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DIETARY INTERVENTION AND NEONATAL BIRTHOUTCOMES & HEALTH STATUS: AN INTERVENTONAL STUDY AMONG GESTATIONAL DIABETIC MOTHERS AT TERTIARY CARE UNITS IN PESHAWAR, PAKISTAN

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Abstract

Background: *Commonly called as diabetes of pregnancy, Gestational Diabetes Mellitus (GDM) has been linked to adverse fetal-maternal outcomes threatening the life of both mother and fetus and pose a serious risk of perinatal outcomes. The true prevalence of glucose intolerance during pregnancy in Pakistan is still to be determined, However, these mothers need proper dietary interventions for better outcomes both in terms of maternal and neonatal health.*

Objectives: *To analyze the impact of nutritional counseling among GDM mothers the complications associated with delivery outcomes and neonatal health status.*

Methodology: *Target population was the registered cases of pregnant mothers with GDM in Khyber Teaching Hospital, Health Care Center, and Kalsoom Maternity Home Peshawar, Pakistan. Seventy-three gestational diabetic patients were selected for the counseling purpose by through written consent at the Gynae departments of these hospitals. This experimental study was based on counseling procedures, specifically designed diet plan and psychological support. The patients were provided with individualized diet plans based on the specific needs of the mothers either alone or with their prescribed pharmacological therapy and were followed till the termination of pregnancy/Birth. The neonatal birth outcomes were analyzed and compared for the results of diet plan alone and with medications.*

Results: *The present research revealed that dietary intervention either diet alone therapy or diet with insulin therapy exert a positive effect on the reduction of severity of complications associated with the outcome of delivery and neonatal health status. The length of gestation was improved with the dietary intervention. 71.2% patients reached to the full term. The*

rate of normal vaginal delivery was much high as compared to C-section and instrumental deliveries. 68.5% patients underwent normal vaginal delivery. Similarly, the dietary intervention exhibited a positive effect on the outcome of delivery as 91.8% patients delivered live babies without any injury or birth defect. Health status of the neonates after delivery showed a better improvement in the present research. 94.52% neonates were delivered with normal birth weight that is > 3.0 kg. Similarly, the effect of dietary intervention on the blood glucose levels of the neonates showed that 87.67% neonates were delivered with normal range of blood glucose level.

Conclusion: *It was observed that appropriate dietary management in gestational diabetes mellitus help reduce hyperglycemia to normoglycemic levels and aids in minimizing the complications linked with delivery outcomes and neonatal health status.*

INTRODUCTION

Gestational Diabetes Mellitus is a global health concern and prevailing immensely worldwide especially in developing countries. It is associated with substantial maternal, fetal and neonatal morbidity and mortality. Furthermore, it is also associated with long-term consequences for the mother. Gestational diabetes mellitus (GDM) is a metabolic condition that occurs in pregnancy. In this condition, pregnant mothers who did not have diabetes prior to pregnancy presents a newly developing hyperglycemia and this condition normally resolves after giving birth [1].

Gestational diabetes mellitus (GDM) is a state of hyperglycemia (fasting plasma glucose ≥ 5.1 mmol/L, 1 h ≥ 10 mmol/L, 2 h ≥ 8.5 mmol/L during a 75 g oral glucose tolerance test according to IADPSG/WHO criteria) that is first diagnosed during pregnancy [3]. GDM is one of the most common medical complications of pregnancy, and its inadequate treatment can lead to serious adverse health effects for the mother and child (4,5).

GDM is prevalent worldwide due to advance maternal age, BMI higher than 24.9 kg/m^2 and reduced physical activity. GDM occurs due to the inability of the mother's pancreas to adjust to the increased insulin demand throughout gestation. During pregnancy, the body becomes insulin resistant in order to ensure adequate glucose supply to the growing fetus, therefore, the beta cells of the pancreas excrete increase amount of insulin to maintain the blood glucose level within normal range [6].

This insulin resistance is a normal metabolic change in healthy pregnancy which is induced by placental hormones to ensure the fetus receives the necessary nourishment for proper growth and development. Maternal beta cells respond by increasing their number, insulin production, and release to sustain glucose balance despite insulin resistance [2]. The insulin resistance is due to the placental hormone estrogen, cortisol, and human placental lactogen which block the effect of insulin. This is called contra-insulin effect, which usually begins about 20 to 24 weeks into the pregnancy. As the placenta grows, more of these hormones are produced, and the risk of insulin resistance becomes greater. Normally, the pancreas is able to make additional insulin to overcome insulin resistance, but when the production of insulin is not enough to overcome the effect of the placental hormones, gestational diabetes results.

Early detection and proper treatment of GDM is essential as it exerts both short- and long-term harmful impact on the mother and the fetus. Short-term pregnancy complications of GDM include high blood pressure, pre-eclampsia, difficulty during childbirth and a cesarean section (6, 24). Long term consequences include the reoccurrence of GDM in subsequent pregnancies and the mother may prone to develop type 2 diabetes later in life [7. 8]. GDM increases the risk of complications, including cardiovascular disease, obesity, and impaired carbohydrate metabolism, leading to the development of type 2 diabetes (T2DM) in both

mother and infant [9-11]. In addition, GDM harms the fetus as the growing fetus can only produce a small amount of glucose; hence, it gets the majority of its glucose from the mother's blood. Another harmful effect of GDM on the fetus is an increase in neonatal size at birth, also known as macrosomia and and estimated 15%-45% macrosomic babies are born in to GDM mother with complications of prematurity, shoulder dystocia due to an abnormal labor via C-section and hypoglycemia and respiratory distress [12, 14].

GDM requires proper dietary control and pharmacological intervention in order to minimize the risks associated with hyperglycemia for both the mother and the baby. Nutritional recommendations help women to achieve normoglycemia, optimal weight gain and proper development of the fetus [3]. The dietary strategy for treating GDM include the DASH diet (dietary techniques to treat hypertension), calorie-restricted diets, low-glycemic index diets, low-carbohydrate diets, low-unsaturated fat diets, high-fiber diets, and soy-based diets. The emphasis of nutritional advice should be on a balanced diet with reasonable portion sizes, healthy fats, complex carbs, and 20% protein 40–50% of the energy requirement should come from carbohydrates, that is 180 g/day, and consist mainly of starchy foods with a low glycemic index (GI), 25–28 g of fiber per day should be given to the GDM patient which means a portion of about 600 g of fruit and vegetables per day with a minimum of 300 g of vegetables, whole grain bread, pasta and rice Recommended 30% of the caloric value should be fulfilled with protein intake that is about 1.3 g/kg of body weight, with the minimum recommended daily intake of 71 g of protein. Increased intakes of plant protein, lean meat and fish, and reduced intakes of red and processed meats are beneficial in the treatment of GDM and may improve insulin sensitivity [3, 15-20].

A diet with a high fat content should be avoided as it leads to placental dysfunction and infant obesity, increased inflammation and oxidative stress, and impaired maternal muscle glucose uptake. 20–30% of the caloric value is recommended, including < 10% saturated fat. Dietary errors should be treated pharmacologically in those patients who cannot achieve glycemic targets with a properly balanced diet. Insulin therapy is considered the safest form of treatment to control hyperglycemia in pregnant mothers. Orally administrated drugs can cross the placental barrier but it should be introduced only in the case of the patient's lack of consent to insulin therapy or its unavailability [21-25].

1. METHODOLOGY

2.1: Study design & Sample

It was a hospital based experimental study in which a counseling procedure was used to give information to the selected patients. Information about the risk factors, medical history and complications of GDM was collected through a structured questionnaire. A face-to-face interview with the gestational diabetic patients was taken and reviewed the antenatal cards and pathologists results in antenatal phase.

2.2: Dietary Counseling

Patients were given personalized diet plan and strictly advised to follow it and explained the benefits of dietary intervention. Those patients who were on insulin therapy were also given the diet therapy and weekly diet plans.

2.3: Post Pregnancy Assessment

The patients were also investigated for the results of diet plan on the complications of gestational diabetes mellitus after delivery.

2. RESULTS AND DISCUSSION

1. NEONATAL GESTATIONAL AGE AT BIRTH

Table-1 and Graph 1 shows both the frequency and percentage of gestation age at delivery of GDM patients after the dietary intervention. Result shows that dietary intervention put a positive effect on the length of gestation as 71.23% patients reached to full term delivery due to controlled hyperglycemia through dietary intervention either diet therapy alone or diet with insulin therapy. According to the results, seventeen patients with 23.29% reached to late preterm whereas only four patients with 5.48% underwent early preterm labor. The results on modes of delivery displayed in table 1 shows that after dietary intervention, fifty patients underwent normal deliveries with 68.49% followed by twenty-two cases of cesarean deliveries with 30.14%. The rate of

cesarean deliveries can be minimized through controlling hyperglycemia. Only one patient had instrumental vaginal delivery. According to the results on the delivery outcomes of GDM patients after intervention displayed in table 3.31 indicated greater ratio of live birth neonates as sixty-seven patients with 91.78%. Four patients delivered live neonates but with injury. However, two patients delivered stillborn babies.

Table-1:NEONATAL GESTATIONAL AGE AT BIRTH

Variables	Frequency	Percentage
Gestation age at delivery		
< 32 weeks	4	5.48
32-36 weeks	17	23.29
> 37 weeks	52	71.23
Mode of delivery		
Normal	50	68.49
Assisted	1	1.37
Cesarean	22	30.14
Outcome of delivery		
Live birth	67	91.78
Live birth with injury	4	5.48
Still born	2	2.74

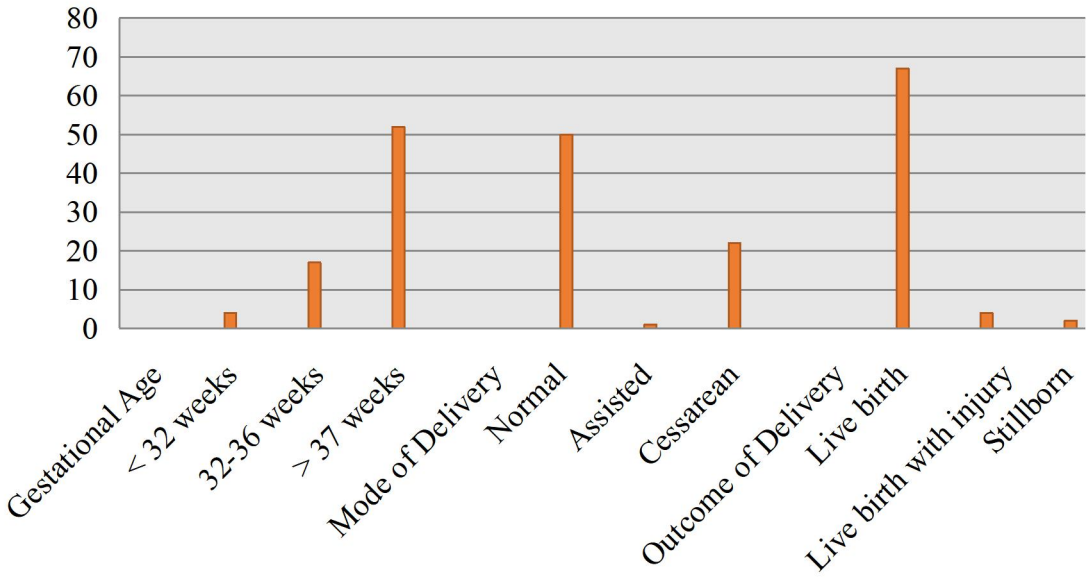

Figure 2: Neonatal Gestational age at Birth

2. EFFECT OF DIET THERAPY ON GESTATIONAL LENGTH AND AGE OF THE NEONATES

Table 2 and Graph 2 exhibit the descriptive analysis of the diet therapy and length of gestation. According to the findings of the present research both diet therapy alone and diet with insulin therapy has a positive effect on the length of gestation. Trends in births by gestational age in GDM patients are displayed in figure 3.4, which show that almost 71.2% of the patients either receiving diet therapy alone or diet with insulin therapy reached to the full term. However, those who received diet with insulin therapy had slightly lower rate of reaching full term as compared to those who received the diet alone therapy. The cross-tabulation data in table 3.32 (a) showed that percentage of patients reached to early preterm deliveries were same that is 2 each for both diet alone therapy and diet with insulin therapy. Whereas slight difference was observed in the number of patients reached to late preterm in both type of therapies that is 21.1% patients were those who received diet alone therapy and 25.7% patients were those who received diet with insulin therapy. A notable difference was observed in the number of patients in both therapies reached to the full-term delivery. 73.7% patients who reached to the full term belonged to the group of diet alone therapy as compared to 68.6% patients of diet with insulin therapy. From the above results, it can be concluded that the diet alone therapy was as much effective as the diet with insulin therapy in increasing the length

of pregnancy. The present findings regarding the length of gestation confirmed that diet improves the condition of hyperglycemia which in turn reduces the complications of pregnant mothers associated with gestational diabetes mellitus allowing the mothers to reach to full term during gestation. Furthermore, we observed that the patients who received diet therapy alone had slightly higher rate of reaching to the full-term delivery. This shows that diet therapy is effective for those patients who maintain their fasting blood sugar below 105 mg/dl and random blood sugar below 140 mg/dl as they don't need insulin therapy.

TABLE-2: GESTATIONAL LENGTH, AGE AND DIET THERAPY Therapy

		Diet alone	Diet and Insulin	Total
<32 weeks	Count	2	2	4
	% within Therapy	5.3%	5.7%	5.5%
32-36 weeks	Count	8	9	17
	% within Therapy	21.1%	25.7%	23.3%
≥ 37 weeks	Count	28	24	52
	% within Therapy	73.7%	68.6%	71.2%
Count		38	35	73

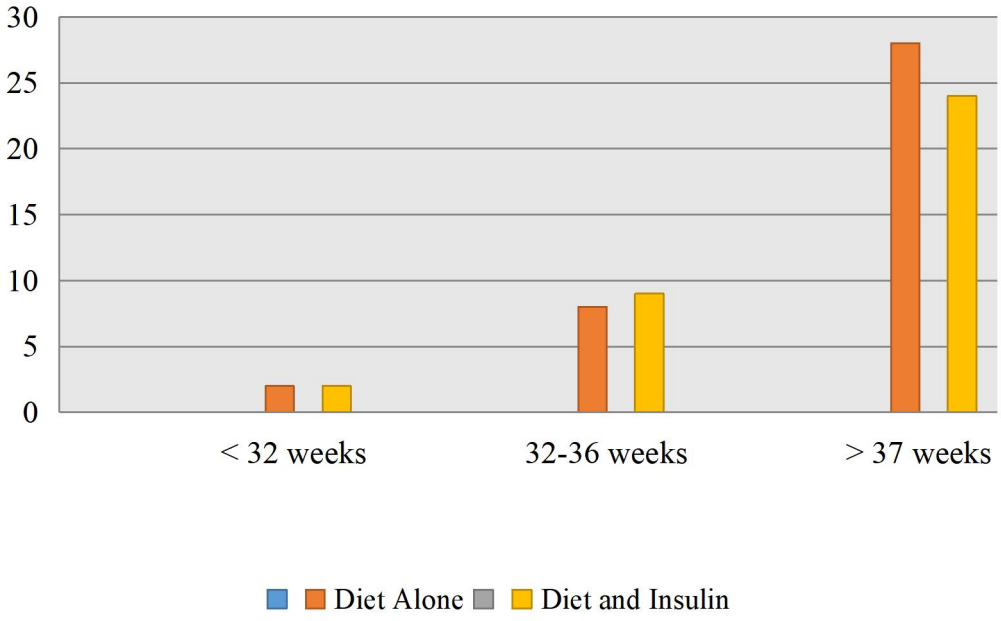

Figure 2: **Gestational Length, age and Diet Therapy**

3. MODE OF DELIVERY OF THE NEONATES BORN TO GDM MOTHERS

Table 3 and Graph 3 shows cross tabulation the diet therapy and mode of delivery. The present research illustrated that diet therapy can exert a positive effect on the mode of deliveries of GDM patients. We observed that about 68.5% of the patients had a normal vaginal delivery. Cesarean section delivery rate in our findings was 30.1% especially in those patients who had uncontrolled hyperglycemia. Mode of deliveries by GDM patients are displayed in figure 3.5, which show those who received diet with insulin therapy had slightly lower rate of normal deliveries and higher rates of caesarian deliveries as compared to those who received the diet alone therapy. The data in table 3.33 (a) showed comparatively lower rate of normal deliveries in patients who received the diet with insulin therapy. 76.3% of the patients who undergone the normal delivery had received the diet alone therapy as compared to 60.0% of the patients who received the diet and insulin therapy. A clear difference was observed in cesarean deliveries by the patients that is 23.7% of the patients had caesarian deliveries were those who received the diet alone

therapy as compared to 37.1% for those who received diet and insulin therapy. Only one patient had assisted delivery who received the diet and insulin therapy.

Table-3: Diet Therapy and Mode of Delivery

Mode of delivery	Percent Distribution	Therapy		Total
		Diet alone	Diet and Insulin	
Normal	Count	29	21	50
	% Within Therapy	76.3%	60.0%	68.5%
Assisted	Count	0	1	1
	% Within Therapy	.0%	2.9%	1.4%
C-section	Count	9	13	22
	% Within Therapy	23.7%	37.1%	30.1%
Count		38	35	73

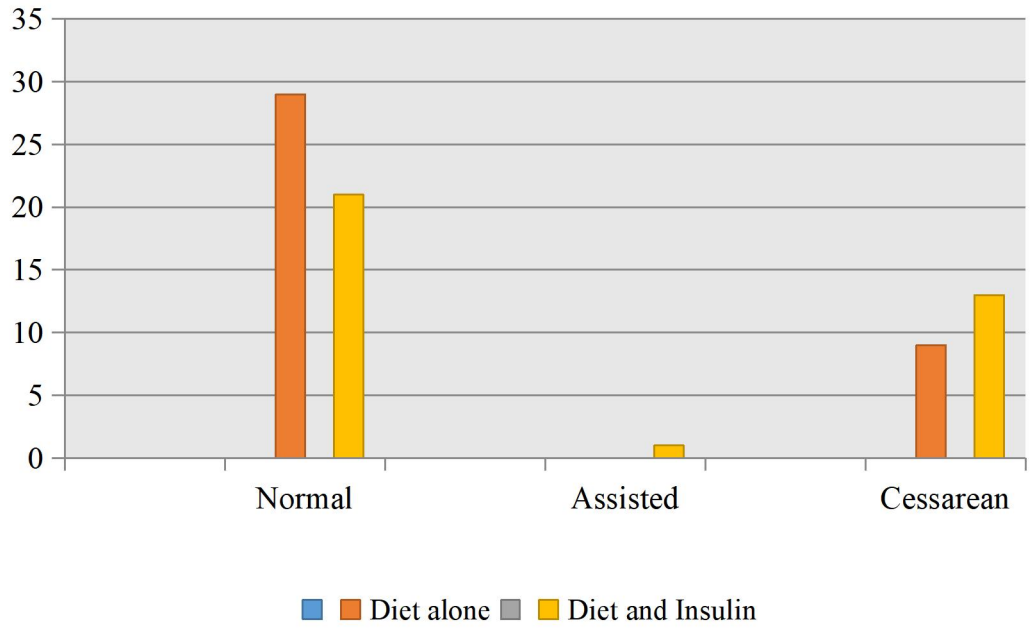

Figure 3: Frequency of mode of delivery within the diet therapies

4. BIRTH OUTCOMES OF THE GDM MOTHER ON DIETARY THERAPIES

The present research revealed that diet therapy alone or diet therapy with insulin results in better outcome of deliveries displayed in figure 3.6 illustrated that on average 91.8% GDM patients deliver live babies without any injury or birth defect. Table 4 and Figure 4 demonstrated the cross tabulation of delivery outcomes by the patients within diet therapy. The result showed slightly higher rate of live births of the neonates in patients who received the diet alone therapy. 97.4% live births of the neonates without any injury were observed in patients who received diet alone therapy as compared to 85.7% of live births without any injury born to the patients received diet with insulin therapy. Three babies were delivered alive but with birth injury to the mothers who received diet with insulin therapy whereas one patient who received diet alone therapy gave birth to one alive baby but with injury. Two patients who received diet with insulin therapy delivered stillborn babies as they were suffered from pre-eclampsia along with GDM and could not control the complications. From the above results, it can be concluded that the

diet alone therapy was as much effective as the diet with insulin therapy on the outcome of delivery.

Table-4: Diet Therapy and the Outcome of delivery

Mode of Delivery/Births		Therapy		Total
		Diet alone	Diet and Insulin	
Live birth	Count	37	30	67
	% Within Therapy	97.4%	85.7%	91.8%
Live birth with injury	Count	1	3	4
	% Within Therapy	2.6%	8.6%	5.5%
Still born	Count	0	2	2
	% Within Therapy	.0%	5.7%	2.7%
Count		38	35	73

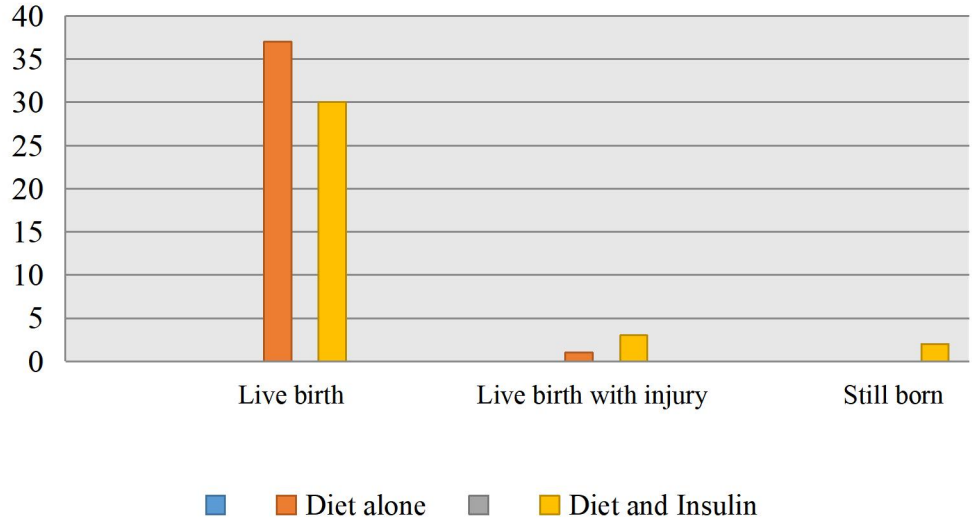

Figure 4: Frequency of outcome of delivery within the diet therapy

5. NEONATAL HEALTH STATUS BORN TO GDM MOTHERS RECEIVING DIETARY INTERVENTIONS

Table 5 and Graph 5 compare the birth weight and blood glucose level of the neonates delivered to GDM patients. According to the result, the frequencies of birth weight and blood glucose level of neonates after delivery. Higher percentage about 94.52% of neonates delivered with normal birth weight. Three patients delivered premature babies whereas one patient delivered macroscopic baby. Blood glucose values of the neonates at birth showed that 87.67% had normal blood glucose level. Six neonates were found hypoglycemic. Only two neonates exhibited slightly high blood glucose level.

Table-5: Neonatal health status born to GDM Patients receiving dietary intervention

Variable	Frequency	Percentage
Birth weight		
< 2.5 kg	3	4.11
2.5-4.0 kg	69	94.52
> 4.0 kg	1	1.37
Blood glucose		
< 70 mg/dl	6	8.22
70-90 mg/dl	64	87.67
> 90 mg/dl	2	2.74

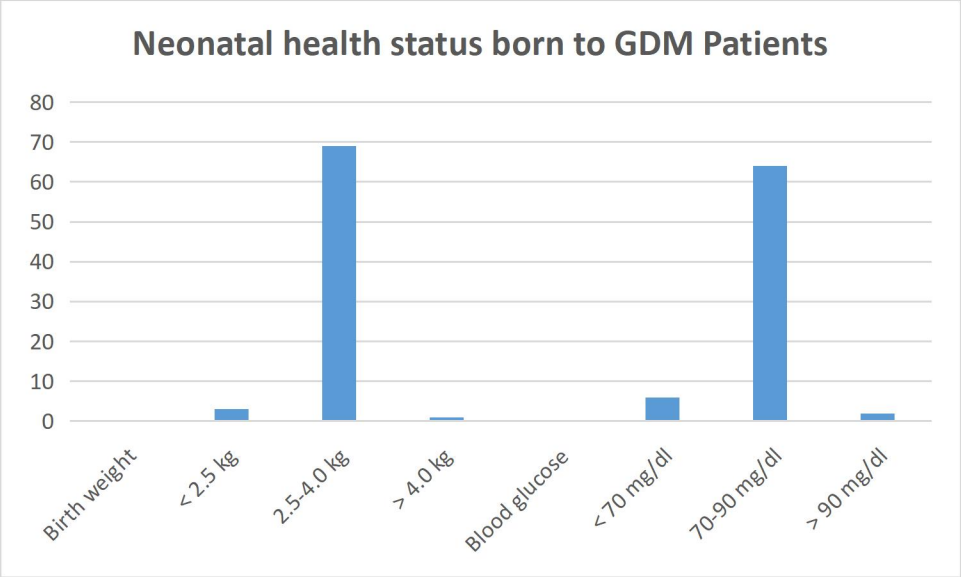

Figure 5: Neonatal health status born to GDM Patients

6. EFFECT OF DIET THERAPY & BIRTH WEIGHT OF THE NEONATES

The present findings on the effect of diet therapy on the birth weight of neonate revealed that both diet therapy alone and diet therapy with insulin exert a positive effect on the birth weight of the neonates as shown by the cross tabulation of diet therapy and birth weight of neonates in table 3.36 (a). Birth weight of the infants born to GDM patients are displayed in figure 3.7, which show that almost 94.5% of the patients either receiving diet therapy alone or diet with insulin therapy delivered normal birth weight infants. However, those who received diet with insulin therapy had slightly lower rate of delivering normal birth weight infants as compared to those who received the diet alone therapy. The data in table 6 and Figure 6 showed that all those patients who were on diet alone therapy delivered normal birth weight infants. However, 88.6% of the patients who were on diet with insulin therapy delivered normal weight infants. Whereas 3 patients delivered low birth weight babies and one patient delivered macrocosmic baby that is above 4.1 kg were those who received diet with insulin therapy. The result demonstrated that diet plan is an effective measure for those who are either treated with diet alone therapy or diet with insulin therapy

Table-6: Effect of Diet Therapy and the Birth Weight of the infant

Birth Weight of Infant			Therapy		Total
			Diet alone	Diet and Insulin	
1.	< 2.5 Kg	Count	0	3	3
		% Within Therapy	.0%	8.6%	4.1%
2.	2.5-4.0 Kg	Count	38	31	69
		% Within Therapy	100.0%	88.6%	94.5%
3.	> 4.0 Kg	Count	0	1	1
		% Within therapy	0%	2.9%	1.4%
Total		Count	38	35	73

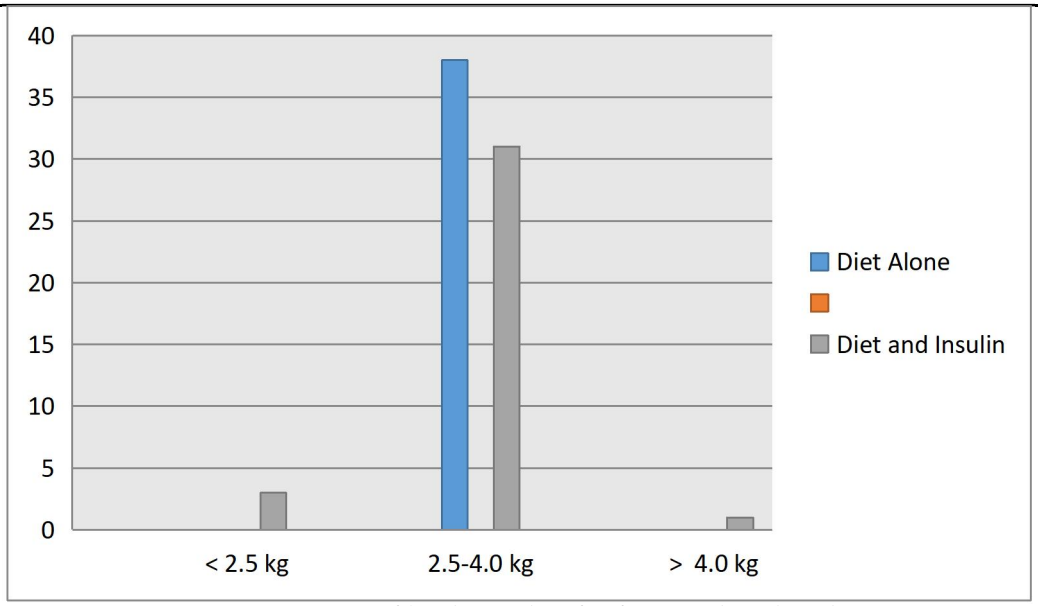

Figure 6: Frequency of birth weight of infants within diet therapy

7. EFFCET OF MATERNAL DIET THERAPY ON THE NEONATAL GLYCEMIC REGULATION AT BIRTH

Dietary intervention exerts a positive effect on the blood glucose level of the neonates as illustrated by table 7 and graph 7 demonstrated the frequency of blood glucose level of neonates born to GDM patients received diet alone therapy or diet with insulin therapy. Blood glucose level of infants born to GDM patients are displayed in figure 3.8, which show that 88.9% of the infants had normal range of blood glucose level that is fall between 70-90 mg/dl born to the patients either receiving diet therapy alone or diet with insulin therapy. Neonates born to patients who were on diet alone therapy had higher percentage of normal blood glucose level as compared to those infants who were born to the GDM mothers received diet with insulin therapy. The data in table 3.37 (a) showed that 97.4% infants had normal blood glucose level born to GDM mothers received diet therapy alone as compared to 79.4% infants having normal blood glucose level born to mothers who were on diet with insulin therapy. Low blood glucose level that is below 70 mg/dl was noted in 5 infants born to mothers of diet with insulin therapy as compared to one infant born to mother of diet alone therapy. Only two infants reported to have higher range of blood glucose level that is > 90 mg/dl born to the mothers who were on diet with insulin therapy. The result demonstrated that diet plan is highly effective measure for those who are either treated with diet alone therapy or diet with insulin therapy.

Table-7: Effect of the Diet Therapy on the Blood Glucose level of the infant at Birth

Blood Glucose	Sample Distribution	Therapy		Total
		Diet alone	Diet and Insulin	
< 70 mg/dl	Count	1	5	6
	% Within Therapy	2.6%	14.7%	8.3%
70-90 mg/dl	Count	37	27	64
	% Within Therapy	97.4%	79.4%	88.9%
> 90 mg/dl	Count	0	2	2
	% Within Therapy	.0%	5.9%	2.8%
Total	Count	38	34	72

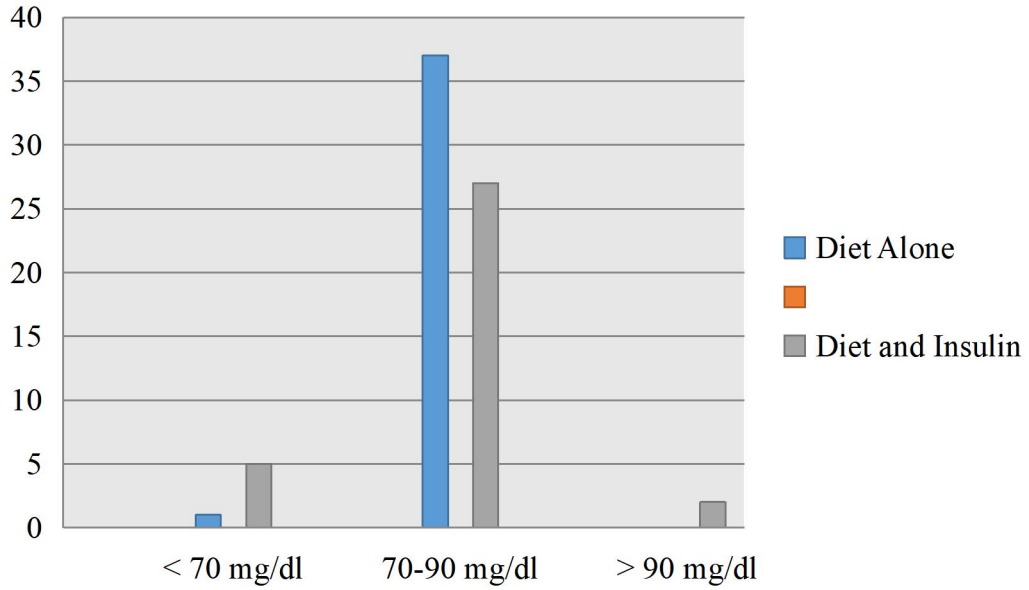

Figure 7: Blood Glucose Level of infants within diet therapy

4. CONCLUSION

The current study can be concluded on the facts that dietary regulation of the GDM mothers exert significant positive impacts on the birth outcomes and neonatal status. This study also highlights the role of nutrition education and the mass level in the prevention and well being of the mothers of this region.

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