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Original Research Article

Effects of Exercise on Blood Glucose Level, Weight Gain and Pregnancy Outcome in Patients with Gestational Diabetes Mellitus

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Abstract

Background: The estimated prevalence of gestational diabetes mellitus worldwide is 17.8%. GDM can affect the health of mothers and their offspring due to transient abnormalities in carbohydrate metabolism. Women with GDM are at risk of adverse pregnancy outcomes.

Objectives: To find the effects of exercise on blood glucose level, weight gain and pregnancy outcome in patients with gestational diabetes mellitus.

Methods: A longitudinal follow-up study was carried out during September 2019 to August 2022 on 224 pregnant women with GDM at SHKBM hospital associated with Jhalawar Medical College, Jhalawar. Women were enrolled between 24 to 30 weeks of gestation. They were separated into two equal groups: exercise and control groups and followed till delivery.

Results: Mean age of participants was 28.78 ±4.6 years. Reduction in mean blood glucose level was significant in exercise group in comparison to control group ($p<0.05$). In exercise group mean weight gain during pregnancy was significantly less in comparison to control group ($p=0.02$).

Conclusion: Exercise is beneficial as a means of achieving better glycaemic control, gestational weight gain in women with GDM and thereby improving maternal and neonatal outcomes.

Keyword: Exercise, Blood glucose level, Gestational diabetes mellitus, Pregnancy outcome.

Introduction

Globally, the Gestational Diabetes Mellitus (GDM) has become a significant high incidence metabolic disorder [1]. Gestational diabetes mellitus (GDM) is a common complication of pregnancy; based on the diagnosis criteria published by the International Association of Diabetes and Pregnancy Study Groups (IADPSG), the estimated prevalence of GDM worldwide is 17.8% [2]. The incidence of GDM is increasing each year worldwide and the prevalence in low-income and middle-income countries has increased by >30% in the last 20 years [3].

Gestational diabetes mellitus refers to any degree of abnormal glucose tolerance first detected during pregnancy and it accounts for approximately 90%–95% of the total number of women with hyperglycemia during pregnancy [1,4]. Gestational diabetes

mellitus can affect the health of mothers and their offspring due to transient abnormalities in carbohydrate metabolism [5,6] Women with GDM are at risk of adverse pregnancy outcomes, such as preeclampsia, preterm delivery, macrosomia, hyperinsulinemia, polyhydramnios, fetal respiratory distress, infection and cesarean section than the general population [7,8]. Furthermore, both women with GDM and their infants are more likely to developing metabolic disorders such as type 2 diabetes mellitus, obesity, cardiovascular diseases and neuropsychological deficits later in life than the normal group [9,10].

Despite its severe repercussions, GDM is preventable, and if detected at an early stage, it can be reversed through appropriate interventions [11]. The management of GDM varies depending upon availability of resources. In daily practice, physicians use various medical, non-medical and combination of both to treat GDM.

The most common medical interventions include oral hypoglycaemic drugs and insulin therapy. Pharmacological treatment has its own challenges [12,13]. For this reason, non-pharmacological intervention should be recommended as the first line treatment option. This involves adopting lifestyle modifications such as diet control and exercise. Women with GDM are usually advised to first try controlling their glucose levels through diet control alone or in combination with physical exercise [14].

There has always been a controversy about exercising during pregnancy. For this reason, around 80% of pregnant women are physically inactive, increasing this inactivity during the last trimester of pregnancy. However, today it is known that there are many benefits that exercise offer to both the fetus and the mother [15,16]. Exercises which are considered safe and acceptable during an uncomplicated pregnancy are: walking, running or jogging, swimming, stationary cycling, low-intensity aerobics, modified pilates, yoga, resistance training, and stretching exercises [17]. The benefits of physical activity requires physical activity for 30 min at a moderate intensity for five days, or 150 min of aerobic activity every week on average, depending on the women's physical activity level or fitness status before pregnancy. In addition to other benefits, physical activity reduces the rate of GDM to those who perform it between three to twelve months regularly before or during the gestation period [18].

Objectives: To find the effects of exercise on blood glucose level, weight gain and pregnancy outcome in patients with gestational diabetes mellitus.

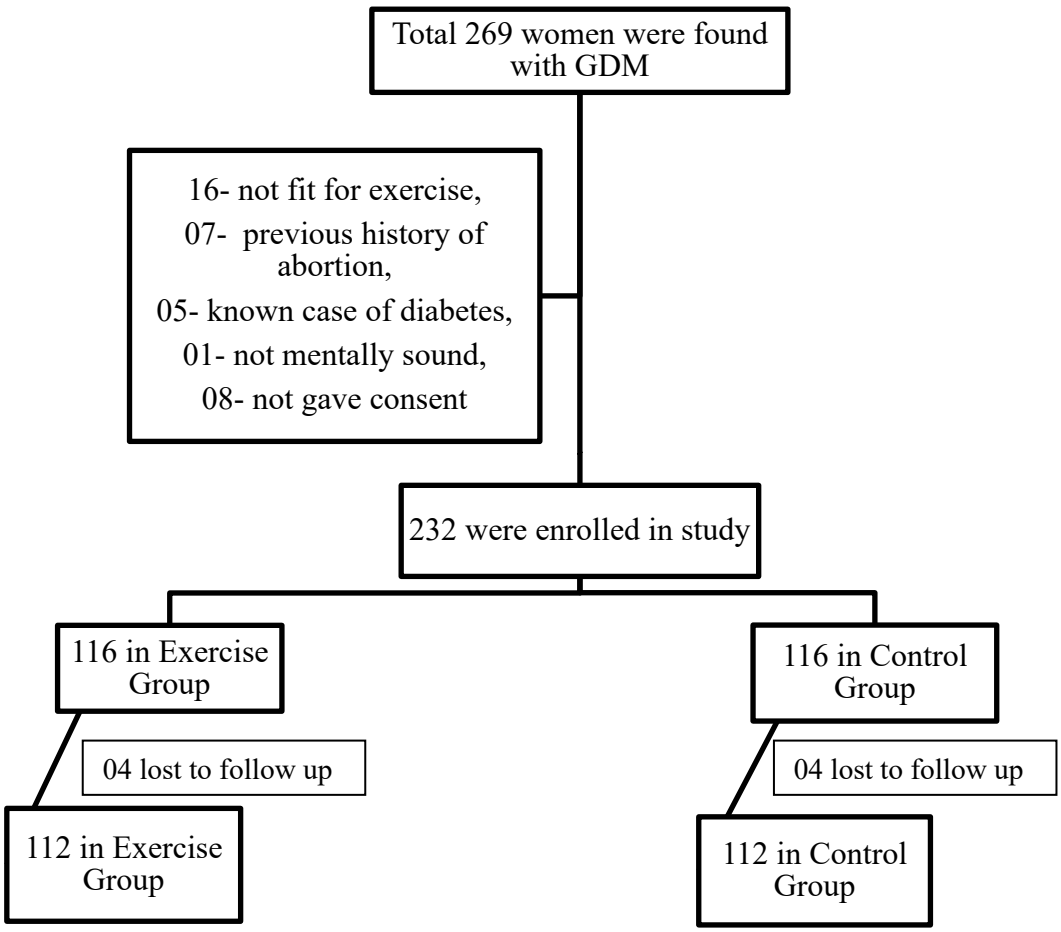
Material and Methods

A longitudinal follow-up study was carried out during September 2019 to August 2022 at SHKBM hospital associated with Jhalawar Medical College, Jhalawar. Women came for antenatal check-up and diagnosed as GDM were enrolled in study. Complete enumeration method and convenience sampling was used to enrolled participants.

Inclusion criteria included: 1) All adult pregnant women (age above 18 and below 40 years) diagnosed with GDM by standard Oral Glucose Tolerance Test as published by the International Association of Diabetes, 2) Single pregnancy, 3) Gestational stage was between 24 and 30 weeks (to allow for at least 6 weeks of intervention), 4) No contraindication for physical exercise (confirm by obstetrician and physician), 5) Resident of Jhalawar city (for feasibility of home visit), 6) Consenting woman.

Exclusion criteria included: 1) Previous diabetes, 2) Woman with severe obstetric complications and contraindications for exercise, 3) Previous history of abortion, 4)

Mentally not sound (not able to follow exercise schedule), 5) Non-consenting woman.



Flowchart 1

Total 269 women were found with GDM and among them 232 were enrolled in study (16- were not fit for exercise, 07- had previous history of abortion, 05- were known case of diabetes, 01- was not mentally sound, 08- did not gave consent). A simple random method was used to group the half of women in exercise group and half of women in control group. Under the supervision and guidance of obstetrician and physician, individual exercise plan was prepared for six weeks. Exercise includes walking, stationary biking, pelvic tilt, side plank, squats, breathing exercise and yoga.

Confirmation of exercise was done by personal visits and by telephone calls on daily basis. Except exercise protocol, exercise group and control group received the same personalized diabetes diet guidance, routine prenatal care, education intervention and treatment. Participants were followed-up throughout pregnancy and till delivery to assess various parameters such as blood glucose level, weight gain and maternal and infant pregnancy outcomes.

Statistical Analysis

SPSS 23.0 was used for data statistical analysis. All variables were described statistically. Quantitative data were described as the mean ± standard deviation and qualitative data were presented as

number and percentages. Student t-test and Chi square test was used for statistical association.

Ethical Clearances

Study was started after approval from Institutional Ethic Committee. Participants were enrolled after taking inform written consent.

Results

Based on inclusion and exclusion criteria, 232 women were enrolled in study. Half of participants (116/232) were grouped as exercise and control group. These participants were followed up till delivery. During follow up, four participants from each group were lost. So, final results were calculated for 224 participants (112 in each group). Mean age of participants was 28.78 ±4.6 years (exercise group-28.34±4.4, control group-29.10±5.2 years). Most of women (95.98%) were literate. Family history of diabetes was found in 42 (18.75%) women and among these, 23 were in exercise group and 19 were in control group.

Gestational age at diagnosis of GDM was 24.6±2.12 weeks in exercise group and 24.05±2.52 weeks in control group. No statistical differences were observed in baseline blood sugar level, weight and blood pressure in both groups (p>0.05).

Table 1: Comparison of participants characteristics between exercise and control group.

Variables	Exercise group (n=112)	Control group (n=112)	P value
Mean age	28.34±4.4	29.10±5.2	0.24
Education			0.66
Illiterate	04	05	
Primary	05	08	
Secondary	44	34	
Senior secondary	38	42	
Degree	21	23	
Family history of diabetes			0.49
Yes	23	19	
No	89	93	
Gestational age at diagnosis of GDM (weeks)	24.6±2.12	24.05±2.52	0.07
Weight at diagnosis of GDM (kg)	54.90±6.44	55.30±6.24	0.63
Height (cm)	152.2±8.5	154±7.2	0.08
Pre-intervention fasting blood glucose	156.1±12.6	153.6±14.8	0.17
Pre-intervention 2-hour postprandial blood glucose	264.2±23.52	259.4±22.8	0.12
SBP (mmHg)	122.80±16.6	120.2±15.8	0.23
DBP(mmHg)	76.88±8.8	75.64±10.2	0.33

Table 2: Comparison of blood glucose levels and weight gain in exercise group before and after intervention.

Parameters		Exercisegroup (n=112)	
Mean fasting glucose (mg/dL)	Before intervention	156.1±12.6	0.0001
	After intervention	136.6±8.2	
Mean 2-hour postprandial blood glucose (mg/dL)	Before intervention	264.2±23.52	0.0001
	After intervention	190.3±15.6	
Mean weight (in Kg)	Before intervention	54.90±6.44	0.0001
	After intervention	58.80±5.2	

Table 2 and 3 shows comparison of various parameters in exercise and control group before and after intervention. Mean fasting glucose and mean 2-hour postprandial blood glucose level was significantly reduced after six weeks exercise. Mean weight gain was approximately 4 kg in exercise group during intervention. Similar reduction in blood glucose level was observed in control group. Mean weight gain was approximately 5 kg in control group.

Table 3: Comparison of blood glucose levels and weight gain in control group before and after intervention.

Parameters		Control group (n=112)	P value
Mean fasting Glucose (mg/dL)	Before intervention	153.6±14.8	0.001
	After intervention	139.9±11.6	
Mean 2-hour postprandial blood glucose (mg/dL)	Before intervention	259.4±22.8	0.0001
	After intervention	198.4±21.4	
Mean weight (in Kg)	Before intervention	55.30±6.24	0.0001
	After intervention	60.20±3.6	

Table 4: Comparison of blood glucose levels and weight gain in exercise and control group after intervention.

Parameters (After intervention)	Exercise group (n=112)	Control group (n=112)	P value
Mean fasting glucose (mg/dL)	136.6±8.2	139.9±11.6	0.014
Mean 2-hour postprandial blood glucose (mg/dL)	190.3±15.6	198.4±21.4	0.001
Mean weight (in Kg)	58.80±5.2	60.20±3.6	0.02

Table 4 shows comparison of blood glucose levels and weight gain in exercise and control group after intervention. Reduction in mean blood glucose level was significant in exercise group in comparison to control group ($p<0.05$). In exercise group mean weight gain during pregnancy was significantly less in comparison to control group ($p=0.02$).

Table 5: Comparison of pregnancy outcomes in exercise and control group.

Variables	Exercise group (n=112)	Control group (n=112)	P value
Premature rupture of membranes	12	19	0.17
Preterm birth	13	24	0.04
Prolonged labor	5	7	0.55
Cesarean section	38	53	0.04
Newborn weight	2.62±0.6	2.88±0.8	0.006
Macrosomia	03	06	0.30
Fetal distress	12	16	0.41

Table 5 shows pregnancy outcome in exercise and control group. Preterm birth (p=0.04), delivery by cesarean section (p=0.04) and birth weight (p=0.006) were significantly high in control group.

Discussion

This study was carried out to find effects of exercise on blood glucose level, weight gain and pregnancy outcome in patients with gestational diabetes mellitus. For that, 232 women were enrolled and followed up till delivery. Due to lost to follow-up of 08 women, final result was considered for 224 participants. these 224 participants were divided equally into exercise and control group. Exercise in cases of uncomplicated pregnancies has been known to be beneficial and may have longterm positive effects on maternal health. Among the maternal benefits are decreases in cramps, lower back pain, oedema, depression, urinary incontinence, the duration of labour, and constipation as well as the number of caesarean sections of the mother. Physical activity has benefits for the fetus: decreased fat mass, improved stress tolerance, and advanced neurobehavioral maturation, among others [19,20] On the other hand, there are severe restrictions to exercise in circumstances such as heart or lung problems, cervical incompetence, threatened labour, or premature rupture of the membrane, pre-eclampsia or severe anaemia [21].

In present study, mean age of participants was 28.78 ±4.6 years (exercise group-28.34±4.4, control group-29.10±5.2 years). Gestational age at diagnosis of GDM was 24.6±2.12 weeks in exercise group and 24.05±2.52 weeks in control group. Reduction in mean blood glucose level was significant in exercise group in comparison to control group ($p<0.05$). In exercise group mean weight gain during pregnancy was significantly less in comparison to control group (p=0.02). Pregnancy outcome was positively affected by exercise.

Zhao Huifen *et al* [22]. conducted study on 99 patients with GDM. They found that blood glucose levels in both groups were lower after the intervention compared with before intervention ($p<0.05$). After intervention, the average fasting blood glucose, the 2 h postprandial blood glucose, the utilization rate of insulin, the amount of insulin, gestational weight gain and blood pressure ($p<0.05$) in the experimental group were lower than the control group. Although there was no statistical significance in the incidence of adverse pregnancy outcomes between the two groups after intervention ($P > 0.05$).

The results of this study conducted by Barros and Brankston *et al* [23,24] were different on blood glucose control, which may be due to the difference in intervention time and resistance exercise forms. Systematic review don by José Alberto Laredo-Aguilera *et al* [25]. confirms the benefits of physical activity on fasting, postprandial glucose, and HbAc1 control in pregnant women with GDM during pregnancy.

Conclusion

For women with GDM, exercise is beneficial as a means of achieving better glycaemic control, gestational weight gain thereby improving maternal and neonatal outcomes. Exercise significantly decreases adverse pregnancy outcomes. While exercise provides the greatest benefit but diet is also important factor to control glucose values. Patients can choose the type of exercise intervention they prefer, considering factors such as comfort, available resources, and exercise of light to moderate intensity.

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