The Relation between Prepregnancy Body Mass Index and Abnormal Placental Morphology and Birth Weight

Eman A. Soliman El-Hosary[1], Sahar Abdelrady Elkheshen[2] , Reda M-Nabil Aboushady[3]

[1] Assistant Professor of Maternal and Newborn Health Nursing, Faculty of Nursing, Menoufia University, Egypt.

[2] Assistant Professor of obstetrics and Gynecology at Misr University for Science and Technology Egypt.

[3] Assistant Professor of Maternal and Newborn Health Nursing, Faculty of Nursing, Cairo University, Egypt.

Corresponding author: redaaboushady.77@gmail.com

Abstract

Background: Birth is enormously important, and the care that a woman receives during labor affects women`s health physically and emotionally in the short and long-term periods. The placenta plays a pivotal role during pregnancy by being intimately connected to the mother and fetus**. Aim** of the current study is to examine the relation between prepregnancy body mass index and abnormal placental morphology and birth weight. **Methods**: A descriptive correlational research design was used for this study to achieve the study aim. **Sample**: A purposive of 150 laboring women were enrolled in the study. **Setting**: the study was conducted at the delivery unit at Al kaser Alini University Hospital, Cairo University, Egypt.**Tools**: Three tools were used to collect the data; 1) Structured Interviewing Questionnaire, 2) Maternal Assessment Tool, And 3) Neonatal Assessment Tool. **Results**: The mean age of the study sample was 29.77 ± 5.47 years old. The mean prepregnancy body mass index (BMI) was 26.22 ±3.20 and there is a positively correlated with it and newborn birth weight (r=0.18; p=0.02), placental weight (r=0.16; p =0.04), and placental thickness (r=0.21; p=0.03). **Conclusions**: The study findings concluded that prepregnancy body mass index parameters which are known to influence birth weight and determinants of abnormal placental morphology. **Recommendations**: Authoritive personnel should encourage protocols and develop guides/checklists for placental examination in health care facilities.

Keywords: Placental Morphology , Laboring Women, Birth Weight, prepregnancy BMI

Introduction

The placenta plays an important role in mediating fetal growth and viability, and it is involved in hormonal and metabolic alterations during pregnancy [1]. Changes in maternal metabolism influence placental function and morphology, based on the type and timing of the effect [2]. The well-being of the newborn is affected by a number of factors [3], including maternal characteristics, the placenta, umbilical cord morphology, and functions [4].

It is a fantastic organ regularly neglected due to its transient existence; it performs functions as separate organs, including the lungs, liver, gut, kidneys, and endocrine glands [5]. It is the interface between mother and fetus and influences newborn morbidity and mortality [6]. Careful examination of the placenta can shed light on the in-utero environment of the fetus [7&8] and can help to explain an abnormal neonatal outcome and might have consequences for treatment. It might identify a risk of recurrence, resulting in preventive measures during subsequent pregnancies. However, there is evidence that the quality of the examination of the placenta is very variable [9&10].

The global epidemic of overweight and obesity is rapidly becoming a major public health problem in many diverse parts of the world, with recent statistics revealing that 38

of 136 countries have more than 50% of their female population classified as being above the recommended Body Mass Index (>25 Kg/m2) [11]. It is well established that maternal obesity like gestional diabetes influences both the placenta and the fetus, often resulting in fetal overgrowth and a greater frequency of large for gestational age (LGA) infants). Maternal obesity is associated with a higher probability of delivering a large for gestational age (LGA, birth weight >90th centile after adjustment for gender and gestational age) or macrosomic (birth weight >4000 g) infant [12&13]. Children born to obese mothers are also more likely to develop childhood obesity and metabolic disease [14].

In pregnancy, women with a high Body Mass Index (BMI) have an increased risk of developing gestational diabetes and often give birth to offspring with high birth weight [15]. High birth weight has been linked to both short-term and long-term adverse outcomes lead to major placental abnormalities and offspring shoulder dystocia at delivery even in non-diabetic mothers [16], and hypertension and obesity in adulthood [17]. High maternal BMI has also been associated with a large placenta and a large placenta relative to birth weight [18]. This factor increase the risk of short- and long-term adverse outcomes for the child and mother [19&20]. Therefore, the aim of this study is to examine the relation between the prepregnancy Body Mass Index and abnormal placental morphology and birth weight.

Significance of the Study

Obesity has been cited as a health problem in women of childbearing age. A recent report found that 25% of the adult population was obese. The obesity rate has rapidly increased in the general population and in women of childbearing age [21]. The increasing incidence of obesity among women worldwide has become one of the most significant public health concerns. High maternal body mass index (BMI) is related to changes in placental morphology and adverse maternal pregnancy outcomes such as pre-eclampsia, eclampsia, pre- and post-term delivery, induction of labor, macrosomia, cesarean section, and postpartum hemorrhage [22].

Developing countries like Egypt and India, also face problems of malnutrition and complications related to being underweight like anemia, premature rupture of membranes, low APGAR scores, low birth weight babies, preterm delivery, and increased perinatal mortality [23]. Antenatal ultrasound examination and placental examination after delivery which evaluates the placental parameters and morphology such as the weight, diameters, shape, thickness, and cord insertion has been proven to be of predictive value in the pregnancy outcomes such as fetal weight and adverse effects [24]. These emphasize the need for the present study. There is a need for increased evaluation of placental morphology in relation to the body mass index and neonatal birth weight. The findings of the current study will highlight the priority areas to be addressed in parturient women to raise awareness about the importance to be in ideal body weight before pregnancy to improve well-being. Moreover, the results of this study will serve as input for program designers and policymakers to design evidence-based interventions related to the importance of examining palcenta after delivery. Also, this study will be of paramount importance for future researchers interested in related topics.

Operational Definition

Placental morphology: In the current study placental morphology means placental characteristics as; placental weight, diameters, thickness, number of cotyledons, cord length and diameters, insertion of the cord, and cord around the neck.

Aim

The aim of the study is to examine the relation between prepregnancy Body Mass Index and abnormal placental morphology and birth weight.

Research questions

1-Is there a relation between prepregnancy (BMI) and abnormal placental morphology?

2-Is there a relation between prepregnancy (BMI) and neonatal birth weight?

Subjects and Methods

Research Design:

A descriptive correlational research design was used for this study to achieve the study's aim. This design will be suitable for the study because it allows the description of variables and identifies the relationship that occurs naturally between and among them.

Sample

A purposive sample of 150 laboring women. The sample was recruited according to the following **inclusion criteria:** women with singleton fetuses full term, primiparous and multiparous women (not more than 3 times), and free from any chronic diseases and prepregnancy weight recored in the sheet or women know her weight before pregnancy. **Exclution criteria:** Women who were diagnosed with fetal congenital anomaly, on anticoagulant therapy, current pregnancy complications, and any serious bleeding episode in the current pregnancy were excluded from the current study.

Sample size

One hundred Fifty laboring women (150) were selected according to the following statistical formula: n = Z2p (1-p), where Z is the level of confidence according to the standard normal distribution (for a level of confidence of 95%, Z = 1.96); p is the estimated proportion of the population that presents the characteristic (when unknown, we used p = 0.5), (P is considered 0.05).

Setting

The study was conducted at the delivery unit at Al kaser Alini University Hospital, which is a Cairo University-affiliated hospital that provides care for women in labor and abortions. The department consists of reception of labor unit which contain two rooms; one for history taking and the other for examination with four beds and ultrasonography , delivery suites which contains two parts; one for first stage of labor which includes 9 beds and the other part for delivery which includes 3 delivery rooms with heater for newborn and delivery bed in each one. This unit conducts approximately 14108 deliveries annually according to (***Kasr Al-Ainy university hospital Statistics, 2021***).

Tools for Data Collection

Three tools were used for data collection after an extensive literature review.

Tool (1). Structured interview sheet

This tool was designed by the researcher after reviewing of literature and included data relate to socio-demographic characteristics as; maternal age, level of education, occupation, and residence as well obstetric history as; parity, number of abortions, mode of previous delivery, pervious pregnancy and delivery complications; data related to current pregnancy as the first day of the last menstrual period (LMP) to calculate expected date of delivery (EDD) and determine the gestational age.

Tool (2). Maternal Assessment Tool

This tool was designed by the researcher after revirewing of literature and consisted of two parts; **The first part**: Encompassed of baseline of body weight before pregnancy from the medical record, and height, to calculate body mass index (BMI) and determine prepregnancy Body Mass Index (BMI) according to the international scoring classification by ***WHO (2017)***. BMI was calculated by utilizing the formula "weight in Kg, divided by hight squared in meters [32].

$$\mathbf{BMI} = \frac{\mathbf{mass_{kg}}}{\mathbf{height_m}^2}$$

The following diagnosis BMI of < 18.5kg/m² = underweight; BMI of 18.5 < 24.9 kg/m² = appropriate weight; BMI of > 25-29.9 kg/m²

Category	WPRO	New (Ife) criteria*	WHO
Underweight	<18.5	<17.8	<18.5
Normal	18.5-22.9	17.8-24.7	18.5-24.9
Overweight	23.0-24.9	24.8-27.8	25.0-29.9
Obesity	≥25.0	≥27.9	≥30.0

*New (Ife) criteria for both sexes. WHO: World Health Organization, WPRO: Regional Office for Western Pacific of WHO, BMI: Body mass index

= overweight, and BMI of 30 kg/m² = obese) As in the following table [32].

The second Part: Placental Examination Chart. This tool for examination of the placental criteria was developed by the researchers after an extensive literature review. It examines placental characteristics such as weight, diameters, thickness, number of cotyledons, cord length and diameters, insertion of the cord, and if there was a special condition such as a cord around the neck or abnormal shape of the placenta.

Tool (3). Neonatal Assessment Tool: This tool was designed by the researcher after reviewing of literature and consisted of two parts; **The first part**: included data related to neonatal birth weight. This part was adopted by the researchers from (***WHO, 2017***) to document neonatal weight after birth directly according to categories based on gestational age (normal weight at term is 2500–4200g; Low birth weight (LBW) is 2,499 g or less, Subcategories included very low birth weight (VLBW), which is less than 1500 g, and extremely low birth weight (ELBW), which is less than 1000 g, and high birth weight is more than 5000g. **The second part**: included data related Neonatal Gestational Age Assessment Chart (Tenth and ninetieth percentile). This part was adopted by the researchers from (***WHO, 2017***), and it included an assessment of neonatal Anthropometric measurements such as weight, length, head & chest circumference and plotted the results on the chart and compare them against the curve at the tenth and ninetieth percentile on the growth chart to determine if the neonate was appropriate for gestational age (AGA), small for gestational age (SGA) or large for gestational age (LGA). The research investigator plotted the neonate's weight, length, and head circumference by gestational age on the chart, to determine if the growth was below the 10th percentile, the neonate was small for gestational age (SGA), if the growth was above the 90th percentile, the neonate was large for gestational age (LGA) called macrosomic baby, if the growth was in between 10th and 90th percentiles, the neonate was appropriate for gestational age (AGA).

Tool validity and Reliability

Tools were submitted to 5 experts in the field of maternity nursing to test content validity, clarity of sentences, and appropriateness of content; modifications were carried out according to the expert's judgment. Reliability analysis was done to investigate the consistency of internal instruments, used in the study; Cronbach's alpha coefficients were calculated for examining the measurement reliability with multipoint items (r=0.92).

Pilot Study

It was conducted on 10% of the study sample, were selected randomly (15 women). It aimed to evaluate the simplicity and clarity of the tools. It also helped in the estimation of the time needed to fill in the forms. According to the results of the pilot study, simple modifications were done as rephrasing questions or canceling some questions. The needed modifications were done, and the participants in the pilot study were excluded from the final study sample.

Ethical Considerations.

The research approval was obtained from the Research and Ethics committee at the Faculty of Nursing Cairo University (**Code of Ethics number 2021/55**). At the initial interview, each potential participant was informed about the purpose, procedure and benefits of the study. They were informed that participation in the study is completely voluntary and they have the right to withdraw from the study at any time without any penalty, moreover, the entire participant was informed that the study posed no risk or hazards to their health. Confidentiality also will be assured.

Procedure:

Official permission was obtained from the hospital as well as written informed consent from women who met the inclusion criteria.

The study was carried out through: recruitment, interviewing, and assessment.

A) Collecting the data (recruitment) and Interviewing: The researcher introduce herself to each woman and explain to them the purpose and the scope of the study to gain their cooperation then was proceed with the data collection with those who fit the inclusion criteria and accept to participate in the current study also asked to sign the consent form. Each woman in the groups was interviewed individually in a quiet environment to collect data (the researcher asked questions and recorded the answer. The interview took around 15 minutes for each woman in the forth stage of labor. Data related to socio-demographics as age, level of education, occupation, monthly income, and residence; and obstetric history as parity, number of abortions, mode of previous delivery, previous pregnancy, and delivery complications; current pregnancy as the first day of last menstrual period (LMP) to calculate Expected Date of Delivery (EDD) and to determine gestational age (GA). Determine prepregnancy BMI from the medical record.

B) Assessment: after delivery, the researchers assesses placenta weighing in the third stage of labor using the same scale to assure accuracy among study samples look of characteristics, and cord characteristics and recorded it in the maternal assessment tool as well as, Length, weight, and head circumferences for the newborn were assessed by the researcher after delivery in the second stage of labor and plotted on a growth chart to determine if the growth below the 10th percentile, within or above the 90th percentile. The researcher measured neonates, weight when they were quiet, and unclothed, utilizing a baby weight scale where the accuracy was obtained by balancing zero prior weightings. Also, the neonates' length was measured from head to toe when the neonates were in a supine position and their legs were extended was measured. Then, measured head circumference was through measurement tape firmly around the head above the eyebrow ridge. If the growth was below the 10th percentile the neonate was small for gestational age (SGA), if the growth was above the 90th percentile, the neonate was large for gestational age (LGA) called macrocosmic baby, if the growth was in between 10th and 90th percentiles, the neonates were appropriate for gestational age (AGA). The researcher ask the study participant the questions in clear Arabic language and plotted their answer in the designed tool. Also Apgar scale assessment in the 5^{th} minutes had been assessed for the newborn.

Statistical Analysis

Upon the completion of data collection, data will be tabulated and analyzed, relevant statistical analysis will be used to test the obtained data using Statistical Package for Social Science (SPSS) program, version 20. Descriptive and inferential statistics will be carried out: (1) Descriptive statistics: On the basis of the raw data, the mean, and standard deviations will be calculated for each component of the dependent variables for all subjects, in addition to frequencies and percentages distributions. (2) Inferential statistics: (T-test& Chi-square) will be used to examine the differences and similarities between the study groups.

RESULTS

The aim of the current study was to examine the relation between prepregnancy body mass index and abnormal placental morphology and birth weight. The results were presented in three sections which include; 1) Description of the study sample, 2) The relation between prepregnancy BMI and abnormal placental morphology, and 3) The relation between neonatal characteristics and prepregnancy BMI.

1) Description of the study sample

This section included data related to the socio-demographic and clinical characteristics of the study sample and the obstetrical and past medical history of the study sample. The age of the study sample ranged from 18-35 years with a mean of 29.77±5.47 years old. Regarding the level of

education, 39.3 % of the study sample had received primary education, and 81.3% of the selected sample were housewives compared to 18.7% who were working. Seventy -six point seven percent lived in urban areas compared to 23.3% who lived in rural areas, and 47.3% of them had adequate socioeconomic status as presented in **Table** (**1**).

Concerning the prepregnancy BMI, more than half of the study sample (65.3%) were overweight, while 3.3% of them were underweight, 24% were normal, and the remaining of them 7.3% were obese as presented in **figure (1)**.

Regarding current obstetrical profile, 70.7% of the study sample were primiparous with the mean of gestaional age was 38.69 ± 1.40 weeks. Regarding mode of delivery among the study sample nearly half (42.7%) of them delivered through vaginal delivery with episotomy, while 32.7% of them delivered cesearn section as presented in **Table** (**2**).

2) The relation between prepregnancy BMI and placental morphology

Table (3) showed that there were statistically significant differences between placental weight, placental thickness, and diameter, and different categories of BMI (p=<0.05) with increased placental mean weight in overweight and obese categories (525.27 ±77.16 grams and 545.09±89.80 grams) respectively. While, there were no statistically significant differences between the number of cotyledons, cord length, cord diameter and insertion, cord around the neck, and different categories of prepregnancy BMI (p= >0.05).

3) The relation between Neonatal Characteristics and prepregnancy BMI

Half (54.6%) of the 150 neonates were male and 45.3% were female with statistically significant differences between baby gender and different categories of maternal prepregnancy BMI. the majority (86%) had a normal birth weight of 2.5 - 3.9 kg; the mean birth weight was 3102.84 ±700.82. In the overweight category, 17.3% had LGA for their neonates and 60% had SGA in the underweight category. There were statistically significant differences between maternal prepregnancy BMI categories and Apgar score in the fifth minute with a mean score of 8.00 ±0.70 in the underweight group and 8.61±0.94 in the overweight group as presented in Table (4). There was a positive correlation between maternal prepregnancy BMI, neonatal birth weight, and placental weight as shown in **Table (5)**.

Table 1:Distributions of the study sample according to socio- demographic charecterstics (n=150)

Characteristics	Frequency	%
Maternal age		
<20	13	8.7
20-29	51	34
≥30	86	57.3
Mean maternal age (yrs.)	29.77 ± 5.47	
Residence		
Urban	115	76.7
Rural	35	23.3
Level of education		
Can't read & write	4	2.7
Read &Write	39	26
Primary level	59	39.3
Preparatory level	13	8.7
Secondary level	34	22.7

University level	1	0.7
Occupation		
House wife	122	81.3
Working	28	18.7
Socioeconomic status		
Adequate	71	47.3
Inadequate	28	18.7
Adequate & save	51	34

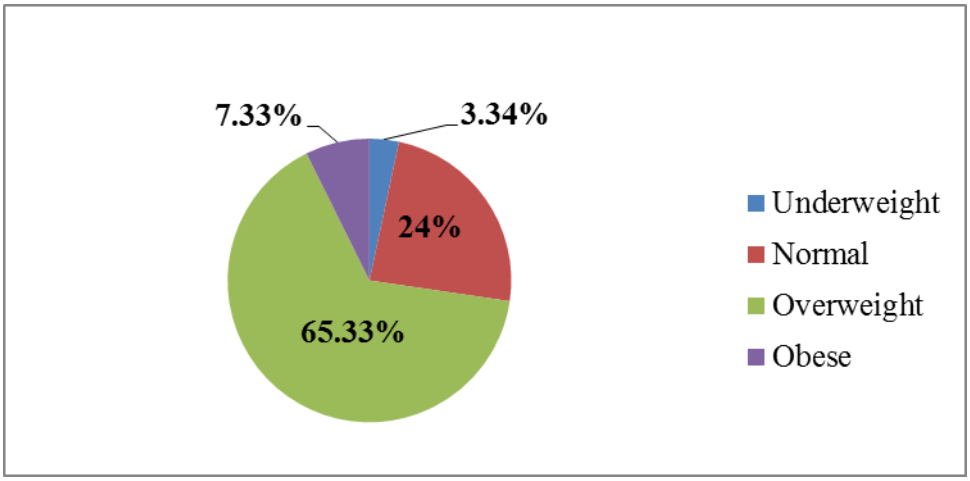

Figure (1) Prepregnancy Body Mass Index Categories Among The Study Sample

Table (2): Distribution of the Study Sample Regarding Current Obstetrical Profile (n=150)

Characteristics	Frequency	%
Parity		
Primipara	106	70.7
Multipara	44	29.3
Gestational age at recruitment/weeks	38.69 ± 1.40	
BMI in Kg/m2 at study recruitment		
Mean ±SD	26.22 ±3.20	
Mode of delivery among the study sample		
Normal delivery	37	24.7
Vaginal with episiotomy	64	42.7
Cesarean Section	49	32.7

Table 3. The Relation between Prepregnancy BMI And Abnormal Placental Morphology (n=150)

Placental Morphology	Underweight (n=5)	Normal (n=36)	Overweight (n=98)	Obese (n=11)	Test
Weight of the placenta(g)	397.80 ±2.58	515.38± 83.15	525.27 ±77.16	545.09±89.80	P=0.00*
Number of cotyledons **Less 15** **15-20** **More than 25**	0(0%) 5(100%) 0(0%)	1(2.8%) 35(97.2%) 0(0%)	1(1%) 94(95.9%) 3(3.1%)	0(0%) 11(100%) 0(0%)	P=0.87
Placental thickness **< 2 (thin)** **2-4(normal)** **> 4.1(thick)**	5(100%) 0(0%) 0(0%)	6(16.7%) 30(83.3%) 0(0%)	52(53.1%) 40(40.8%) 6(6.1%)	8(72.7%) 3(27.3%) 0(0%)	P=0.00*
Diameter of placenta(cm) **< 11(small)** **11-22(normal)** **≥ 23(large)**	2(40%) 3(60%) 0(0%)	0(0%) 36(100%) 0(0%)	0(0%) 94(95.9%) 4(4.1%)	4(36.4%) 7(63.6%) 0(0%)	P=0.00*
Cord length(cm)	49.60 ±3.57	50.08 ±0.93	49.60 ±4.96	51.09 ±2.94	P=0.69
Cord diameter(cm) **< 1(thin)** **1-2(normal)** **>2(thick)**	0(0%) 5(100%) 0(0%)	0(0%) 36(100%) 0(0%)	0(0%) 95(96.9%) 3(3.1%)	0(0%) 11(100%) 0(0%)	P=0.65
Cord around the neck **Yes** **No**	0(0%) 5(100%)	2(5.6%) 34(94.4%)	8(8.2%) 90(91.8%)	0(0%) 11(100%)	P=0.66
Cord insertion **Centric** **Eccentric** **Marginal**	5(100%) 0(0%) 0(0%)	33(91.7%) 1(2.8%) 2(5.6%)	92(93.9%) 2(2%) 4(4.1%)	11(100%) 0(0%) 0(0%)	P=0.96

Table (4) The Relation between Neonatal Characteristics and Prepregnancy BMI (n=150)

Characteristics	Underweight (n=5)	Normal (n=36)	Overweight (n=98)	Obese (n=11)	Test
Baby gender					
Male Female	5(100%) 0(0%)	18(50%) 18(50%)	50(51%) 48(49%)	9(81.8%) 2(18.2%)	P=0.04*
Newborn weight (kg)					
<2.5 (Underweight) 2.5-3.9 (Normal) ≥ 4 (Big baby)	0(0%) 5(100%) 0(0%)	3(8.3%) 30(83.3%) 3(8.3%)	10(10.2%) 81(82.7%) 7(7.1%)	0(0%) 6(54,5%) 5(45.5%)	P=0.006 *
M ±SD (g)	2840	3130.83 ±602.02	3107.82±648.	3086.36±13	P=0.85

	±89.44		82	87	
Birth weight percentile					
SGA AGA LGA	3(60%) 2(40%) 0(0%)	3(8.3%) 27(75%) 6(16.7%)	7(7.1%) 74(75.5%) 17(17.3%)	9(81.8%) 2(18.2%) 0(0%)	P=0.001 *
Apgar score (5 min)	8.00 ±0.70	8.80 ±0.88	8.61 ±0.94	8.00±1.00	P=0.04*

Statistically Significant at p ≤ 0.05

Table (5): Correlation Between Prepregnancy BMI And Placental Morphology And Neonatal Birth Weight

Variable 1	Variable 2	Pearsons	P-value
Prepregnancy Body Mass Index (BMI)	Neonatal birth weight (kg)	0.18	0.02**
	Placental weight (g)	0.16	0.04**
	Placental thickness (cm)	0.21	0.03**

Statistically Significant at p ≤ 0.05

Discussion

Fetal well-being is influenced by a number of factors, including maternal characteristics, and placental and umbilical cord characteristics. So the aim of the current study is to examine the relation between prepregnancy body mass index, placental morphology, and birth weight. The frame of the study sample and answers to the research questions.

Regarding the socio-demographic and clinical characteristics of the study sample, the age ranged from 18–35 years with a mean of 29.77±5.47 years old. This finding is consistent with the findings of **Elly et al [25],** who found that the maternal age ranged from 18 to 39 years old. Regarding the level of education, 39.3 % of the study sample had received primary education, and 81.3% of the selected sample were housewives compared to 18.7% who were working. 76.7% lived in urban areas compared to 23.3% who lived in rural areas, and 47.3% of them had adequate socioeconomic status. On the same line, **Martino et al. [26]** concluded in their study results that 40% of their study sample were in primary education, 80% were housewives, 75% lived in urban areas, and 45% had adequate socioeconomic status. More than one third of the study sample received primary education and this reflects that low education may be a risk factor for obesity because they had not enough knowledge to achieve the ideal body weight before pregnancy. Furthermore more than three third of the study sample were housewife and this may be another risk factor for obesity other than working women.

Concerning prepregnancy BMI categories, more than half of the study sample (65.3%) were overweight, while 3.3% of them were underweight, 24% were normal, and 7.3% were obese, this results contradictory with the study of **Elly et al [25]** who indicated in their results that 8.5 % were underweight, 88.1% were normal, and 3.4% were overweight, this difference may be related to different sample size and setting .

Concerning the relation between prepregnancy (BMI) and abnormal placental morphology

Findings of the current study indicated statistically significant differences between placental weight thickness, and diameter, with different categories of maternal BMI ($p<0.05$), while there is no statistically

significant difference between the number of cotyledons, cord length, cord diameter, insertion, and the cord around the neck, versus different categories of maternal BMI ($p > 0.05$). These results were in accordance with the study of **Elly et al.** [25], who indicated in the Chi-square analysis of the maternal BMI with abnormal morphology of the placenta of the study that there were highly statistically significant differences between placental weight, thickness and maternal BMI ($p<0.0001$), and no significance between cord length & diameter, cord around the neck, cord insertion, and maternal prepregnancy BMI and recommended that it is very important to discuss this issue with health care providers [25]. Similarly, **Hailey et al.** [27] concluded that prepregnancy maternal BMI (maternal underweight and obesity) had a significant impact on placental pathology and increased risk for neonatal inflammation, and they recommended support interventions to optimize placental neonatal health [27]. So, it is very important to achieve normal prepregnancy BMI and prepregnancy ideal body weight to increase positive maternal and neonatal outcomes and avoid any complications.

A study was done by **Nasralla et al.** [33] to evaluate the association between neonatal birth weight and placental weight and other demographic characteristics. The researchers found that the association between the placental weight and birth weight was significant, and we found that for each gram increase in placental weight, birth weight increased by 2.848 g ($SE = 0.178$, $p < 0.01$). Similarly, there was a significant relation between placental weight and newborn birth weight, and researchers found that for each kg increase in maternal weight, birth weight increased by 17.018 g ($SE = 5.281$, $p =0.001$).

Concerning the relation between prepregnancy (BMI) and neonatal birth weight

Regarding neonatal characteristics, the findings of the current study mentioned that the neonatal birth weight was 3102.84±700. 82 grams. Placental weight had a mean of 520±57.13 grams. The mean gestational age was 38.69±1.40 weeks. There was a significant relations between placental weight and birth weight, with each gramme increase in placental weight increasing birth weight by ($p = 0.01$). Similarly, there was a significant relation between placental weight and neonatal birth weight, and researchers found that for each kilo-gram (Kg) increase in maternal weight, birth weight increased ($p = 0.001$), with statistically significant differences between prepregnancy maternal BMI and birth weight percentile and an Apgar score at the fifth minute. These findings were consistent with the findings of **Laura et al.** [28] who concluded that abnormal prepregnancy BMI worsened maternal and fetal complications even in normal pregnancy and that there were significant correlations between them, recommending that more research be conducted to evaluate infant health born to underweight and overweight mothers.

Our study concluded that there was a strong correlation between maternal prepregnancy BMI and placental weight and neonatal birth weight, these results were in accordance with the study of **Ellen et al.** [29] who concluded in their study that placental weight and newborn birth weight increased with increasing prepregnancy BMI in women without diabetes. Also, **Wen-Yuan et al.** [30] concluded in their study that prepregnancy overweight and obesity are significantly associated with the rapid growth of offspring from birth to age three**.** On the same line, **Toki Jin et al.** [31] concluded that the

prepregnancy BMI had a great effect on the placental size and neonatal health and recommended the importance of pre-conception counseling to improve maternal and fetal outcomes. In addition, **Nasralla et al.** [33] concluded that; placenta weight and prepregnancy BMI are independent predictors of fetal birth weight. This may be related to the placenta being the interface between the mother and the fetus, through which all nutrients and metabolic excretions must pass to the fetus. Therefore, it plays a major role in fetal growth and development, and it can be an independent predictor of fetal condition. Prepregnancy BMI is a major risk factor for the mothers and newborn and women should be encouraged to achieve ideal body weight before pregnancy.

CONCLUSION

The study supports the research questions that maternal prepregnancy BMI are known to influence birth weight and placental morphology. Underweight women had a low placental weight of <400g and thin placental thickness. There is a positive correlation between maternal prepregnancy body mass index versus placental weight and newborn birth weight.

Recommendations

1) Midwives, doctors, and delivery assistants should check the placenta to make sure it is complete because if some is missing the woman is in danger of bleeding or infection.

2) Authoritative personnel should encourage protocols and develop guides/checklists for placental examination in health care facilities.

3) Healthcare providers should encourage women to achieve normal BMI before pregnancy to avoid maternal and fetal complications.

References

1. Costa MA. "The endocrine function of human placenta: An overview". Reproductive BioMedicine Online 32.1 (**2016**): 14-43.

2. Ismail KI, Hannigan A, O'Donoghue K, Cotter A. Abnormal placental cord insertion and adverse pregnancy outcomes: a systematic review and meta-analysis. Systematic reviews. 2017;6(1):242.

3. Adane AA, Mishra GD & Tooth LR Maternal pre-pregnancy obesity and childhood physical and cognitive development of children: a systematic review. International Journal of Obesity 40 1608–1618. 2016 (doi:10.1038/ijo.2016.140)

4. Dimasuay KG, Boeuf P, Powell TL & Jansson T Placental responses to changes in the maternal environment determine fetal growth. Frontiers in Physiology 7 12. 2016 (doi:10.3389/fphys.2016.00012)

5. Costa MA. The endocrine function of human placenta: An overview. Reproductive Bio Medicine Online 2016; 32(1), 14–43. https://doi.org/10.1016/j. rbmo.2015.10.005

6. Burton G J, Fowden AL. The placenta: a multifaceted, transient organ. Philosophical Transactions of the Royal Society B: Biological Sciences 2015; 370(1663), 20140066–20140066.
https://doi.org/10.1098/ rstb.2014.0066

7. Higgins LE.. Assessing And Quantifying Placental Dysfunction In Relation To Pregnancy Outcome In Pregnancies Complicated By Reduced Fetal Movements. Thesis Faculty of Medical and Human Sciences University of Manchester 2015

8. Adesina K T., et al. "Relationship between Gross Placental Characteristics and Perinatal Outcome of Low-risk". Singleton Deliveries (2016): 191-195.

9. Russa A D and Kaziri K M. "The Effect of Placental weight and cotyledon count to the fetal birth outcome at a regional referral hospital in Tanzania". International Journal of Anatomy and Research 5.4 (2017): 4538-4542.

10. Senapati S, Nayak L, Behera SS, Chinara PK.Morphometric Study of Placenta of Full Term NewBorn & Its Relation To Fetal Weight: a Study in Tertiary Care Hospital of Odisha. Journal of Evolution of Medical and Dental Sciences-Jemds 2015; 4(5), 742–747. https://doi.org/10.14260/jemds/2015/107

11. World Health Organization. Global database on body mass index, http://apps. who.int/bmi/index.jsp; 2012 [accessed 22.12.11].

12. Stang J & Huffman LG 2016 Position of the academy of nutrition and dietetics: obesity, reproduction, and pregnancy outcomes. Journal of the Academy of Nutrition and Dietetics 116 677–691. (doi:10.1016/j.

13. jand.2016.01.008)Driul L, Cacciaguerra G, Citossi A, Martina MD, Peressini L, Marchesoni D.Prepregnancy body mass index and adverse pregnancy outcomes. Arch Gynecol Obstet 2016;278:23e6.

14. Santangeli L, Sattar N & Huda SS 2015 Impact of maternal obesity on perinatal and childhood outcomes. Best Practice and Research Clinical Obstetrics and Gynaecology 29 438–448. (doi:10.1016/j. bpobgyn. 2014.10.009)

15. Poston L, Caleyachetty R, Cnattingius S, et al. Preconceptional and maternal obesity: epidemiology and health consequences. Lancet Diabetes Endocrinol. 2016;4(12):1025–1036.

16. Overland EA, Vatten LJ, Eskild A. Risk of shoulder dystocia: associations with parity and offspring birthweight. A population study of 1 914 544 deliveries. Acta Obstet Gynecol Scand. 2012;91:483–8.

17. Bannon AL, Waring ME, Leung K, et al. Comparison of selfreported and measured pre-pregnancy weight: implications for gestational weight gain counseling. Matern Child Health J.2017;21(7):1469–1478.

18. Di Angelantonio E, Bhupathiraju SN, Wormser D, et al. Body-mass index and all-cause mortality: individual-participant-data meta-analysis of 239 prospective studies in four continents. The Lancet. 2016;388(10046):776-786. doi:10.1016/S0140-6736(16)30175-1

19. Adane AA, Mishra GD & Tooth LR Maternal pre-pregnancy obesity and childhood physical and cognitive development of children: a systematic review. International Journal of Obesity 40 1608–1618. 2016 (doi:10.1038/ijo.2016.140)

20. Leon-Garcia SM, Roeder HA, Nelson KK, et al. Maternal obesity and sex-specific differences in placental pathology. Placenta. 2016;38:33-40. doi:https://doi.org/10.1016/j.placenta.2016.12.006

21. Nakayama M. Significance of pathological examination of the placenta, with a focus on intrauterine infection and fetal growth restriction. Journal of Obstetrics and Gynaecology Research. 2017;43(10):1522-1535. doi:10.1111/jog.13430

22. Lutsiv O, Mah J, Beyene J & McDonald SD The effects of morbid obesity on maternal and neonatal health outcomes: a systematic review and meta-analyses. Obesity Reviews 16 531–546. 2015 (doi:10.1111/obr.12283)

23. Ramya S, Ashok Kumar, Shweta Sharan, Renuka Ramaiah, Study of body mass index in pregnancy and its correlation with maternal and perinatal outcomes,DOI-10.21276/obgyn.2019.5.2.11 ISSN Print – 2454-2334; ISSN Online – 2454-2342

24. MacInnis N, Woolcott CG, McDonald S & Kuhle S Population attributable risk fractions of maternal overweight and obesity foradverse perinatal outcomes. Scientific Reports 6 22895. 2016 (doi:10.1038/ srep22895)

25. Elly O. Kiliopaa, Peter Ainory Gesaseb, and Athanase Lilunguluc: The effects of maternal Body Mass Index on placental morphology and foetal birth weight: a study from Dodoma Central Region,Tanzania, South Sudan Medical Journal Vol 12 No 3 December 2020

26. Martino .J, S. Sebert, M. T. Segura, L. García-Valdés, J. Florido, M. C. Padilla, A. Marcos, R. Rueda, H. J. McArdle, H. Budge, M. E. Symonds, and C. Campoy: Maternal Body Weight and Gestational Diabetes Differentially Influence Placental and Pregnancy Outcomes, J Clin Endocrinol Metab, January 2016, 101(1):59–68 press.endocrine.org/journal/jcem. doi: 10.1210/jc.2016-2590

27. Hailey Scotta, David Grynspanb, Laura N Andersonc, Kristin L Connora,1: Maternal underweight and obesity are associated with placental pathologies in human pregnancy. medRxiv preprint doi: https://doi.org/10.1101/2021 DOI:.06.01.21258127; this version posted June 4, 2021

28. Laura Brouwers1 , Arie Franx1, Tatjana E Vogelvang2, Michiel L Houben3, Bas B van Rijn1, and Peter GJ Nikkels4: Association of Maternal Prepregnancy Body Mass Index With Placental Histopathological Characteristics in Uncomplicated Term Pregnancies, Pediatric and Developmental Pathology 2019, Vol. 22(1) 45–52, DOI: 10.1177/1093526618785838.

29. ELLEN M. STRØM-ROUM1, TOM G. TANBO & ANNE ESKILD: The associations of maternal body mass index with birthweight and placental weight. Does maternal diabetes matter? A population study of 106 191 pregnancies, 2016, DOI: 10.1111/aogs.12947.

30. Wen-Yuan Jin,1 Yao Lv,1 Yu Bao,2 Li Tang,3 Zhi-Wei Zhu,1 Jie Shao,1 and Zheng-Yan Zhao1: Independent and Combined Effects of Maternal Prepregnancy Body Mass Index and Gestational Weight Gain on Offspring Growth at 0–3 Years of Age, Hindawi Publishing Corporation BioMed Research International Volume 2016, Article ID 4720785, 10 pages http://dx.doi.org/10.1155/2016/4720785.

31. Toki Jin1, Hyo Kyozuka , Toma Fukuda , Mimori Fujimori1, Tsuyoshi Murata, Shinji Nomura1, Daisuke Suzuki1, Yasuhisa Nomura1, Takashi Imamura1, Shun Yasuda, Akiko Yamaguchi2 and Keiya Fujimori: Effect of gestational weight gain on placental weight: A single tertiary referral center study of Japanese women, J. Obstet. Gynaecol. Res. 2021, doi:10.1111/jog.15058.

32. . WHO, About BMI cateogry, Healthy weight, www.cdc.gov. 2017-08-29. Retrieved 2018-01-26.

33. Nasralla, K., Khieri, S. A., Kunna, A., Saadia, Z., Ali, A. O., & Alsammani, M. A. (2020). The Relationship Between the Weight of the Placenta, Body Mass Index and Fetal Birth Weight Among Sudanese Women. *Hemoglobin*, *7*(11.9), 13-47.