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Depression, Gestational Diabetes Mellitus and the Impact on Pregnancy Outcomes: A Hospital based study from Bangladesh

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ABSTRACT

Background: Data regarding Gestational Diabetes Mellitus (GDM) and Depression in Bangladesh are inadequate. Though we have sufficient information on depression and diabetes especially during pregnancy but information about depression and gestational diabetes and the consequences are very scanty in Bangladesh. This comparative, longitudinal research study was done to better understand the relationship between gestational diabetes and depression, and the outcome of pregnancy. GDM effects fetal growth is well stablish but whether and how depression aggravates the condition was another specific objective to find out from this study. Mode of delivery, fetal morbidity and mortality and postpartum depression as a consequent was also tried to explore. Moreover this study focused on other principal social factors which might have influence over this condition

Methods: 748 pregnant women participated in the study (366 with GDM, 382 without GDM) among them 734 completed the whole. Depressive symptoms was scored following MADRS scale. To detect GDM, Blood glucose was measured following WHO and ACOG criteria. Delivery procedure, Complications, Birth weight and APGAR score at 1st and 5th minute were assessed for the outcome measurement.

Results: Prevalence of Post-Partum Depression (PPD) was 8.6% (lower than antenatal) and the mean depressive score was 18.63 ± 6.98 (more than antenatal). Six subjects experienced neonatal death. Prevalence of persistent diabetes after delivery was 1.6%. Prevalence of PPD was higher in groups; aged between 26-35 years (73%), housewives (71.4%), dependents (73%), coming from rich family (47.6%) and urban dwellers (71.4%). GDM subjects with PPD delivered slightly earlier (36.58 ± 1.19) than women without GDM and without PPD (37.35 ± 1.00). GDM and PPD both had significant associations ($p < 0.001$) with Gestational Age at delivery, Neonatal birth weight and APGAR scores.

Conclusion: This study supported the trend of PPD and GDM but need more qualitative and longer follow-up to specifically chalk-out the problem. As maternal health being the ultimate necessity to keep the future generation free of non-communicable diseases, developing countries should focus more on mental health.

Keywords: Pregnant mother; Depression; Postpartum depression; Gestational Diabetes Mellitus; Pregnancy outcome; Neonate; Bangladesh.

ABBREVIATIONS

WHO: World Health Organization; DAB: Diabetic Association of Bangladesh; BIRDEM: Bangladesh Institute of Research and Rehabilitation for Diabetes, Endocrine and Metabolic Disorders; DM: Diabetes Mellitus; GDM: Gestational Diabetes Mellitus; NGDM: Non-Gestational Diabetes Mellitus; PPD: Post-Partum Depression; NCD: Non-Communicable Diseases; FPG: Fasting Plasma Glucose; 2hPG: 2 hours after 75 g Plasma Glucose; MADRS: Montgomery-Asberg Depression Rating Scale; BMI: Body Mass Index; WHR: Waist Hip Ratio; CS: Caesarean Section; NVD: Normal Vaginal Delivery; APGAR: Appearance, Pulse, Grimace, Activity, Respiration; HTN: Hypertension; CI: Confidence Interval; OR: Odds Ratio

INTRODUCTION

Diabetes and depression, both are common in pregnancy and result serious concerns for maternal and foetal health. Gestational Diabetes Mellitus (GDM) occurs about 14% of pregnancy all over the world [1]. Some studies found there was a 122% rise in the prevalence of GDM between 1989 and 2004 [2]. Freshly documented reports say that there are more than 200,000 pregnancies which are complicated by GDM each year [3]. Potential lifelong metabolic problems may occur in children as a consequence of exposure to a hyperinsulinaemic foetal environment. Therefore GDM has great public health significance, both for improving pregnancy outcomes and identifying women and children at risk of future type 2 diabetes and GDM in the female offspring. In Bangladesh some population-based studies have revealed an increasing trend of GDM prevalence ranging from 6% to 14% in different time period [4,5].

Depression affected more than 350 million people and counted as one of the leading causes of disability worldwide. Prevalence of depressive disorders in Bangladesh is 4.6%. [6] It is also projected that non-communicable diseases would increase many folds in 2020 in developing countries. Bangladesh with 218 million population would be over 60 years by 2050 which guarantees a high dependency ratio and high NCD burden [7] WHO has included mental health in NCD burden and producing plans to fight it. Researches on depression showed their incidences to be two to threefold increase during the perinatal period, which includes pregnancy (antepartum) and the first months following delivery (postpartum). Postpartum depression is common and is defined as any non-psychotic depressive illness occurring during the first postnatal year. One study from India showed 15.8% prevalence of PPD [8]. Study from rural community of Bangladesh revealed that prevalence of antepartum depression was 18% and the incidence proportion of PPD was 8% at 2-3 months of postpartum and 18% at 6-8 months of postpartum [7]. Other 2 studies from southwest part of Bangladesh have reported the prevalence of antepartum depression to be 33% and postpartum depression to be 22% [9,10].

In spite of the association between depression and diabetes (both type) there are gap of knowledge on gestational diabetes and depression. Hyperglycaemia and depletion of brain monoaminergic activity specifically the serotonin (5-hydroxytryptamine [5-HT]) are the risky complications occurring in GDM. They are proved to be related to depression [11]. A cross-sectional, descriptive study revealed more than half of the participants (57%) were with gestational diabetes, 70% risk for preterm delivery and 33.3% incidence rate of depression among the uncomplicated pregnant women (≥ 16 on the CESD) [12]. A study conducted in New Jersey found, prevalence of depression during pregnancy or postpartum was 15.2% in subjects with GDM but only 8.5% in subjects without GDM [13]. Other researchers revealed women with pre-existing diabetes had 54% higher odds of any antenatal depression compared to those without diabetes [14].

Despite these findings, depression remains to be underdetected and undertreated especially in pregnancy. Very few observational studies have examined the association between these disorders

during the pregnancy period, but no interventional study report was found in Bangladesh while this paper was prepared. Thus we feel in Bangladesh this data is really fewer. To meet up the necessity of what are the outcome of depressive mother with or without GDM was a new approach to develop interventional model for the pregnant mothers.

The Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM); a concern of Diabetic Association of Bangladesh (DAB), has probably one of the largest outpatient departments in Asia, enrolling 80-100 new patients with diabetes per day and 2500-3000 diabetics seeking routine follow-up and specialized care every day [15]. From, August 2011 to September 2012 a total of 491 new GDM subjects were registered. DAB synchronizes thousands of researches related to diabetes every year. The patients who attend this hospital are bound to attend the health educational classes while they are being registered as diabetic. They get the diabetic controlling education there. But when someone is detected with depression nothing more or special is added to her educational module. This study was expected to help the health education setup to improvise their module in case of depressed mothers and achieve a better pregnancy outcome.

The main objectives of the study were to find out the prevalence of depression in postpartum period and evaluate the pregnancy outcome among mothers who were attending BIRDEM hospital. Another objective was to compare both the measurements between pregnant mothers with GDM and without GDM. Beside the study objectives to get a reflection of causes behind depression was an extra effort of this study, though not published in this paper.

METHODS

Design

The original study was a comparative longitudinal study. Current study is the later part of the research exploring pregnancy outcome of depressed mothers with or without GDM. Data was collected at different steps. The first one was between 24th to 28th weeks of gestational period, and 2nd one was taken within one week after delivery. The principal researcher approached each pregnant women individually while they were attending a routine perinatal care visit at outdoor department of BIRDEM hospital.

Time period

This study was conducted from August 2011 to September 2012.

Piloting

A pilot study was done prior to the study between June & July 2011 to calculate the sample size. Fifty GDM subjects and 50 subjects without Gestational Diabetes Mellitus (NGDM) were selected to find out the prevalence of depression among them. It was found that 32 and 19 subjects were depressed among GDM (64%) and NGDM (38%) group respectively.

Sample size

From, the formula $(z^2 \times pq) \div d^2$ ($z = 1{,}96$ $p = 0{,}64$ $q = 1\text{-}p$ $d = 0{,}05$)

The sample size was calculated for GDM n = 354, for control NGDM n = 350

Sample selection

For ease of calculation and to avoid wash out a total of 400 newly registered pregnant women with GDM and total of 400 pregnant women NGDM abnormality were approached and responded to take part in the study considering the exclusion criteria. But later 748 women (382 with GDM and 366 with NGDM) could continue for the first part of study and 734 could continue till the second part.

Exclusion criteria

Subjects with pregnancy over 28th week, diagnosed diabetes prior to pregnancy, twin pregnancy, old registered GDM subjects (previous pregnancy), complications due to medical disorder, depression diagnosed before pregnancy and subjects unwilling to participate (specially to give contact no) were excluded. Fourteen cases with foetal death (still birth 24 < 28 week) could not be included in few final analysis particularly for this paper.

Diagnosis of gestational age

The gestational age was determined for all of the women based on the last menstrual period and according to the findings of ultrasonography performed between 8th to 20th weeks of gestation. Gestational age at delivery was documented.

Face to face interview

At the first visit, data on sociodemographic status and personal information was collected using a pretested semi structured questionnaire. The questionnaire consisted of closed-ended questions, such as; age, educational background, religion, occupational status, self-income (if) and average household income (classified relative to the minimum wage), obstetric history, history of diabetes, mental disorder (depression), specific drug intake, personal habits and lifestyle, family history of diabetes, hypertension and mental illness.

Assessment of depressive symptoms

In 1979, Montgomery and Asberg developed a quantitative tool for depression rating scale with 10 questions. The sum of each item is from 0 to 6 thus total sum of the questionnaire ranges from 0-60. Since its development, the Montgomery and Asberg Depression Rating Scale (MADRS) has been widely used all over the world, including Bangladesh, Pakistan and Sri Lanka. In Bangladesh MADRS was started to use as a research tool through Diabetic Association of Bangladesh specially in the projects in joint collaboration with Oslo University, Norway. Azad Khan AK et al and Bhowmik B et al has already several papers published to establish the tool in Bangladesh [16,17]. The rating is based on a clinical interview moving from broadly phrased questions about symptoms to more detailed ones which allow a precise rating of severity. MADRS scores are categorized into 4 groups, Healthy (0-12), Mild depression (13-19), Moderate depression (20-34), and severe depression (35-60) [18]. The questionnaire was translated into local language 'Bangla". Principal researcher was specially trained to conduct the interview by a psychiatrist in Norway who has extensive experience in assessing the depression score by MADRS, during her PhD study. Face to face interview was used for this measurement. Both the interviews at mentioned visits, depression was measured. If someone was found depressed an additional open ended standardized question was put to find out the cause.

Diagnosis of GDM

The diagnostic test for GDM was done between 24th and 28th weeks of pregnancy. For screening WHO and American Congress of Obstetricians and Gynaecologists (ACOG) criteria was used [19,20]. Venous blood samples were collected in the morning after

an overnight fast of atleast 8 h and 2 h after administration of 75 gm oral glucose. At least 3 days of unrestricted diet and regular physical activity was ensured. Venous Plasma Glucose (VPG) was measured by the glucose oxidase method using Dimalesion RxL Max (Siemens Healthcare Diagnostics Ltd., Camberley, UK). The women were diagnosed as a Case of GDM if: Plasma Glucose found ≥7.0 (WHO) or ≥5.3 mmol/L at. Fasting, and ≥8.6 mmol/L at 2 h after 75 gm Glucose intake (ACOG), (which ever detected first). After delivery again same method of blood collection was done for each GDM subjects and Diabetes was defined if; FPG value was ≥7.0 mmol/L and/or 2hPG was ≥11.1 mmol/L. Random blood glucose (≥11.1 mmol/L) was done for the rest of appointments for NonGDM subjects.

Gestational assessment at and after delivery

For mothers complications during pregnancy (other than GDM also), ongoing treatment, gestational age at delivery, mode of delivery (spontaneous vaginal delivery, caesarean, instrumental delivery), complications during delivery (lacerations, post-partum haemorrhage, prolonged labour) were documented.

For Foetus and Infant Intrauterine foetal condition (from record book), complication during delivery (shoulder dystocia, meconium and nuchal cord), birthweight, gender and APGAR score at 1st and 5th minute were documented after delivery.

Data analysis and statistical methods

The prevalence rate of Depression, in total population and in classified groups, was determined by simple percentages. Normality test was done prior to other tests preferring Shapiro-Wilk model (p = 0.000). Socio demographic state was also presented through simple percentage form. Statistical comparisons of delivery mode and few other factors, between different groups were evaluated using chi-square test. Independent sample T test were done to explore the association between GDM and Non-GDM group for pregnancy outcome and neonatal status, maternal age and gestational age. Using SPSS 23 for all statistical analysis (SPSS Inc., Chicago, IL, USA).

ETHICS

The protocol was approved by Ethical Review Committee of Diabetic Association of Bangladesh. The principal researcher discussed the study to every interested pregnant. If the patient agreed to participate, informed written (with signature or thumb impression) consent was received (from all subjects). Objectives and the procedure of study were oriented to the subjects, including their right to refuse and withdraw at any stage of the study or to bar their data from analyses. All information and data collected were deemed confidential. All subjects received a hardcopy of their own biochemical results.

RESULTS

Overall prevalence of depression (18.32%) and the associated factors (higher in GDM subjects = 25.92% compared to without-GDM subjects = 10.38%) are the results we found in the previous part of the study and has been described earlier [15]. In this part of the study or the current study we found a total of 734 women in their post natal period to interview. Among the total study population with whom we started 8 with GDM and 6 NGDM dropped due to still birth. From this population (734) total 63 subjects (8.6%) found to be depressed, where 48 (76.2%) subjects detected to have GDM and 15 (23.8%) were not with GDM (NGDM). Mean depressive score did not vary much between the two periods; during pregnancy (18.10 ± 5.04) and after delivery 18.63 ± 6.98).

On the other hand persistence of diabetes found only in 6 subjects (1.6%) who were diagnosed as GDM in their pregnancy period. Subjects with GDM were more aged (28.35 ± 5.34 years) compared to NGDM (27.17 ± 4.39 years) in term of mean age at the time of pregnancy. On the contrary mean age of depressed women during pregnancy was less (27.71 ± 4.51) than non-depressed (28.07 ± 6.48) and Post-Partum Depressed (PPD) (29.84 ± 4.59) women. Statistically age had a significant relation with depression also (p <.001).

Prevalence of PPD was higher in groups; aged between 26-35 years (73%), housewives (71.4%), dependants (73%), coming from rich family (family income more than 20001/-BDT) (47.6%) and urban dwellers (71.4%). Among the subjects with postpartum depression 8% found with GDM and 1.6% did not cure from diabetes after delivery. As well as 76% PPD subjects were suffering from depression from the beginning of pregnancy and 9.5% of the subjects with PPD reported that they had suffered from depression in their

Table 1: Socio-demographic variables of depressed mothers.

Characteristics	Subjects with Depression during pregnancy n. (%)	Subjects with Depression after pregnancy n. (%)
N = 748 (%)	137 (*18.32*)	63 (8.6)
AGE		
≤18	3 (*2.2*)	
18-25	41 (29.9)	12 (19.0)
26-35	85 (62.0)	46 (73.0)
36-45	8.0 (*5.8*)	5 (7.9)
EDUCATION YEARS		
0	1 (.7)	1 (1.6)
1-5 yrs	8 (5.8)	8 (12.7)
6-12 yrs	46 (33.6)	27 (42.9)
> 13 yrs	82 (59.9)	27 (42.9)
OCCUPATION		
Housewives	85 (62.0)	45 (71.4)
Students	16 (11.7)	3 (4.8)
Labours and Farmers	1 (0.73)	1 (1.6)
Business and Others	1 (0.73)	
Service holders	34 (24.8)	14 (22.2)
SELF INCOME		
< 5000 tk	3 (2.2)	2 (3.2)
5001-10000 tk	2 (1.5)	1 (1.6)
10001-15000 = 3	9 (6.6)	2 (1.5)
15001-20000 = 4	10 (7.3)	3 (4.8)
> 20001 = 5	14 (10.2)	9 (14.3)
Dependant = 6	99 (72.3)	46 (73.0)
FAMILY INCOME		
< 5000tk = 1		3 (4.8)
5001-10000tk = 2	9 (6.6)	7 (11.1)
10001-15000 = 3	26 (19.0)	6 (9.5)
15001-20000 = 4	39 (28.5)	17 (27.0)
>20001=5	63 (46.0)	30 (47.6)
DWELLING PLACE		
Urban	71 (71.7)	45 (71.4)
Semiurban or Rural	28 (28.3)	18 (28.6)
History of depression		
Self reported	1 (0.7)	6 (9.5)
diagnosed	12 (8.8)	
Sedentary Life	7 (5.1)	10 (15.9)
No Physical Exercise	102 (74.5)	39 (61.9)
Depression at pregnancy		48 (76.2)

earlier pregnancy also. Ten subjects with PPD lead sedentary life and 40 did not do any physical exercise.

Average gestational age at delivery was 36.96 ± 1.16 week. GDM subjects with PPD delivered slightly earlier (36.58 ± 1.19 weeks) than women without GDM and without PPD (37.35 ± 1.00 week). Overall rate of CS was very high in the study (63%) as predicted. Rate of NVD was comparatively higher in NGDM (58.7%) and without depression (40%) group. Instrumental delivery was measured but the rate was too small (0.4%). Type of delivery was made a dichotomous variable to do chi-square analyses, where only vaginal delivery and caesarean section delivery were analysed. The complications during delivery were also dichotomous where no complication was considered one group and presence of all complications (laceration, heavy bleeding and prolonged labour) was considered as another group.

An important issue found from the study was as predictable by all human nature mothers will suffer from mental pain after their children's death. In this study also all mothers (statistically 100%) suffered from postpartum depression. Relating to the child death another weak point for the researcher was 14 subjects who was included in the study from the beginning could not continue till the end due to loss of their fetus (still birth). The descriptive statistics and frequency tables were also completed for women with GDM, NGDM, with and without depression during pregnancy.

From, total 748 pregnant cases we got 728 alive babies (97%)

Table2: Pregnancy outcome of the participants.

Characteristics	Whole Population (%)	Subjects without GDM n. (%)	Subjects with GDM n. (%)	Subjects without Depression n. (%)	Subjects with Depression n. (%)	Subjects without PPD n. (%)	Subjects with PPD n. (%)
Antenatal participants n=748 Post-partum participants n=734		366 (48.93)	382 (51.07)	611 (81.68)	137 (18.32)	671 (89.8)	63 (8.6)
Mean Age	27.77 ± 4.93	27.17 ± 4.39	28.35 ± 5.34	28.07 ± 6.48	27.71 ± 4.51	27.61 ± 4.95	29.84 ± 4.59
Mean Gestational week at delivery	36.96 ± 1.16	37.35 ± 1.00	36.58 ± 1.19	36.98 ± 1.16	36.84 ± 1.20	37.04 ± 1.01	36.40 ± 1.82
Mode of Delivery							
CS	471 (63)	148 (40)	323 (84.6)	364 (59.6)	107 (78.1)	411 (61.3)	53 (84.1)
NVD	274 (36.6)	215 (58.7)	59 (15.4)	245 (40)	29 (21.2)	260 (38.7)	10 (15.9)
Instrumental	3 (0.4)	3 (0.8)	-	2 (0.3)	1 (0.7)		
Maternal Complications during delivery							
Laceration	17 (2.3)	12 (3.3)	5 (1.3)	13 (2.1)	4 (2.9)	15 (2.2)	
Heavy bleeding	5 (0.7)	2 (0.5)	3 (0.8)	4 (0.7)	1 (0.7)	5 (0.7)	2 (3.2)
Prolonged labour	5 (0.7)	3 (0.8)	2 (0.5)	3 (0.5)	2 (1.5)	5 (0.7)	
Neonatal condition							
Alive	728 (97.3)	358 (97.8)	370 (96.9)	594 (97.2)	134 (97.8)	671 (89.7)	57 (7.6)
Still birth	14 (1.9)	6 (1.6)	8 (2.1)	12 (2)	2 (1.5)		
Neonatal Death	6 (0.8)	4 (0.5)	4 (1)	5 (0.8)	1 (0.7)		6 (0.8)
Neonatal Complications during delivery							
Shoulder dystocia	5 (0.7)	5 (1.4)	-	5 (0.8)	1 (0.7)	5 (0.7)	
Meconium	11 (1.5)	7 (1.9)	4 (1)	10 (1.7)	-	10 (1.5)	1 (1.6)
Nuchal Cord	3 (0.4)	2 (0.5)	1 (0.3)	3(0.5)	-	2 (0.3)	1 (1.6)
others	2(0.3)	2 (0.5)	-	2 (0.3)	-	2 (0.3)	
Mean Birthweight	2.97 ± 0.37	2.92 ± 0.35	3.01 ± 0.38	2.96 ± 0.0.37	2.99 ± 0.37	2.95 ± 0.36	3.17 ± 0.44
APGAR							
1st minute	6.81 ± 1.30	7.16 ± 1.34	6.47 ± 1.15	6.93 ± 1.20	6.25 ± 1.16	6.88 ± 1.26	5.90 ± 1.31
5th minute	7.54 ± 1.22	7.83 ± 1.21	7.26 ± 1.17	7.63 ± 1.20	7.16 ± 1.13	7.61 ± 1.19	6.66 ± 1.28
Gender							
Male	421 (56.3)	214 (58.5)	207 (54.2)	349 (57)	72 (52.6)	387 (57.7)	33 (52.4)
Female	312 (41.7)	144 (39.3)	168 (44)	250 (40.9)	62 (45.3)	284 (42.3)	30 (47.6)
Depression detail							
population	137(18,32)	38(10,38)	99(25,92)				
Mild	95 (12,70)	27(7.401)	68(17.801)				42 (66.7)
Moderate	41 (5,48)	11 (3.001)	30 (7.901)				17 (27.3)
Severe	1 (0,13)	0	1 (0.301)				4 (6.3)
Mean		4.42 ± 5.89	8.33 ± 7.23		18.10 ± 5.04		18.63 ± 6.98

till the date of last data collection. Fourteen experienced still birth, where 8 cases were with GDM and 2 with mild antenatal depression. Later on 6 subjects (0.8%) experienced neonatal death and 2 of them had GDM and one with mild antenatal depression. According to the chi-square results, there was a significant difference in the type of delivery between women with and without GDM [$\chi 2$ (1) = 156.018, p = <.0001] where GDM subjects had significantly more caesarean sections than non-GDM. Like previous study [20] statistical tests proved, GDM had a significant association with depression even after delivery ($\chi 2$ = 16.55, p = < 0.001), Gestational Age at delivery (t = 9.58, p < 0.001) Neonatal birth weight (t = -3.375, $p \leq 0.001$) and APGAR scores at 1st (t = 7.51, p < 0.001) and 5th (t = 6.64, p < 0.001) minute.

Independent-Sample T sample tests were done to explore the association between PPD and Maternal age; gestational age at delivery (t = 2.99, p < 0.01); Neonatal birth weight (t = 3.58, p < 0.001); APGAR score at 1st (t = 5.82, p < 0.001) and 5th (t = 6.09, p < 0.001) minute. Results found significant association between postpartum depression and other five factors (maternal age, gestational age at delivery, neonatal birth weight and APGAR scores at 1st and 5th minute) . History of previous or earlier depression was not associated with postpartum depression, gestational age at delivery and APGAR at 1st and 5th minute.

DISCUSSION

From, the year 2004 the research team is exploring the prevalence of Diabetes and depression in different group of people in Bangladesh. This particular study is the second part of the specific research on pregnant women exploring the association between GDM and Depression and some other related factors. The principal aim of the whole study was explained earlier. Prevalence of depression after pregnancy was found around 9%, whether during pregnancy it was found 18.32%. One study assessed that mood state during pregnancy [21] improves in the second and third trimesters in patients experienced depression in the first trimester. Thus the decline was expected. The dropping rate can be described similarly with another study [8] where the last trimester's depression fell down from 18% to 14% at 2-3 months of pregnancy. This finding differs with the results from a systematic review of perinatal depression from rich countries, where an upward trend was observed in the first 3 months postpartum [13] and also some studies from Neighbouring countries like India (19-22%) [22,23] and Pakistan (15-28%) [24]. It would be more clear if long term follow up could made possible in this study also. Assuming from common human nature that a healthy newborn always brings peace and happiness to mother and family, we can explain the reason beneath decreasing prevalence of depression in postpartum period especially in cases of mothers with GDM which exposed an extra mental stress during pregnancy.

Mean age was higher (29.41 ± 4.52) in 'Post-partum depressed' group than 'during pregnancy depressed' group. Subjects who delivered a bit earlier were found to have Postpartum depression in comparison to the non-depressive mothers Depression found in 26-35 years age group mostly in both stages (during pregnancy 62% and post-partum 73%). Statistically age had a significant relation with depression also (p <.001). With age, anxiety and stress increases, that might be the reason of depression in both the stages of perinatal period. Other study also supports the statement that younger women have lesser rates of depression than women of advanced maternal age [25]. Although women with GDM were found to have higher mean depressive scores (18.17 ± 5.22) with GDM than without GDM (17.92 ± 4.57) during pregnancy but PPD mothers scored the highest (18.63 ± 6.98). This is predicted specifically because of the loss of neonate which turned them severely depressed and effected statistically on mean depressive score. But on contrary a research from UK said that "Symptoms of depression are not more common or severe after childbirth than during pregnancy" [25]. Literature from different part of the world indicated that physical activity has a better association with mental health. Our study also found that not doing any physical activity might be a factor for depression during (74.5%) and after (61.9%) pregnancy.

Table 3: Independent t-tests for infant outcomes in women with and without gdm.

Variable	Df	t statistic	*p* value
Gestational age at delivery	746	9.58	0.000
Birth Weight	732	-3.37	0.001
1 min Apgar	732	7.51	0.000
5 min Apgar	732	6.64	0.000

Table 4: Independent t-tests for infant outcomes in women with and without ppd.

Variable	D_f	t statistic	*p* value
Age	732	-2.80	0.005
Gestational age at delivery	732	2.99	0.003
Birth Weight	732	-3.58	0.000
1 min Apgar	732	5.82	0.000
5 min Apgar	731	6.09	0.000

Educated women (more than primary level) seem to have more risk of depression in both stages of pregnancy. As found in earlier study this result coincides. But most of the other researchers did not justified the educational level is a factor for perinatal depression [26].

Occupation could not be included in the significant findings as most of the participants were housewives so it could not reflect the occupational influence on PPD.

Surprisingly subjects who were dependent financially with highest family income group scored more mostly in both types of depression (46% during and 47% after pregnancy). Other literatures also found 'finance' as an important factor but little influential [27]. It can be assumed that depression related to pregnancy actually is not strong dependent on finance.

Dwellers of urban suffered from perinatal depression around 71.4%. The trend was same for gestational depression also. Study in Canada matches with the trend that urban women scored more in depression rating scale than semi urban or rural [28].

Another important finding was that women with a history of depression were more likely to have GDM. This finding suggests that a history of depression is a risk factor in development of GDM, but not for PPD. Antenatal depression is the strongest risk factor for postnatal depression and it increases in severity from the first to the second trimester, negatively affecting fetal development and neonatal outcome. There are different reviews on this particular issue where no solid conclusion regarding this relationship could be found [29]. Regarding GDM persistence of diabetes found in only 6 subjects (1.6%) who were diagnosed as GDM in their pregnancy period. The rate was very low when compared to other studies; 7.3% in Philippine [30], 15.1% in Korea, [31] 13.4 % in Taiwan [32] and 13.1% in China

[33]. This difference may be explained as, the criteria were not always same. Moreover greater proportion of participants were with low level of Blood sugar and thus the recovery chance increased when treated properly. The blood glucose and related issues will be clarified in detail elsewhere. While doing the statistical analysis (independent sample t test) age and gestational age at delivery had a significant association with GDM ($p < 0.01$). Studies from other researchers also suggested the same as they found older maternal age remained associated with increased risk of preterm birth (OR 1·33 [95% CI 1·05–1·67]), after adjustment [34].

The outcomes of depression related pregnancy was analyzed by following points: gestational age at delivery, type of delivery, maternal complication (fever, postpartum haemorrhage) and others related to delivery, foetal status at birth (weight, macrosomia) Apgar scores at 'first' and 'fifth' minutes, and complications related to delivery (shoulder dystocia, presence of meconium, nuchal cord).

Women with GDM had delivered slightly earlier may be because they were at risk of foetal macrosomia and induction at 36 weeks probably reduces the rate of macrosomia [35]. Surprisingly who delivered earlier (mean gestational age at delivery 36.40 ± 1.82 weeks) suffered PPD. Though this statement of delivering earlier with GDM and depression than without GDM and depression was not significant statistically [t = 3.65, $p = 0.299$] but clinically important. Depressed women both in stages of antenatal and post-natal delivered earlier. A study from Iran corresponded with this as they found significant association between depression during pregnancy and preterm labour ($p < 0.001$) [36]. It was marked that women with GDM had significantly more caesarean sections (84.6%) than women without GDM (40%), which correspond with other research [37]. Depressed women also under gone CS (78.1%) than non-depressed women (59.6%). This finding correlates with previous researches [26,38]. Women without GDM were more likely to have delivery related complications (3.3% laceration); which would make sense, since they were more likely to deliver vaginally. On the other hand depressed subject had more laceration though not significant (2.9%) than non-depressed women (2.1%).

Fourteen percent cases of still birth and 16% cases of neonatal death had antenatal depression but statically ($X^2 = 0.91$ and 0.92 respectively) had no significant relation with neonatal or foetal death but PPD was strongly related as 100% case of neonatal death mothers got PPD. Studies suggested that post-natal depression could be strongly associated with increased risk of infant mortality especially for low-and-middle income country. A study from Ghana found PND was associated with an almost threefold increased risk of mortality up to 6 months (adjusted rate ratio (RR), 2.86 (1.58 to 5.19); $p = 0.001$) [39]. Neonatal complications during delivery was minimal and nothing found significant with diabetes and or depression.

Different studies from Scandinavia, Pakistan, Ethiopia, Peru and Bangladesh found strong association between maternal depression and low birth weight and preterm delivery [40-44]. But current study though agrees with second part of the statement not first one of low-birth weight.

Rather Mean neonatal birthweight was slightly higher in GDM (3.01 ± 0.38), depression (2.99 ± 0.37) and PPD (3.17 ± 0.44) than subjects without any complains. Independent t-sample tests found very strong association among the issues ($p < 0.001$) which means neonatal birth weight had strong relationships with depression in opposite direction.

While measuring APGAR; neonates from mothers with GDM, depressed and PPD had lower scores in both the 1st and 5th minutes reading. Statistical tests also proved to find highly significant relationship both for GDM and PPD ($p < 0.001$). The study by Byron M A found conflicting result with high APGAR score. Studies from other sides have shown depressed mother who are taking serotonin uptake inhibitor as treatment had low APGAR score which indirectly supports current study findings, because none of our subjects were diagnosed depressed clinically thus no drug was used [45].

Among the alive neonates still the end of study 420 were male and 314 were female. Mothers with PPD had no statistically proven association with gender. Somehow it is pretended in our country female babies are not well accepted by the family especially with low income which causes the mother to face social blame in turn depression arises. But in this study the cause is faded.

LIMITATIONS

Patients could not be followed up after one week of delivery, but the risk of developing postpartum depression was left still. Also the mothers with still birth were missing which was another important part of the mental health study. Causes of depression need to be elaborately explored which was not possible in this study. The diagnostic tool for depression measurement was an epidemiological tool rather than a clinical one. Need of treatment remained obscure.

CONCLUSION

The study was an attempt to find out the outcome of pregnancy with Depression and especially with GDM. Both the diseases are uprising worldwide and expected to have serious consequences with maternal and child mortality and morbidity. Mothers with physical and mental complications gave bigger babies with low APGAR score, which sinks with risk alarm for maternal and child health. But more factors which could be associated with depression especially in post-partum period remained undiagnosed due to the limitation of the study. Thus more study with in depth focus on maternal and fetal health and longer observation is recommended.

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