

The Effect of Gestational Diabetes on Placental Weight in Sudanese: A Comparative Study

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Abstract

Gestational diabetes may cause some structural alterations of placenta. To find out the effect of gestational diabetes on placental weight in a singleton pregnancy, a case control study was conducted in Omdurman Maternity Hospital, Khartoum (January 2015–September 2017), after due approval from institutional research committee, Alzaeim Alazhari University. The subjects were mothers who delivered in the hospital. Cases were selected randomly, and divided in two groups: group B consisted of mothers having normal pregnancy, group A consisted of mothers whose pregnancies were complicated by gestational diabetes mellitus. The data was managed statistically by SPSS. A total of 385 placentae were collected, 128 were gestational diabetic placentae (Group A) and 257 were normal placentae (group B). The mean placental weight in group A was 660 ± 116 gm (range, 470–900), while it was less in group B as 545 ± 206 (range, 300–900), and the difference was significant (P -value < 0.021). In conclusion there is significant increase in the placental weight in gestational diabetes placentae.

Keywords

Placenta, Gestational Diabetes Mellitus, Normal Pregnancy, Placental Weight, Parity, Body Mass Index

1. Introduction

The placenta is a new organ formed in the uterus during pregnancy, creating a vital connection between the developing baby and the mother and it is an important organ for maintaining and continuing healthy pregnancy [1]. It is usually regarded as a fetal organ although it contains maternal and fetal vascular beds that are juxtaposed. It receives the highest blood flow of any fetal organ (40% of fetal cardiac output) and towards the end of pregnancy, competed with the fetus for maternal substrate, consuming the major fraction of glucose and oxygen taken up by the gravid uterus [2]. It transfers and exchanges oxygen and nutrition needed for fetus from the maternal circulation to the umbilical circulation and vice versa [1, 3, 4], as well as producing and transporting some growth hormones, including generating the amount of enzyme [3, 4].

Fetal growth was influenced by the interaction of the mother, placenta, and fetus [3, 4, 5]. So, the ability of the fetus to grow and thrive in utero depends on the placental

function and weight [5]. The examination of placenta would demonstrate significant information about whatever has happened in fetus [1].

Placental weight reflects placental development and functions and is correlated with maternal age, gestational age, parity, route of delivery, and infant's gender. Increase in placental size is an independent predictor of birth weight [6]. The weight of the placenta has been varied in different studies over the many years but many studies show that it has an average weight of about 590 grams with a range of 350 to 750 grams [7].

GDM is a pathological condition, in which women without previously diagnosed diabetes exhibit high blood glucose levels during pregnancy, irrespective of whether it is treated with diet or insulin, which disappears or maintains after pregnancy [8]. It affects 2 to 5% of all pregnancies [6, 7, 9]. During pregnancy extra demand on the pancreas causes some women to develop gestational diabetes [9]. In the presence of diabetes, the placenta undergoes a variety of structural changes that consequently affect placental function [10, 11].

This study focuses on the effect of gestational diabetes mellitus on the placental weight.

2. Material and Methods

The placentas of 385 women; 257 control (group B) and 128 with GDM (group A), were studied after acceptance of the pre-given informed consent and approval by the research committee, Faculty of Medicine, Alzheim Alazhari University, Sudan. The selection criteria were singleton delivery at term (37–40 weeks), The gestational age was estimated using with known last menstrual period (LMP) and mothers' willingness to participate in the study after explanation. Women with a history of pre-gestational diabetes or hypertension or other chronic diseases or with more than singleton pregnancy or with intrauterine fetal death were excluded. The placentae were collected in a clean tray. An accurate preparation of the placentas was performed by trimming off all membranes, superficial fetal vessels were drained of all blood and adherent blood clots were removed from the maternal surface, the umbilical cord was severed at the insertion site on the placenta surface.

Then the placentae was put in a hard surface for detailed examination and measurements. The weighing of each placenta was accomplished within one hour after delivery. The placenta was weighed two times on a calibrated digital device in grams. After measuring the weight of the placenta, weight of newborn baby was obtained, foeto-placental weight ratio calculated. Placental coefficient was calculated by dividing placental weight (PW) by birth weight of the baby (BW).

The data were managed statistically using Chi-square test and Student's t test. A *P*-value of less than 0.05 was considered to be statistically significant.



Figure 1. Photograph showing the technique of measuring the placenta and neonate weight.

3. Results

Most of the control 62 (24%) was between (35 – 40 years), while the most of GDM 44 (34.4%) were between (30 – 35 years).

Regarding the maternal age, group A women were younger than the control, the mean age for group B was 38 ± 7.3 years (range, 15–45) while it was 31 ± 5.8 years (range, 15–45) in GDM (group A). The difference was statistically significant (*P*-value = 0.025).

The gestational age was increased in group B than in group A women, the mean gestational age at delivery was 37.3 ± 1.011 (range, 37–39 weeks) in group A versus 37.7 ± 1.5 (range, 37–40 weeks) in group B. The difference was significant (*P*-value = 0.002). Most of GDM had regular hospital visit 103 (80.5%), while most of the control 171 (66.5%) had regular hospital visit (Table 1).

Table 1. Maternal, placental and neonate characteristics.

Characteristics	Group A (n=128)		Group B (n=257)		P value
	Mean	Range	Mean	Range	
Maternal age / year	31 ± 5.8	(15–45)	38 ± 7.3	(15 - 45)	0.025
Gestational age/ weeks	37.3 ± 1.01	(37–39)	37.7 ± 1.5	(37 - 40)	0.002
Weight of placenta	660 ± 116	(470–900)	545 ± 206	(300–900)	0.021
Neonate weight	3742.5 ± 641	(2400–4900)	3137.5 ± 513	(2300–4500)	0.000

The mean placental weight in group A was 660 ± 116 gm (range, 470–900), while it was less in group B as 545 ± 206 (range, 300–900), and the difference was significant (*P*-value < 0.021) (Table 1 & 2)

Table 2. The weight of placenta in study groups.

Placental weight/gm	Group A		Group B	
	Frequency	%	Frequency	%
< 500	3	2.3	74	28.8
500–600	54	42.2	154	60
600–700	36	28.2	15	5.8
700–800	20	15.6	6	2.3
800–900	15	11.7	8	3.1
Total	128	100	257	100

(*P*. Value= 0.021)

A significant positive correlation was observed between placental weight and newborn birth weight ($r = 0.58$, $p = 0.05$), demonstrating that as birth weight increased, the

placental weight increased.

The mean PW/BW ratio in group A was 0.17 ± 0.141 (range, 0.111–0.175), whereas in the controls group B it was

0.18±0.103 (range, 0.086–01.24), and the difference was significant (P-value <0.000). Feto-placental weight ratio in gestational diabetes (5.88:1) was significantly higher than in the controls (5.56:1).

4. Discussion

Placenta is a matter of interest and curiosity for ages for many anatomists, embryologists and obstetricians because of its incomparable importance in the intrauterine development of human being. It is the most accurate record of infant's prenatal experiences, so study of placenta gives valuable clues in cases of adverse fetal outcome. Placenta is considered as a leading cause of maternal and perinatal mortality and important factor affecting foetal growth which is generally associated with placental insufficiency. Pregnancy complications like gestational diabetes might be reflected macroscopically and microscopically in the placenta [12].

The mean maternal age among participants was 34.5± 6.55 years. This was in concordance with the study in Norway by Roum et al. (2013) in the study of 590835 pregnancies; the mean maternal age at delivery was 33.0±6.1 years [13]. Whereas, it was higher than that reported in studies Iran by Asgharnia et al. (2008) and in Turkey by Erbil N. et al. (2015) where they reported a mean maternal age (years) of 25.35±5.64 (range, 15–45), and 27.2 years (range, 18-40) respectively [14, 15].

In the current study the mean age for group B was 38±7.3 years (range, 15-45) while it was 31±5.8 years (range, 15-45) in GDM group. It was comparable with the study by Saini P. et al. (2015) in India when the mean maternal age for GDM was 26.88 ± 3.67, while in controls group it was 26.33 ± 4.33 [16]. Whereas, Abdelghany AH. (2018) in Egypt revealed higher than Indian findings where the mean maternal age for GDM was 29.20 ± 1.36, and for controls was 28.85 ± 0.88 [17]. While in the study by Arshad et al. in Pakistan (2014), mean maternal age in GDM group was 31.60±4.27 and in control group it was 30.08±3.16 years and the difference was not significant (P-value = 0.159) [18].

The weight of placenta is an important and functionally

significant parameter. It may become the single most important factor in determining foetal growth [19]. The mean placental weight was 602.5 (300–900 gm), it was comparable with the findings of different authors, some of them reported heavy placental weight whereas others reported lighter weight (Table 3) [14, 15, 20-35].

Table 3. The various placental weights reported in the literature.

Author's name	Year	Country	Placental weight/ gm
Williams et al. [20]	1969	USA	500
Hamilton & Boyd [21]	1973	England	508
Chung et al. [22]	1974	Korea	**621
Bhatnagar et al. [23]	1983	Pakistan	500
Frisancho et al. [24]	1984	Peru	551
Jaya et al. [25]	1995	India	502.4
Tewari et al. [26]	1997	India	*310–510
Majumdar et al. [27]	2005	India	485
Susan and Thomas [28]	2005	England	470 (200–800)
Ashfaq et al. [29]	2008	Pakistan	530
Asgharnia et al. [14]	2008	Iran	529.72
Appiah PK [30]	2009	Ghana	563.47
Petekkaya E. et al. [31]	2011	Turkey	445.14 (159–836)
Raghunath G. et al. [32]	2011	India	528.55
Pei H. [33]	2012	USA	550
Lakshmi et al. [34]	2013	India	325–523
Anjum S. et al. [35]	2015	India	513
Erbil N. et al. [15]	2015	Turkey	563.6
The current study	2018	Sudan	602.5 (300–900)

In general, placenta from diabetic women tends to be heavier than the general population at the same gestational age. The significant accumulation of non-parenchymal tissue and only a moderate increase in parenchymal tissue may be the cause of heavier placenta in GDM [36]. This was in concordance with the findings of the current study when the placenta from women with GDM found tends to be heavier than normal healthy mother. The increased placental weight and volume in diabetic mothers were also stated by various authors as seen in table 4 [16, 17, 18, 19, 36-41].

Table 4. Comparative studies of placental weight in GDM versus controls in literature.

Author's name	Year	Country	Mean weight /gm		P value
			GDM	Control	
Akhter et al. [36]	2010	Bangladesh	417.97	361.68	0.050
Hussain et al. [37]	2013	Pakistan	527.20	582.56	0.050
Khaskhelli et al. [38]	2013	Pakistan	967.50	499.00	0.0068
Arshad et al [18]	2014	Pakistan	698	590	0.005
Saha et al. [19]	2014	India	565.75	504.42	—
Jeelani et al. [39]	2015	India	589.30	511.00	0.0001
Saini et al. [16]	2015	India	426.25	397.50	0.010
Elshennawy [40]	2016	Egypt	678.08	643.50	—
Sharmila et al. [41]	2017	India	537.28	412.08	0.0001
Abdelghany [17]	2018	Egypt	485.25	460.25	0.001
The current study	2018	Sudan	660.00	545.00	0.021

The Placental Weight Ratio (PWR) is defined as the ratio between the placental weight and fetal weight and it changes

with gestational age as the placenta matures. Abnormally low and high PWR were associated with adverse pregnancy

outcomes (10th and 90th percentiles), normal ratio is 6:1 [42].

In the present study, the mean fetoplacental weight ratio in gestational diabetes (5.88:1) was significantly higher than in the controls (5.56:1). Other studies in India had observed

almost the same result. Whereas, the observation of Jeelani *et al.* in India was reverse, as they found that the mean fetoplacental weight ratio in the controls was significantly higher than in gestational diabetes (Table 5) [19, 39, 41].

Table 5. Comparative studies of Feto-placental ratio in GDM versus controls in literature.

Author name	Year	Country	Feto-placental ratio		P value
			GDM	Control	
Saha [19]	2014	India	5.8	4.99	
Jeelani <i>et al.</i> [39]	2015	India	5.7	6.0	0.0001
Sharmila <i>et al.</i> [41]	2017	India	6.44	5.96	0.04
The current study	2018	Sudan	5.88	5.56	0.000

5. Conclusion

In the current study significant change in the placental weight have been observed between normal and gestational diabetes placenta. Gestational diabetes mellitus is associated with adverse fetal and neonatal outcomes. In this study there was an increase in birth weight and feto-placental ratio in group with gestational diabetes. Many studies suggest that diabetic placental changes are associated with inflammation and oxidative stress. The role of this intrauterine environment in fetal development remains unclear and further investigation is needed.

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Conflicts of Interests

There are no conflicts of interest.

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