

The Relationship between Maternal, Placental and Newborn Parameters

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Abstract

Objective: The aim of this study was to investigate the relationship between maternal, placental and newborn parameters.

Methods: The study was conducted in the delivery unit, Ordu province, Turkey. The sample consisted of 104 women who had agreed to participate in the research and whose pregnancy had reached 37 weeks or over. Only singleton births were included. The placental and newborn parameters were measured after delivery.

Results: We found that the mean placental weight was 563.6±135.65 grs, and the mean of newborn weight was 3358±487.58 grs. The placental weight was significantly positively correlated with infant's birth weight (p=.000), infant's length (p=.024), maternal weight before pregnancy (p=.021), maternal weight on last day of pregnancy (p=.002) and maternal Body Mass Index (BMI) (p=.015) The placental weight of smoker during pregnancy was 628.82±107.40 grams; placental weight of non-smoker during pregnancy was 550.91±137.44 grams, and the difference was statistically significant (p=.007).

The infant's weight was significantly negatively correlated with the number of cigarettes smoked each day during pregnancy (p=.042). It was also significantly positively correlated with the infant's placental weight (p=.000), length (p=.000), head circumference (p=.004), chest circumference (p=.000), and gestational week (p=.001). In addition to, it was significantly positively correlated with the maternal weight before pregnancy (p=.002), maternal BMI before pregnancy (p=.007), maternal weight on the last day of pregnancy (p=.000), and maternal BMI on the last day of pregnancy (p=.002).

Conclusion: In conclusion, we determined that the placenta is an indicator of fetal growth. Also, maternal BMI has an effect on the newborn's weight. Maternal smoking during pregnancy was associated with an increase in placental weight as well as a decrease in an infant's weight.

Key words: Maternal parameters; maternal BMI; maternal smoking; placental weight; birth weight; newborn parameters.

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Introduction

Placenta structure and function are important for maternal and fetal health during pregnancy and in later life of newborn. Studies have revealed that abnormal placental growth is associated with adverse pregnancy outcomes (Wallace et al., 2004; Baptiste-Roberts et al., 2008; Altuncu et al., 2008). Other studies on the human placenta refer to the relationship between placental, maternal, and neonatal factors such as birthweight (Kırımı and Peñçe, 1999; Zeyneloğlu et al., 1999; Little et al., 2003), fetal malnutrition (Bleker et al., 2006; Altuncu et al., 2008), anemia (Lao et al., 2000), gestational diabetes (Madazlı et al., 2007), chronic diseases (Üstün and Malatyaloğlu, 1990; Kırımı and Peñçe, 1999; Lindley et al., 2000), maternal body mass index and ethnicity (Sivarao et al. 2002). Furthermore, abnormal placental weight is correlated with chronic diseases in later life such as cardiovascular disease, hypertension and diabetes (Barker et al. 1990; Wills et al., 1996; Barker, 1998; Godfrey 2002).

Birth weight/placental weight ratio has been correlated with perinatal morbidity and mortality (Barker et al., 1990). The effects of maternal risk factors on placental weight and birth weight have been previously studied (Jaya et al., 1995; Williams et al., 1997; Karim and Mascie-Taylor, 1997; Sivarao et al., 2002) and because a relationship between birth weight and later chronic disease has been found, more focus should be placed on the importance of placental and fetal health.

In this study, we investigated the relationship between maternal, placental and newborn parameters.

Materials and Methods

Setting and Sample

The study was conducted in the delivery unit, Ordu province, Turkey. The sample consisted of 104 women who had agreed to participate in the research and whose pregnancy had reached 37 weeks or over. Only singleton births were included.

Data collection

The data were collected in two stages. Data from the mother were taken before birth, and the placenta and the newborn data were collected after the birth. The data were collected using a questionnaire form, and a digital scale with sensitivity and a tape measure were used to measure the placenta.

Collection of maternal characteristics

The questionnaire identified the mother's socio-demographic characteristics and gave information about the latest pregnancy, placenta and newborn. It also included questions about maternal socio-demographic characteristics such as age, education level, occupation, husband's education level and occupation, family type, place of residence, family income, and where they live. Additional information requested included maternal obstetric characteristics and data about pregnancy such as number of parity; number of abortions, number of children; pre-pregnancy weight; current weight and height; time of last menstrual period; diseases during pregnancy; admissions to hospital during pregnancy for illness; if medicines used to correct anemia; diet habits during pregnancy; number of doctor visits during pregnancy; smoking before and during pregnancy; whether violence/trauma had occurred during pregnancy; whether this pregnancy was planned or wanted; whether psychological problems existed during pregnancy; whether the mother had been informed about the sex of the child to be born; whether the mother had negative feelings about the sex of the child to be born; and the time of delivery and delivery type and infant's sex.

Collection and measurements of placental and infant's parameters

Placenta was collected from patients who had delivered between 37 weeks and above the gestational age. The umbilical cord was clamped after delivery to minimize blood loss from the fetal vasculature and was enclosed in a bag. The placenta was trimmed after tying the umbilical cord and was cut 2 cm above the point where it was tied off. The placenta's membrane was cut immediately after birth and weighed after thoroughly wiping it to drain excessive fluid, mucous and maternal blood. The scale was used to measure the infant's weight and placental weight in the maternity room. The placenta's weight and infant's weight were measured with a Soehnle brand digital scale. Infant's length was measured with an infantometer, and head circumference and chest circumference were measured with a tape measure.

Ethical statement

Before the study could begin, permission was obtained from the institution, and the participants were then invited to participate in the study. They were also informed by the researchers and through an approval protocol that they would not be

paid for their participation. The researchers guaranteed participants that their identities and answers would be kept confidential. The study conformed to the principles of the Declaration of Helsinki.

Statistical methods

Descriptive statistics including mean, median, standard deviation, frequency, and percentage were used for demographic, obstetric, placental and infant data. The Pearson correlation analysis test, Mann-Whitney U test, Kruskal Wallis test and t test were used to analyse the correlation between dependent and independent variables. A level of $p < 0.05$ was considered as statistically significant.

Results

Maternal, placental and newborn characteristics

The number of mothers invited to participate was 104, and the mean age of mothers at their child's birth was 27.2 years (range 18-40 years). Table 1 shows maternal characteristics. The mean gestational age was 39.1 weeks. The mean weight before pregnancy of the mother was 61.4 kgs; the mean weight gain during pregnancy was 14.3 kgs; and the mean height of mothers was 162.5 cms. The Body Mass Index (BMI) mean for mothers before pregnancy was 23.2 and the maternal BMI mean at the end of pregnancy was 28.6.

Data gathered for this study revealed the following: 21.2% of mothers had smoked before pregnancy; 16.3% of them continued smoking during pregnancy. The mean placental weight of smoker mothers during pregnancy was 628.82 ± 107.40 grams; mean placental weight of non-smoker mothers during pregnancy was 550.91 ± 137.44 grams. Analysis of these characteristics found that maternal smoking during pregnancy was associated with increased placental weight, and the difference was statistically significant ($p = 0.007$), (see Table 3). The placental weights and newborn weight of mothers who had violence or trauma during pregnancy, had planned the pregnancy, had no psychological problems during pregnancy, knew the sex of their baby during the pregnancy and were pleased about it, and gave birth at term were higher than others; but the differences between the groups were not found to be statistically significant ($p > 0.05$). Increased birth weight was found in women giving birth via caesarean section and when the infant's sex was male, but the difference between the groups was not statistically significant ($p > 0.05$) (see Table 2).

Placental and newborn characteristics

Placental and newborn parameters are summarized in Table 3. The mean placental weight was 563.6 grs; mean infant's birth weight was 3358 grs; mean neonatal length was 49.5 cms; mean head circumference was 34.2 cms; mean chest circumference was 36.5 cms; mean placental weight/birth weight rate was 0.16; and the mean infant's apgar score was 8.2 (in 1st minute). The correlations between placental weight and birthweight, maternal, placental and infant parameters were examined.

Placental weight was significantly positively correlated with infant's birth weight ($r = 0.440$, $p = 0.000$), infant's length ($r = 0.222$, $p = 0.024$), maternal weight before pregnancy ($r = 0.225$, $p = 0.021$), maternal weight in last day of pregnancy ($r = 0.295$, $p = 0.002$), and maternal BMI in the last days of pregnancy ($r = 0.238$, $p = 0.015$) (see Table 4).

The infant's weight was significantly negatively correlated with the number of cigarettes smoked each day during pregnancy ($r = -0.052$, $p = 0.042$). It was also significantly positively correlated with the infant's placental weight ($r = 0.440$, $p = 0.000$), length ($r = 0.497$, $p = 0.000$), head circumference ($r = 0.277$, $p = 0.004$), chest circumference ($r = 0.464$, $p = 0.000$), gestational week ($r = 0.314$, $p = 0.001$). In addition to, it was also significantly positively correlated with the maternal weight before pregnancy ($r = 0.306$, $p = 0.002$), maternal BMI before pregnancy ($r = 0.265$, $p = 0.007$), maternal weight in the last day of pregnancy ($r = 0.354$, $p = 0.000$), and maternal BMI in the last day of pregnancy ($r = 0.300$, $p = 0.002$) (see Table 5).

Table 1. Maternal characteristics's mean, SD, median and range values

Maternal characteristics	Mean	SD	Range
Age mean	27.2	5.05	18-40
Number of pregnancy	2.1	1.29	1-6
Number of abortion (n=22)	1.4	0.79	1-4
Number of child	1.7	0.85	1-4
Weight before pregnancy (kg)	61.4	11.29	40-93
Height mean (cm)	162	6.14	1.50-1.75
Maternal pre-pregnancy BMI	23.2	3.71	14.19-33.35
Weight gain during pregnancy (kg)	14.3	5.79	2-31
Gestational week mean	39.1	0.86	37-40
Visit number to doctor at pregnancy	8.0	3.83	0-25
Period of smoking (year)	7.9	5.14	1-22
Cigarette number at pregnancy (day)	6.4	6.8	1-20
Learn time of foetal sex at pregnancy (m)	4.4	1.1	3-9

Table 2. Placenta weight mean according to maternal, newborn characteristics (n=104)

Variables	n	%	Placenta weight mean±Sd	P Value
Cigarette smoke				
Yes	22	21.2	590.00±136.69	M-WU=773.000
No	82	78.8	556.58±135.33	p=.304
Cigarette smoking during pregnancy				
Yes	17	16.3	628.82±107.40	M-WU=435.000
No	87	83.7	550.91±137.44	p=.007
Violence during pregnancy				
Yes	8	7.7	511.25±152.82	M-WU=321.500
No	96	92.3	568.02±134.09	p=.446
Desirability of pregnancy				
Yes	77	74.0	563.89±139.66	M-WU=1021.500
No	27	26.0	562.96±126.02	p=.894
Birth type				
Caesarean section	86	82.7	559,65±138.68	M-WU=686.000
Spontaneous delivery	18	17.3	582,77±121.88	p=.449
Sex of newborn				
Female	62	59.6	571.61±142.33	t=.725 df=102
Male	42	40.4	551.90±125.89	p=.470

Table 3. Mean, standard deviation, range of placental and newborn parameters

Placental and newborn parameters	Mean	Sd	Range
Placental weight (g)	563.65	135.65	290-990
Placental weight/birth weight	0.16	0.03	0.09-0.31
Birth weight (g)	3358	487.58	2000-4800
Neonatal length (cm)	49.56	2.89	30-55
Head circumference (cm)	34.24	3.19	24-43
Chest circumference (cm)	36.55	4.53	26-52
Newborn apgar score	8.27	0.52	7-10

Table 4. Correlations between placenta weight with maternal and newborn variables

Maternal and newborn variables	Correlations
Maternal weight before pregnancy	r= ,225 p=,021
Maternal weight in last day of pregnancy	r= ,295 p=,002
Maternal BMI in the last days of pregnancy	r=.238, p=.015
Number of cigarettes smoked during pregnancy	r=-.052, p=.042
Newborn's birth weight	r= ,400 p=,000
Newborn's length	r= ,222 p=,024

Table 5. Correlations between newborn weight with maternal and fetal variables

Maternal and newborn variables	Correlations
Cigarette number at pregnancy (day)	r=-.052, p=.042
Maternal weight before pregnancy	r=.306, p=.002
Maternal pre-pregnancy BMI	r=.265, p=.007
Maternal weight in the last day of pregnancy (kg)	r=.354, p=.000
Maternal BMI in the last day of pregnancy	r=.300, p=.002
Newborn's length	r=.497, p=.000
Newborn's head circumference	r=.277, p=.004
Newborn's chest circumference	r=.464, p=.000
Gestational week	r=.314, p=.001

Discussion

We evaluated the associations between maternal, placental and newborn parameters. The mean placental weight was found at 563.6 ± 135.65 grs, and the mean of newborn weight was 3358 ± 487.58 grs. Similarly, Sanin et al. found that the average birth weight was 3369 ± 445 grs, and the average placenta weight was 537 ± 96 grs (Sanin et al., 2001). Benirschke and Kaufmann reported the mean placenta weight at 38 weeks gestation as 470 grs without the cord and membrane; Petekkaya et al. found the mean placental weight as 445.14 ± 88 grs. The weight of placentas in our study was greater than the last two studies (Benirschke and Kaufmann, 2000; Petekkaya et al., 2011). The reason for this was possibly because the population characteristics, ethnicity and method differences of these studies can be associated with lower placenta weights.

The majority of maternal risk factors were associated with either a hypertropic or restrictive adaptive growth response of the placenta (Baptiste-Roberts et al., 2008). Maternal smoking during pregnancy is known to affect fetal growth and the

placenta, increasing the risk of giving birth to a small for gestational-age infant (Kramer, 1987; Miller and Jekel, 1989).

The potential effects of smoking during pregnancy on lung and airway development may include structural alterations (Collins et al., 1985). A marked reduction in fetal movements has been reported for at least an hour after the mother has smoked (Thaler et al., 1980). Nicotine may act as a vasoconstrictor, resulting in reduced placental blood flow, reduced supply of nutrients and oxygen to the fetus, and growth retardation and placenta grows and spreads over a wider area (Collins et al., 1985; Üstün and Malatyaloğlu, 1990). We found that 21.2% of mothers had smoked before pregnancy, and 16.3% of them continued smoking during pregnancy. Furthermore, the placenta weight of babies whose mothers had smoked during pregnancy was higher than for nonsmokers. The placenta weights between smoking and nonsmoking mothers were significantly different ($p=0.007$). In this study, birth weight correlated negatively with the number of cigarettes smoked in a day during pregnancy

($p=.042$). Similarly, Üstün and Malatyaloğlu (1990) reported that the placental weight of smoking mothers was 604 ± 11.84 grams, whereas the placental weight of non-smoker mothers was 553 ± 22.86 grams and the difference was significant. It also accounts for lower birthweights and an increase in placental weight and ratio to birthweight of placental weight (Üstün and Malatyaloğlu, 1990). Alp et al. (1995) shown that as the number of cigarettes smoked by mothers during pregnancy increased, birth weight decreased, and placental weight did not change. Kırımı and Peñçe indicated that smoker mothers delivered babies with significantly lower birth and placental weight when compared to the group of nonsmokers (Kırımı and Peñçe, 1999). The results of this study are similar to the results of some; they also differ from others reported in the related literature (Üstün and Malatyaloğlu, 1990; Alp, 1995; Kırımı and Peñçe, 1999).

We determined positively significant correlations between placental weight and infant's birth weight, length ($p=.024$), maternal weight before pregnancy, maternal weight in the last days of pregnancy, and maternal BMI in the last days of pregnancy.

We found that the newborn's weight was significantly negatively correlated with the number of cigarettes smoked each day during pregnancy. In addition, the newborn's weight was significantly positively correlated to the infant's placental weight, length, head circumference, chest circumference, and gestational week. It was also significantly positively correlated with the maternal weight before pregnancy, maternal BMI before pregnancy, maternal weight in the last days of pregnancy, and maternal BMI on the last day of pregnancy.

Previous studies have found positive correlations among placental weight, newborn's weight (Zeyneloğlu et al., 1999; Sanin et al., 2001; Sivarao et al., 2002; Little et al., 2003), and newborn's height (Sanin et al., 2001). Zeyneloğlu et al.(1999) indicated that there were significant correlations between placental weight and newborn weight and placental diameter and newborn

weight; placental weight and height of the newborn were significantly correlated; but there was no relationship between maternal weight and maternal weight gain during pregnancy. Lo et al.(2002) stated that there was a positive correlation between placenta weight and newborn weight, and newborn height. Alwasel et al.(2010) reported that high maternal body mass index was associated with a high placental ratio (placental weight/birth weight) at birth. Sanin et al. (2001) revealed that for each gram increase in placental weight, birth weight increased by 1.98 g.; placental weight has a nonlinear relation to the birth weight and is an important predictor of birth weight. Petekkaya et al. (2011) reported that only the relationship between placental weight and newborn weight was found to be statistically significant ($r=0.543$, $p<0.001$); no statistically significant relationship was found among placental weight and the age of the mother, number of births, newborn gender and height.

Conclusion

In conclusion, we found correlations between maternal, placental and infant parameters. The placental weight and maternal BMI have been shown to exert an effect on the newborn's weight. Maternal smoking during pregnancy was associated with an increase in placental weight as well as a decrease in an infant's weight. While the placenta is often weighed after delivery as a matter of routine in many delivery suites, little attention is usually paid to the relationship between placental weight and clinical complications, the common exception being when there is suspicion of retained placental tissue in the uterus and the low placental weight may provide a clue (Lao, 1998).

Results of our study strongly indicate that the relationship between placental, maternal, and newborn characteristics, both during pregnancy and after the child is born, may have a significant impact on the future health of the mother and the child. Therefore, the importance of increasing awareness of this issue among health care professionals is highly recommended.

Several limitations of our study are: The

mothers' pre-pregnancy weight was obtained by self-report. Although self-reported and measured weights tend to be correlated, women generally tend to underestimate their weight. There was a measurement error in the assessment of the placental growth measurement. There may also be some differential validity in the measurement placental diameter with regard to placental shape used in the estimation of placenta surface area.

Informed Consent: Verbal informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept- NE, NT, ÖA, SG, NA; Design- NE, NT, ÖA; Data Collection - NE, NT, ÖA, SG, NA; Analysis and Interpretation-NE; Literature Review-NE; Writing-NE

Conflict of Interest: The authors have no conflict of interest.

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