Original Article

Effect of exercises on gestational diabetes mellitus in females of third trimester during pregnancy

Afifa Ashraf,[1] Iqrash Fatima,[2] Huma Tabassum,[3]

Abstract

Objective: To ascertain how low-impact exercise affects gestational diabetes mellitus in the third trimester and Compare the efficacy of normal prenatal treatment both on alone and in conjunction with low-impact workouts and physical activity to manage gestational diabetes mellitus.

Study design: It was a Randomized Control Trial study design.

Place and duration of study: The study was conducted in The Physiotherapy Clinic, Saidpur Road, Rawalpindi from 1st August 2021 to 31st January 2022.

Material and Methods: Sample size was calculated by using open epi sample size calculator with 5% level of significance and 95% level of confidence. 30 females were selected by using non probability convenient sampling initially and then randomly allocated into control and experimental groups. Inclusion criteria encompassed obese/overweight females in their 3rd trimester, aged 25-40 years. Females with specific medical conditions and without GDM were excluded. Assessment was done by using data collection tools (OGTT, Weight (kg) BMI).Outcome measures are diastolic, systolic blood pressure, fasting plasma glucose, 1 hour and 2 hours plasma glucose after meal. Data was analyzed by using SPSS version 21. An independent sample t-test was used for comparison of means between the groups.

Results: Out of 30 females, there were 15 in each group and there was a statistically significant differences of all outcome measures from baseline values for both groups($p<0.001$).However, the experimental group's statistical outcomes were better than those of the control group in terms of plasma glucose levels at fasting, one hour, and two hours.($p<0.001$).

Conclusion: It is concluded that low-impact exercises are found to effectively manage glucose levels in females during the third trimester and minimize the complications associated with gestational diabetes mellitus.

Keywords: Gestational Diabetes Mellitus, Impaired Glucose Intolerance, Body mass index, Oral Glucose Tolerance Test, Big Baby syndrome.

1. Introduction

Diabetes mellitus, a metabolic disorder, entails insulin secretion defects causing chronic hyperglycemia and disruptions in carbohydrate, fat, and protein metabolism.[(1)] Type 1, Type 2, and gestational diabetes are the three main forms of diabetes mellitus.[(2)] Type 1 diabetes, an autoimmune condition, is often diagnosed in childhood or adolescence, marked by high blood glucose levels due to insufficient insulin from pancreatic β-cell loss.[(3)] Type 2 diabetes results from lifestyle and genetic factors like physical inactivity, prolonged sedentary behavior, smoking, excessive alcohol intake, and notably, obesity.[(4)] Whereas GDM is characterized by glucose intolerance or high blood glucose concentration during gestation.[(5)] Despite sharing diagnostic criteria and screening methods, GDM prevalence ranges from 1 to 28% globally, influenced by factors like age, ethnicity, obesity, lifestyle, and type 2 diabetes.[(6)] Type 2 diabetes prevalence mirrors GDM rates, with ethnic disparities; for example, in the US, non-Hispanic white women have lower GDM rates than others. Age, obesity, lifestyle, and geography globally influence GDM prevalence.[(7)]

Long-term insulin resistance leads to pancreatic ß-cell dysfunction, reducing glucose tolerance and causing

Physiotherapist, Physiatrics Pain Clinic Islamabad,[1] Physiotherapist, IPRC Islamabad,[2] Physiotherapist, Pak Medical & Diagnostic Center,Rawalpindi.[3]
Correspondence: Afifa Ashraf, Physiotherapist, Physiatrics Pain Clinic Islamabad **Email:** afifaashraf6@gmail.com

gestational diabetes mellitus (GDM). GDM, akin to transient type 2 diabetes, is triggered by pregnancy-related hormonal and metabolic changes.[8] Obesity, sedentary lifestyle, family history, advanced maternal age, and any type of diabetes prior to gestation are general risk factors for gestational diabetes mellitus. (11) Pre-pregnancy and prenatal lifestyles, including diet, impact the risk of gestational diabetes mellitus (GDM). Daughters of smokers have a higher chance of developing GDM. Chronic diabetes mellitus results in organ damage affecting the kidney, heart, nerves, retina, and blood vessels.[9]

Gestational diabetes mellitus (GDM) links to severe complications like pre-eclampsia, hypertension, preterm birth, and more cesarean deliveries, increasing risks of postpartum type II diabetes, impaired glucose tolerance, and perinatal morbidity.[10]

For diagnosis, an oral glucose tolerance test (OGTT) is conducted when casual blood glucose readings are inconclusive. After an overnight fast of 8-14 hours, fasting plasma glucose levels are measured, followed by readings one and two hours after a 75-gram oral glucose load. The OGTT specifies fasting glucose should be <95 mg/dl, 1-hour glucose <180 mg/dl, and 2-hour glucose <155 mg/dl.[11] Treatment may encompass dietary advice (standard or specific), physical therapy, and pharmacological options like oral antidiabetic drugs[12] such as Metformin,[13] Sulfonylureas (e.g., glyburide),[14] and basal and prandial insulin.[15] Rhythmic use of large muscle groups is advantageous with no adverse effects. A daily 30-minute brisk walk effectively regulates blood glucose levels, ideal for beginners with mild aerobic benefits and low joint strain.[16] Weekly 20–30-minute stationary cycling sessions raise postprandial and fasting glucose levels, enhance glycemic control, and boost cardiorespiratory fitness.[17]

Yoga and mindful eating aid glycemic control in pregnant GDM patients, but avoid certain poses like abdominal-pressure, twists, and lying flat on the back to prevent circulation issues during pregnancy, per clinical recommendations.[18] Pilates exercise during pregnancy enhances labor quality and lowers blood glucose levels without causing harm to the mother or fetus.[19] Low to moderate intensity racquet sports are considered safe if a female is already used to play racquet.[20] Avoid vigorous racquet sports like badminton, tennis, and racquetball during pregnancy due to increased risk of falls for women.[21] These low impact exercises recommended for 150 minutes, starting from 5- 10min/day to 30 minutes a day, five days a week and of low to moderate-intensity based on the patient's tolerance and rate of perceived exertion.[22] During pregnancy, avoid contact sports and high-risk activities; opt for low-impact cardio workouts like brisk walking and modified yoga.[23] Throughout gestation, increased ligamentous and joint laxity due to hormonal changes heightens injury risk, necessitating low to moderate intensity physical activity.[24] Research suggests regular pregnancy exercise enhances muscle adaptations, insulin sensitivity, and glucose absorption, benefiting short-term glucose management and improving metabolic health in women with GDM.[25] Laredo-Aguilera et al.'s study recommends aerobic, resistance, or combined exercises at moderate intensity (20-50 minutes, twice a week) for controlling gestational diabetes mellitus effectively.[26] A supervised physical activity program starting early and continuing throughout the pregnancy can lower the risk and complications of these issues.[27]

This study aimed to investigate the effects of exercise on gestational diabetes mellitus (GDM) by assessing the impact of low-to-moderate intensity exercise during the third trimester and its role in preventing complications. By addressing this gap in the literature, the study offers valuable insights into evidence-based treatment, raising awareness among physicians and the population about the preventive benefits of these exercises for GDM and its complications.

2. Materials & Methods

A randomized control trial was done from 1st august 2021 to 31st January 2022 at The Physiotherapy Clinic, Saidpur Road, Rawalpindi. 30 female patients of gestational diabetes mellitus were included in this

study. Sample size was calculated by using open-epi sample size calculator with 5% level of significance and 95% confidence interval. Non-Probability Convenient Sampling and then Random Allocation into control (n=15) and experimental groups (n=15) by Sealed Envelope Method.

Obese, overweight and females of gestational age 27-40 weeks in their 3rd trimester, aged 25-40 were included. Additionally females with an increased risk of gestational diabetes were part of the study population. The study excluded females with medical conditions such as significant heart disease, restrictive lung disease, Persistent 2nd and 3rd trimester bleeding, ruptured membrane, multiple gestation at risk of premature labor and poorly controlled hyperthyroidism. Additionally females without gestational diabetes mellitus were not included in this study.

Data was collected by using semi-structured questionnaire based on demographics, weight, BMI and OGTT. Experimental group was treated with standard antenatal care for gestational diabetes mellitus, and was regularly supervised for exercise program. The exercise program was started from the time of diagnosis of diabetes until birth. It was performed three times per week and sessions lasted 30-40 min plus daily brisk walk of at least 30 min. Control group received only standard antenatal care which includes pharmacological management and dietary precautions. Data was entered and analyzed using MS excel and SPSS version 21. Inference was made by using paired and independent samples t-test and represented in the forms of graphs and tables**.**

3. Results

Within the study population 11 females who had a history of previous GDM, 16 females had a family history of DM,15 females had history of PCO and 6 females were physically active out of thirty participants.

Table. I-Previous History of Study Population

Variable		Count	Group		P value (chi square)
			Experimental N=15	Control N=15	
GDM	YES	11 36.66%	6 54.5%	5 45.5%	0.705
	NO	19 63.33%	9 47.4%	10 52.6%	
F.H	YES	16 53.33%	6 37.5%	10 62.5%	0.143
	NO	14 46.67%	9 64.3%	5 35.7%	
PCO	YES	15	6 40.0%	9 60.0%	0.273
	NO	15	9 60.0%	6 40.0%	
ACTVITY STATE	YES	6	4 66.7%	2 33.3%	0.361
	NO	24	11 45.8%	13 54.2%	

GDM; history of gestational diabetes mellitus.
F.H; family history of diabetes mellitus.
PCO; polycystic ovary syndrome.
Activity state; physical activity state of population.
Stress; level of stress in patient

Mean diastolic BP in Experimental group was 86.33±6.114 and in Control group it was 90.00±9.258 with p value .211.Mean of systolic BP in Experimental group was 122.33±7.037 and in Control group it was 127.33±7.988 with p value .080.Mean of age in Experimental group was 31.53±2.924 and in Control Group it was 33.53±3.701 with p value .112.Mean BMI in Experimental group was 29.50±1.427 while in Control group it was 28.33±3.288 with p value.218.Mean weight in Experimental Group was 81.27±3.674 and in Control group it was 85.67±7.168 with p value .043.Mean diastolic BP in experimental group was 102.67±11.782 and in control group it was 100.67±12.799 with p value .660.Mean of systolic BP in Experimental group was 142.33±11.629 and in Control group it was 144.00±16.388 with p value .750.Mean of fasting plasma glucose in Experimental group was 218.53±41.933 and in Control group it was

283.00±97.409 with p value.026.Mean of 1 hour PG in Experimental group was 283.00±97.409 and in Control group it was 372.67±96.988 with p value .229 .Mean of 2 hour PG in Experimental group was 280.32±60.375 and in Control group it was 320.33±101.567 with p value .199.

Table. II

Independent T test showing comparison of means of baseline clinical parameters and age between two groups:

Variables	Study Group		P value (independentt te
	Experimental N=15	Control N=15	
Age	31.53±2.924	33.53±3.701	.112
BMI	29.50±1.427	28.33±3.288	.218
Current Weight	81.27±3.674	85.67±7.168	.043
Diastolic blood pressure	102.67±11.782	100.67±12.799	.660
Systolic blood pressure	142.33±11.629	144.00±16.388	.750
Fasting plasma glucose of Patient	218.53±41.933	283.00±97.409	.026
One hour plasma glucose of Patient	337.20±55.618	372.67±96.988	.229
Two hour plasma glucose of Patient	280.32±60.375	320.33±101.567	.199

Mean of fasting plasma glucose in Experimental group was 91.00±3.505 and in Control group it was 210.00±70.837 with p value less than 0.001.Mean of 1 hour PG in Experimental group was 174.67±4.593 and in Control group it was 295.33±76.846 with p value less than 0.001 Mean of 2 hour PG in Experimental group was 148.53±4.912 and in Control group it was 250.67±68.056 with p value less than 0.001.

Table. III

Independent T test showing comparison of means of post intervention clinical parameters between two groups:

Variables	Study Group		P value (independent t test)
	Experimental (N=15)	Control (N=15)	
Diastolic blood pressure	86.33±6.114	90.00±9.258	0.211
Systolic blood pressure	122.33±7.037	127.33±7.988	0.080
Fasting plasma glucose of Patient	91.00±3.505	210.00±70.837	<0.001
One hour plasma glucose of Patient	174.67±4.593	295.33±76.846	<0.001
Two hour plasma glucose of Patient	148.53±4.912	250.67±68.056	<0.001

4. Discussion

According to the present study, there were significant improvements observed in both the experimental and control group. However, mean score of the groups showed more improvement in experimental group, who received antenatal care combined with exercises as compared to control group. The control group received antenatal care only not showed much improvement in symptoms and decrease in blood glucose level as compared to the experimental group so they needed more dose of medicines and insulin to control their blood glucose level as compared to experimental group.The patients of experimental group showed marked reduction in antenatal and postnatal depression because of exercises and physical activity. Whereas there was no reduction in antenatal and postnatal depression in control group.

A study found that pregnant women with a predisposition to gestational diabetes mellitus could successfully reduce their blood glucose levels through moderate-intensity aerobic exercise. It revealed a significant decrease in fasting blood glucose and insulin levels in both groups, with a high statistically significant difference (p-value of 0.0001) favoring the interventional group. It relates to the current study as both studies revealed significant decrease in blood

glucose and insulin levels with a high statistically significant decrease in interventional group. [28]

According to the findings of another study, pregnant women who followed a modified GDM meal plan should walk for at least 25 minutes at either low or vigorous intensity if they were at low risk for GDM, or for 35–40 minutes at low intensity if they were at risk for GDM in order to achieve the best decline in glucose concentrations. However in current study daily brisk walk for about 30 minutes, Stationary cycling, modified yoga, modified Pilates, racquet sports were performed for 3 days/week for about 30-40 min at low to moderate- intensity. They only recommended walk to control GDM whereas current study also included other low impact safe aerobic exercises along with walk to control GDM. These exercises gave multiple effects along with GDM, such as lowering depression, weight gain, Diastolic and Systolic blood pressure in patients who have increased blood pressure during their pregnancies. [29]

A study demonstrated that high resistance exercise training may assist overweight women with gestational diabetes mellitus avoid insulin therapy, according to a systemic review and meta-analysis. In the current study low to moderate intensity aerobic exercises were applied and it showed considerable lowering of blood glucose level in patients of third trimester. We cannot recommend high intensity exercises as some high or moderate intensity resistance exercises can cause excessive exertion in females and have negative effects on pregnancy. [30]

Conclusion:

The study concludes that low impact exercises have an effect on Females in controlling their plasma glucose levels during third trimester. These exercises prevent the complications of gestational diabetes mellitus. Females who did these exercises along standard antenatal care for gestational diabetes mellitus have more controlled glucose level than the females who were only on standard antenatal care.

Recommendations:

The combination of various exercise interventions should be used to find their effect on blood glucose levels. At initial stage Gestational Diabetes Mellitus should be treated with exercises alone, but later combined with pharmacological interventions.

Long-term follow-up of therapies with more sample sizes is recommended as the main focus of future research studies. Some other exercises such as active and passive stretching can be incorporated in future studies.

Limitations of the study:

The limitations of current study are:

1. No long term follow up of patients was done after the interventions stopped to determine the maintenance effects.
2. Lack of resources.
3. Poor compliance of the patients with home plan provided.
4. More sample size for generalizability of results.

Disclosure & Conflict of Interest:

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