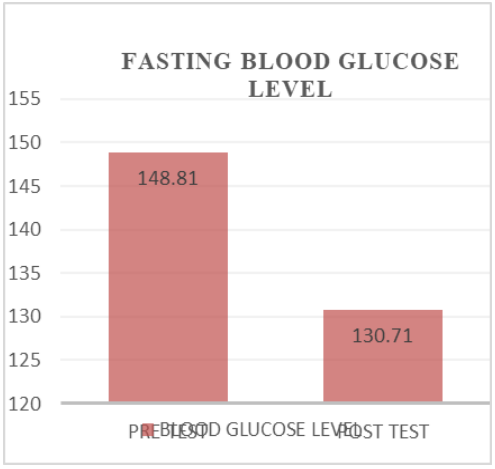

Figure 3.3 Fasting blood glucose analysis

Table 3.3 Fasting blood glucose analysis

Fatigue level	Mean	Sd	P-value
Pre test	34.01	2.663	>0.10
Post test	24.31	3.042	0.0044

Interpretation*: Figure 3.3 and Table 3.3 shows the analysis of fasting blood glucose levels. It could be seen that there is substantial difference in the glucose levels of the pre-intervention and the post-intervention data collected. The P value <0.0001 considered extremely significant. The t value is 13.437.*

3.4 FATIGUE LEVEL

Table 3.4 Fatigue levels

Blood glucose level	Mean	SD	P-value
Pre test	148.81	25.6	<0.0001
Post test	130.71	25.3	0.0063

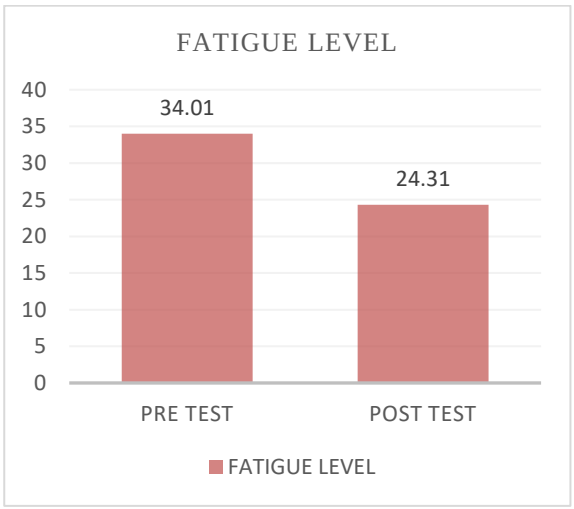

Figure 3.4. Fatigue levels

Interpretation: *Table 3.4 and figure 3.4 indicate fatigue levels assessed pre intervention and post intervention. From the table no. 3.4 and figure no. 3.4 it could be interpreted from the data that the fatigue levels are reduced post intervention, which represents there is an effect of intervention on the levels of fatigue which also showed considerable difference in the*

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values pre and post intervention. P value <0.0001 is considered extremely significant and t value is 23.041

4. Discussion

The intend of this study was to investigate the impact of chair aerobics and resistance training affecting blood glucose level and fatigue levels in diabetic postmenopausal women leading predominantly sedentary lifestyle. Menopause is the long-term cessation of menstruation brought on by oocyte depletion [5]. Menopausal symptoms which include fatigue, lethargy, cold hands and feet, hot flushes, cold sweats, weight gain, irritability, and nervousness. [4] Perimenopause is marked by important alterations in circulating hormones, including a substantial decrease in ovarian oestrogen secretion which lead to insulin resistance, hence postmenopausal women are more likely to develop type 2 diabetes. [8,9] Diabetes Mellitus -2 (DM-II) is crucial for women because it is one of the most common chronic disorders in postmenopausal women. The consensus is widely acknowledged that consistent participation in aerobic exercise and resistance training yield positive outcomes in patients with T2DM, resulting in enhanced glycaemic control and lowering the likelihood of diabetic complications. [18] A study by Maiorana A et al.2002, demonstrated effect of an 8-week circuit training programme that combines resistance and aerobic training on measures of glycaemic control, cardiovascular health, strength of the muscles, and body composition in 16 type 2 diabetic patients. Where as in our study we used chair aerobics and resistance training in 57 postmenopausal women with type 2 diabetes for 8 weeks on indices of glycaemic control solely where it was interpreted that there is a significant difference in the fasting glucose levels, indicating chair aerobics and resistance training together produced positive effects in lowering the increased blood glucose levels. Another study by Lohana ST and Yadav T,2020 conducted a study on effect of chair aerobics on quality of life in sedentary obese individuals where chair aerobics was administered as group therapy in both men and women as a light to moderate intensity exercise program over a period of 8 weeks for 4 days/week. [20] While postmenopausal diabetic women who led sedentary lives were recruited for our study and received a combination of chair aerobics and resistance training. Similar outcomes were shown with reductions in fatigue ($p < 0.0001$), but in our research, adding resistance training led to higher enhancements in physical performance and energy levels. As per study done by Ezati M et al. 2020, the findings indicated that regular aerobic exercise with an escalation in intensity is advised as a viable way to ameliorate fatigue and enhance sleep quality in non-athletic students.[19] Balducci S et al.2004, conducted a comparative study where researchers examined the prolonged impacts (1 year) of specified and supervised combined aerobic and resistance training on glycaemic control, cardiovascular risk factors, and body composition in type 2 diabetic patients, remarkably all of which were improved. [17] The study had a control group and an experimental group where the experimental group received aerobic as well as resistance training for 30 minutes each respectively which was retested every 3 weeks. The control group was asked to continue with their existing diet and pharmacological regimen. Diet and food records were kept, and a nutritionist examined all the nutritional data gleaned from the food records. Our current study did not include any dietary modifications, which is a limitation. Future research on postmenopausal women might use chair aerobics and resistance training strategy along with dietary energy restriction to bring about more significant changes. Diverse advantages of resistance exercise include increased bone and muscle mass, increased strength, and enhanced functional ability. [14] This finding was corroborated by a study carried out by Conceição MS. et al 2013, who found that following a 16-week resistance training intervention, there was a substantial increase in lean body mass (2.46%). They hypothesized that the increase in lean body mass seen in postmenopausal women throughout the current investigation was responsible for the improvement in glucose management [14] This backs up the findings of our study, which show that resistance training improves the process of reducing fasting blood glucose together with an additional component of aerobic exercise.

5. Conclusion:

After conducting the investigation, our study discovered that postmenopausal women with diabetes who lead sedentary lives can significantly reduce their fasting blood glucose levels and tiredness levels by engaging in chair aerobics and strength training. Combination of chair aerobics and resistance training should be contemplated as useful interventions in

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regulation of type 2 diabetes for glycaemic control and fatigue levels.

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