The Effects of Maternal Body Mass Index on Biometric Parameters in the Fetal Period

Anne Beden Kitle İndeksinin Biyometrik Fetal Parametreler Üzerine Olan Etkileri

Kadir DESDİCİOĞLU,[a]
Raziye DESDİCİOĞLU,[b]
Mehmet Ali MALAS[a]

[a]Department of Anatomy,
İzmir Kâtip Çelebi University
Faculty of Medicine,
[b]Clinic of Obstetrics and Gynecology,
İzmir Kâtip Çelebi Üniversitesi
Atatürk Training and Research Hospital,
İzmir

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Yazışma Adresi/*Correspondence:*
Kadir DESDİCİOĞLU
İzmir Kâtip Çelebi University
Faculty of Medicine,
Department of Anatomy, İzmir,
TÜRKİYE/TURKEY
kdesdici@yahoo.com

ABSTRACT Objective: To research the effects of maternal obesity on fetal development at the prenatal stage by observing the pregnant women with individually different body mass indexes. **Material and Methods:** There have been 444 pregnant women ages ranging from 19 to 44 and gestational weeks ranging from 14 to 40 included in the research. The pregnant women divided into three groups according to their body mass indexes. Group 1 consists of 139 pregnant women and the body mass index ranging from 20 to 24,9. Group 2 consists of 185 pregnant women and the body mass index ranging from 25 to 29,9. And group 3 consists of 120 pregnant women and the body mass index ranging from 30 to 34,9. The parameters of head circumference (HC), bi-parietal diameter (BPD), abdominal circumference (AC) and femur length (FL) of fetuses have been measured. Additionally, the means of fetal parameters for each gestational weeks, trimesters and months are calculated for each group according to the maternal body index. **Results:** There was a strong relationship between all the parameters and gestational weeks ($p<0.001$). There was a relationship between maternal weight and fetal parameters ($p<0.001$). Additionally, it has been observed that there was a significant difference between the trimester and months of the same groups ($p<0.05$), while there was no significant difference between the same months and the same parameters among the groups observed ($p>0.05$). **Conclusion:** It has been observed that the more the maternal body mass increases, the more the fetal parameters increases. There is a chance that the greater increase in maternal weight gain during pregnancy may cause negative effects on fetal development. We assume that the data we have gathered in our research will provide the suitable insight about the relationship between the maternal weight in fetal period and the fetal parameters.

Key Words: Pregnancy; fetal development; ultrasonography; body mass index; obesity

ÖZET Amaç: Farklı beden kitle indeksine sahip gebelerdeki maternal obezitenin prenatal dönemdeki fetal gelişim üzerine olan etkilerini araştırmak. **Gereç ve Yöntemler:** Çalışmaya yaşları 19-44 arasında olan ve gebelik haftası 14-40 haftalar arasında değişen 444 hamile dahil edildi. Gebeler beden kitle indeksine göre; beden kitle indeksi 20-24,9 arasında olan 139 gebe kadın I. grup, 25-29,9 arasında olan 185 gebe kadın II. grup ve 30-34,9 arasında olan 120 gebe kadın III. grup olarak üç gruba ayrıldı. Fetuslara ait baş çevresi (HC), bi-parietal çap (BPD), karın çevresi (AC) ve femur uzunluğu (FL) parametreleri alındı. Ayrıca annenin beden kitle indeksine göre fetus parametrelerinin haftalara, trimestere ve aylara göre ortalamaları hesaplandı. **Bulgular:** Tüm parametreler ile gestasyonel yaş arasında anlamlı ilişki vardı ($p<0,001$). Annenin beden kitle indeksi ile fetus parametreleri arasında anlamlı ilişki vardı ($p<0,001$). Annenin beden kitle indeksine göre fetus parametrelerinde, trimester ve ay gruplarında gruplar arası fark varken ($p<0,05$), grup içi karşılaştırmada fark bulunamadı ($p>0,05$). **Sonuç:** Maternal beden kitle indeksindeki artışın fetal parametreleri de artırdığı gözlemlendi. Gebelik süresince anne kilosundaki aşırı artışlar fetal gelişimi negatif yönde etkileyebilir. Çalışmamızdaki verilerin fetal dönemde maternal kilo ile fetal parametreler arasındaki ilişkinin değerlendirilmesinde yardımcı olacağını düşünmekteyiz.

Anahtar Kelimeler: Gebelik; fetal gelişim; ultrasonografi; beden kitle indeksi; obezite

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Fetal development is described as the increase in the anatomic diameters of the fetus.[1] The observation of the gestational week and fetal development are the main parts of the obstetric observations. Developmental failures and macrosomia affect the fetus negatively thus increasing the risks of mortality and morbidity chances. So we can say that it is crucial to know the developmental problems, early diagnosis and treatment methods and the fetal development.[2,3] Because it is known that the controlled termination or monitoring of the pregnancies require the detection of fetal development.[4] Fetal development is mainly under control of the genetics. Moreover the blood stream to the fetus and the nutrients provided by the blood stream also affect the fetal development externally.[5] The biometric parameters of fetal weight, crown-rump height (CRL), head circumference (HC), abdominal circumference (AC), bi-parietal diameter (BPD), femur length (FL) and foot length of fetuses are measured.[6] It is known that the parameter of BPD is the first parameter to determine the fetal age and it is dependable between the gestational weeks of 12th to 28th.[7,8] Additionally the head circumference parameter is a lot less affected than BPD from the developmental disorders.[7] The femur length is also another useful way to determine the age of a fetus. Moreover it has been mentioned in the earlier studies that it is a brilliant way to detect any skeletal system anomalies.[6,7,9,10] It is also known that the fetal abdominal circumference is proven to be useful in detecting the fetal growth but it is easily affected from any deviation occurs in the fetal development.[7,11]

The fetal growth may be affected from the environmental, fetal, maternal, placental and toxic factors.[5] We can describe the maternal factors that affect the fetal growth as the mother's age, weight, feeding habits, the diseases she had and harmful habits.[5] The weight of the mother which affects the fetal growth is considered to be important since the obesity is one of the most important health issues in the developed and developing countries.[8,12,13] Additionally, the obesity before or during pregnancy may affect negatively both mother and the fetus through various mechanisms.[14] In fact there is a thought that the affects of the obesity at the fetal stage may also be the reason of some disorders occur at the adult stage.[13-16]

The previous studies about the affects of maternal obesity on fetal development observed the affects of the body mass index (BMI) values on the fetal birth date.[17-19] There are studies that observed the affects of the maternal obesity on the fetal birth date and whether the maternal obesity caused any anomalies in the fetus.[13,20] Wolfe et al. observed that the increased maternal BMI results in maternal diabetes and preeclampsia and it results in fetal macrosomia.[12,13,21] Additionally, it has been observed that the lower BMI results as premature birth, low birth weight and perinatal death of the fetuses.[21] Abenhaim et al. pointed that the low BMI decreases the chance of any developmental anomalies to occur.[12] Yu et al. showed that high maternal BMI causes an increase in the numbers of macrosomic fetuses thus increasing the rate of cesarean delivery and fetus deaths before the birth.[13] Additionally, it is pointed that the children of the obese mothers are likely to be obese later in life.[13]

In this study we gathered the obese mothers with different BMI values and observed the affects of obesity on the fetal biometric parameters of HC, BPD, AC and FL as a difference from the previous studies.

MATERIAL AND METHODS

The study included the pregnant women who visited frequently the Ozel Isparta Hospital, Obstetrics and Gynecology clinic for pregnancy examination. Patients were informed about the study and patients were included in the check. There were 444 healthy pregnant women ages ranging from 19 to 44 years (mean: 26,4) and gestational weeks ranging from 14 to 40 week included in the research. The fetuses that are observed to have developmental disorders, anomalies, multifetal pregnancies, pregnant women who do not remember their last period and the ones who had any diseases were not included in the research. The weight of the women has been measured by a digital weighing machine and the height

of the women measured by an anthropometry. The BMI values of women calculated by dividing the weight (in kilograms) of the height squared (in meters) (BMI=weight/height^2). The pregnant women divided into three groups according to their body mass indexes. Group 1 consists of 139 pregnant women and the body mass index ranging from 20 to 24.9. Group 2 consists of 185 pregnant women and the body mass index ranging from 25 to 29.9. And group 3 consists of 120 pregnant women and the body mass index ranging from 30 to 34.9. The parameters of head circumference (HC), bi-parietal diameter (BPD), abdominal circumference (AC) and femur length (FL) of fetuses have been measured. The means and standard deviations of the fetal parameters are calculated for gestational weeks, trimesters, months and BMI groups independently. Additionally the means and standard deviations of the fetal parameters belonging to each BMI group are calculated for gestational weeks, trimesters and months.

The measurements are done by a researcher (RD). The data is collected with the help of the 5-2 mHz probe of Philips HD7 diagnostic ultrasound device via the transabdominal way. The methods used in the previous studies are used again to measure the parameters in this study too. HC is measured by the ellipse shape that a skull has.[8] The BPD is measured where the midline of falk cerebri echo and the cavum septi pellisidum are met and where they are largest by measuring the parietal skull bones from outside to inside.[22,23] AC measurement is done where the vena portae is divided right before the umbilical entry by measuring the anteroposterior and transverse diameters.[2,11] FL measured as the distance from the lateral condyle of major trochanter.[10,23]

All the calculations are done by the SPSS statistical program. The significance level of all statistical tests are considered as $p<0.05$. Since the sample sizes in some groups are considerably low, the non-parametrical test of Kruskall-Wallis. The groups that are found significant are tested in groups of two in Mann-Whitney U test. And the Benferroni correction is used for assessing multiple comparison correction. The relationship between the parameters and gestational weeks has been tested with the Pearson correlation. The gathered p values are displayed below and in the tables.

RESULTS

In this study we have calculated the means and the standard deviations of the relationships between the fetal parameters of HC, BPD, AC and FL and the specific groups like gestational weeks, trimesters, months and BMI groups. The results are also shown in the Table 1 to 4. We have observed that the fetal parameters of trimesters and the fetal parameters of months differ significantly from each other ($p<0.05$, Table 2, 3). The BMI groups are observed not to be different from each other significantly ($p>0.05$, Table 3). The fetal parameters belonging to the BMI groups for gestational weeks are shown in the Table 5. The means and the standard deviations of BMI parameters at trimesters and months are shown in Table 6 and 7. It has been observed that there are significant differences among the parameters that belong to same BMI groups in trimesters and months ($p<0.05$, Table 6, 7). However there has been no significant difference observed in the parameters of BMI groups at the same trimesters and months ($p>0.05$, Table 6, 7). It has been observed that the fetal parameters are increased by the gestational age increases and the increase is significant ($p<0.001$).

DISCUSSION

It is common in many studies to use the parameters of fetal weight, CRL, HC, BPD, AC, FL and foot length for evaluating the fetal growth.[6] Since the early diagnosis of any developmental disorders and anomalies is crucial for the treatment process, evaluating the fetal growth and the gestational age become important factors.[3]

There are many studies that pointed out the fetal growth speed at the fetal period.[2,8,23,24] Sener et al. aimed to match the parameters they have gathered with the previous studies.[24] Bese et al. aimed to produce new fetal biometric curves from the fetal parameters they gathered.[23] Johnsen et

TABLE 1: The means and standard deviations of fetal parameters for gestational weeks (mm).

Week	N	HC	BPD	AC	FL
14	11	97.3±5.9	26.7±2.7	82.3±10.2	14.4±2.4
15	12	116.9±10.7	33.0±2.6	103.0±10.4	19.1±3.6
16	34	131.5±11.0	36.4±2.5	111.0±19.2	23.3±2.4
17	13	139.6±8.7	38.6±2.5	123.2±7.1	25.3±2.2
18	6	143.8±3.5	40.5±1.0	135.9±7.3	27.4±0.9
19	9	165.6±11.1	45.7±1.9	145.9±11.0	32.4±2.6
20	11	180.0±8.0	49.2±2.0	163.5±12.4	35.0±2.6
21	18	181.8±11.3	51.3±2.9	166.4±8.4	36.4±2.8
22	19	204.0±9.4	56.5±3.3	183.1±11.2	40.3±2.0
23	15	210.9±9.1	58.4±2.9	191.2±10.7	42.2±2.7
24	18	222.8±13.4	61.1±3.4	199.9±11.4	45.2±2.2
25	20	235.2±9.5	65.2±3.5	216.7±15.0	47.5±2.2
26	27	247.6±17.2	68.1±5.6	231.4±23.1	50.5±4.4
27	15	256.9±11.5	69.7±3.4	232.6±11.5	51.4±3.6
28	14	259.6±12.3	72.7±3.1	249.7±12.7	53.7±2.7
29	18	273.5±8.3	77.0±2.9	258.0±10.7	58.0±2.0
30	14	282.0±12.5	78.7±2.8	266.2±11.3	58.9±1.9
31	11	285.3±16.9	80.1±4.7	269.7±27.4	59.4±8.7
32	10	297.7±6.4	83.0±2.3	293.3±11.6	64.4±2.4
33	13	304.8±4.5	85.6±2.3	302.1±15.0	66.3±2.0
34	28	311.4±7.0	85.8±4.3	308.8±9.3	67.8±2.4
35	14	317.0±8.8	86.8±5.8	313.7±11.5	70.2±2.6
36	15	323.0±7.5	89.6±2.9	319.8±10.9	70.5±2.6
37	34	326.8±8.7	91.7±4.7	331.8±11.9	72.3±3.1
38	27	333.0±11.4	94.0±1.9	339.7±12.5	73.3±2.9
39	12	335.3±8.0	95.6±2.3	340.2±12.7	73.8±3.5
40	6	336.1±6.5	96.7±2.7	346.5±12.8	76.8±2.8

HC: Head circumference; BPD: Bi-parietal diameter; AC: Abdominal circumference; FL: Femur length.

TABLE 2: The means and standard deviations of fetal parameters for trimesters (mm).

Trimester Group	Age (week)	N	HC	BPD	AC	FL
Group 1	14.-25. week	186	172.2±44.4	47.9±12.1	154.4±43.6	33.2±10.6
Group 2	26.-37. week	179	285.6±28.5	79.2±8.3	275.2±35.8	60.6±8.1
Group 3	38.-40. week	79	330.9±10.1	93.5±3.8	336.9±13.0	73.2±3.3
Total	14.-40. week	444	246.4±73.0	68.6±20.7	235.6±81.0	51.4±18.2

p<0.05: There is a significant difference among trimesters. HC: Head circumference; BPD: Bi-parietal diameter; AC: Abdominal circumference; FL: Femur length.

TABLE 3: The means and standard deviations of fetal parameters for months (mm).

Age (month)	N	HC	BPD	AC	FL
4	57	121.8±16.7	33.8±4.5	103.8±19.5	20.7±4.4
5	39	157.6±19.2	43.5±4.9	141.7±18.8	30.0±4.7
6	70	204.6±18.6	56.7±4.7	184.9±16.2	41.0±4.0
7	76	248.4±16.1	68.5±4.9	231.1±20.3	50.5±4.0
8	53	282.8±14.0	79.2±3.8	269.3±19.8	59.7±4.8
9	70	313.8±9.3	86.8±4.3	310.9±12.5	68.6±2.8
10	79	330.9±10.1	93.5±3.8	336.9±13.0	73.2±3.3
Total	444	246.4±73.0	68.6±20.7	235.6±81.0	51.4±18.2

p<0.05: There is a significant difference among months.
HC: Head circumference; BPD: Bi-parietal diameter; AC: Abdominal circumference; FL: Femur length.

TABLE 4: The means and standard deviations of fetal parameters for the BMI groups (mm).

BMI - Group	BMI	N	HC	BPD	AC	FL
Group BMI-I	20-24.9	139	233.9±75.0	65.0±21.0	221.1±80.5	48.3±18.4
Group BMI-II	25-29.9	185	252.0±73.1	70.2±20.7	241.9±81.9	52.6±18.1
Group BMI-III	30-34.9	120	252.2±69.3	70.4±19.9	242.6±78.8	53.0±18.0
Total	20-34.9	444	246.4±73.0	68.6±20.7	235.6±81.0	51.4±18.2

p>0.05: There is not a significant difference among the BMI groups.
HC: Head circumference; BPD: Bi-parietal diameter; AC: Abdominal circumference; FL: Femur length.

TABLE 5: The means of fetal parameters belonging to the BMI groups measured in each gestational week (mm).

	N			HC			BPD			AC			FL		
	BMI Group			BMI Group			BMI Group			BMI Group			BMI Group		
Age (week)	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
14	6	3	2	98,3	94,7	97,8	27,0	26,6	26,2	83,3	83,8	77,0	14,6	14,8	13,2
15	5	4	3	108,9	120,6	125,3	31,3	33,2	35,6	98,9	105,5	106,4	18,8	17,9	21,3
16	10	16	8	128,8	127,7	142,3	35,7	35,8	38,7	114,0	105,2	118,9	22,7	23,1	24,5
17	5	5	3	135,6	144,6	137,7	38,2	40,3	36,4	117,7	128,2	123,8	24,9	26,5	23,7
18	2	2	2	141,2	143,5	146,8	40,3	40,9	40,5	129,1	141,2	137,5	27,5	27,4	27,4
19	4	3	2	173,2	154,4	167,0	47,1	43,6	46,2	149,8	140,2	146,6	32,8	32,0	32,2
20	4	4	3	179,2	183,1	177,2	49,5	49,00	49,2	164,2	166,6	158,4	35,4	36,4	32,8
21	7	6	5	180,0	187,0	178,3	51,3	52,5	50,0	167,5	168,9	161,8	37,1	36,5	35,2
22	6	8	5	208,4	201,3	203,1	58,8	55,3	55,6	187,6	177,4	187,0	41,9	39,4	40,3
23	5	6	4	211,5	211,1	209,9	57,1	59,3	58,6	191,3	193,8	187,0	41,9	42,7	42,0
24	9	5	4	219,9	223,0	229,1	60,2	61,2	63,1	200,9	198,4	199,4	44,8	44,8	46,8
25	4	12	4	234,4	234,8	237,2	63,9	65,6	65,5	217,3	213,5	225,5	46,0	47,6	48,8
26	10	11	6	243,6	255,0	240,8	66,5	70,3	66,7	224,1	241,1	225,5	48,4	52,2	50,8
27	5	4	6	256,4	249,7	262,0	69,4	68,7	70,6	228,0	227,2	240,2	51,0	51,8	51,5
28	5	5	5	263,0	261,0	255,5	70,8	72,8	74,3	246,1	253,5	248,7	54,2	54,0	53,2
29	5	7	6	269,9	275,4	274,3	76,3	75,9	78,8	253,6	255,2	265,1	56,8	57,8	59,4
30	5	5	4	280,7	277,8	288,7	78,6	77,3	80,5	265,1	266,4	267,3	59,2	59,4	57,8
31	3	5	3	284,2	285,7	286,0	78,2	80,6	81,1	254,9	283,7	261,1	61,0	56,4	62,9
32	3	4	3	297,7	297,0	298,5	82,6	82,3	84,5	286,3	291,1	303,2	65,9	63,2	64,6
33	3	5	5	301,2	307,2	304,7	84,9	87,6	84,2	295,9	305,8	302,1	66,0	66,8	66,0
34	9	13	6	309,9	312,3	311,7	85,5	85,6	86,6	308,7	307,0	312,9	67,2	67,9	68,3
35	4	5	5	321,1	314,4	316,2	88,3	87,4	85,2	319,4	311,4	311,6	70,5	69,6	70,7
36	3	7	5	328,7	322,3	320,4	93,3	89,3	88,0	320,1	317,6	322,8	70,1	70,7	70,5
37	6	19	9	328,8	325,8	327,8	92,0	91,2	92,8	332,8	329,7	335,5	72,2	71,5	74,1
38	7	13	7	338,9	332,3	328,5	94,8	93,0	95,1	337,4	341,6	338,6	73,4	72,2	73,4
39	3	6	3	331,6	335,2	339,3	94,0	96,5	95,2	341,9	337,6	343,6	75,2	73,2	73,5
40	2	2	2	331,5	339,9	337,0	98,0	97,5	94,6	346,5	336,9	356,3	78,4	75,6	76,5

HC: Head circumference; BPD: Bi-parietal diameter; AC: Abdominal circumference; FL: Femur length.

al. aimed to determine new parameters from HC and BPD and compare them with the parameters used before for evaluating the fetal age.[8] Additionally, they hoped to find both maternal and fetal factors at the second trimester to determine the fetal age.[8]

Torloni et al. looked for the relationship between the BMI value and the premature births.[18] Cnattingius et al. searched for the affects of high maternal weight on late fetal death, early neonatal death, premature birth and stillbirth prior to the pregnancy.[20] Yu et al. observed the affects of obe-

TABLE 6: The means and the Standard deviations of fetal parameters belonging to the BMI groups measured in each trimester (mm).

	N			HC			BPD			AC			FL		
	BMI Group			BMI Group			BMI Group			BMI Group			BMI Group		
Trimester group (week)	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Group 1 (14-25)	67	74	45	168.3±45.7	175.0±45.2	175.4±40.4	46.7±12.3	48.6±12.5	48.3±11.3	151.8±43.8	155.6±45.9	156.2±40.8	32.4±10.8	33.8±10.7	33.4±10.2
Group 2 (25-37)	54	71	54	282.1±29.4	288.2±28.0	285.7±28.2	77.9±8.9	79.9±8.4	79.5±7.7	268.3±38.2	279.3±34.1	276.8±35.2	59.5±8.3	61.2±8.2	61.0±7.7
Group 3 (38-40)	18	40	21	333.5±9.1	330.0±9.1	330.5±12.5	94.1±2.7	92.9±4.7	94.1±2.3	337.6±14.4	335.1±11.7	339.7±14.1	73.9±3.0	72.2±3.4	74.7±2.6
Total (14-40)	139	185	120	233.9±75.0	252.0±73.1	252.2±69.3	65.0±21.0	70.2±20.7	70.4±19.9	221.1±80.5	241.9±81.9	242.6±78.8	48.3±18.4	52.6±18.1	53.0±18.0

p>0.05: There is not a significant difference in the BMI groups belonging to the same trimester in terms of parameters.

p<0.05: There is a significant difference among the BMI groups belonging to the different trimesters in terms of parameters.
HC: Head circumference; BPD: Bi-parietal diameter; AC: Abdominal circumference; FL: Femur length.

TABLE 7: The means and the standard deviations of fetal parameters belonging to the BMI groups measured in month (mm).

	N			HC			BPD			AC			FL		
	BMI Group			BMI Group			BMI Group			BMI Group			BMI Group		
Age (month)	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
4	21	23	13	115,3±15,4	122,2±14,7	131,6±18,4	32,2±4,5	34,1±3,9	36,0±4,9	101,6±17,0	102,5±23,0	109,6±16,4	19,4±4,2	21,1±4,3	22,0±4,6
5	15	14	10	158,0±22,0	157,5±18,3	157,2±18,0	43,9±5,3	43,5±4,0	43,0±5,8	140,2±21,6	143,6±18,3	141,5±16,5	30,1±5,0	30,6±4,8	28,9±4,3
6	27	25	18	205,4±20,8	204,5±15,6	203,5±19,8	57,0±5,0	56,8±4,2	56,4±5,3	187,5±17,5	183,5±14,4	182,8±16,8	41,6±4,0	40,5±3,7	40,6±4,6
7	23	32	21	248,1±12,5	247,7±19,3	249,7±15,1	67,4±3,8	68,7±6,0	69,4±4,2	227,6±15,0	231,0±26,1	235,2±14,8	49,5±3,8	50,7±4,7	51,2±2,8
8	16	21	16	281,2±16,1	282,5±13,6	284,6±13,1	78,5±4,5	78,5±3,9	80,7±2,7	263,6±20,4	271,5±19,7	272,0±19,4	60,0±3,6	58,9±6,4	60,6±3,1
9	19	30	21	313,8±11,6	314,1±7,9	313,2±9,2	87,2±3,6	87,1±4,4	86,0±4,9	310,7±14,8	310,0±10,8	312,4±13,2	68,2±3,2	68,7±2,5	68,8±2,9
10	18	40	21	333,5±9,1	330,0±9,1	330,5±12,5	94,1±2,7	92,9±4,7	94,1±2,3	337,6±14,4	335,1±11,7	339,7±14,1	73,9±3,0	72,2±3,4	74,7±2,6
Total	139	185	120	233,9±75,0	252,0±73,1	252,2±69,3	65,0±21,0	70,2±20,7	70,4±19,9	221,1±80,5	241,9±81,9	242,6±78,8	48,3±18,4	52,6±18,1	53,0±18,0

p>0.05: There is not a significant difference in the BMI groups belonging to the same month in terms of parameters.

p<0.05: There is a significant difference among the BMI groups belonging to the different months in terms of parameters.
HC: Head circumference; BPD: Bi-parietal diameter; AC: Abdominal circumference; FL: Femur length.

sity at the pregnancy on maternal and fetal morbidity and mortality.[13] Abenhaim et al. searched for the obstetric and neonatal affects of maternal BMI at pregnancy.[12] Wolfe et al. worked on the clinical advantages of maternal BMI at pregnancy.[21]

In this study we gathered the obese mothers with different BMI values and observed the affects of obesity on the fetal biometric parameters of HC, BPD, AC and FL as a difference from the previous studies. The results are also shown in the Table 1 to 4. There is a significant difference observed between the trimesters and months while there is no significant difference observed among the BMI groups. Thus this result brought us to the thought that the fetal parameters are not affected from the maternal BMI (Figure 1 to 4). The previous studies suggest that the increased maternal BMI results in maternal diabetes and preeclampsia and it results in fetal macrosomia.[6,13,21] Which suggest that the fetal parameters, especially the fetal weight will be affected from the maternal BMI positively. Cnattingius et al. suggest that the pregnant women with higher BMI would give birth to the small fetuses for gestational age.[20] Which suggest that the fetal parameters will be affected from the maternal BMI negatively. Thus this concludes that our study is not consistent with previous studies. This led us to the thought that there are geographical differences or mistakes done when gathering the data.

The means and the standard deviations of the fetal parameters belonging to the BMI groups at the same gestational weeks, months and trimesters are calculated (Table 5 to 7). There has been no significant difference observed in the parameters of BMI groups at the same trimesters and months (Figure 1 to 4, Table 6, 7). It has been observed that there are significant differences among the parameters that belong to same BMI groups in trimesters and months (Table 5, 6). As a result we can say from our data that the fetal parameters at the same months and trimesters are not affected from the maternal BMI. Additionally, it has been observed that the fetal parameters are increased by the gestational age increases and the increase is significant ($p<0.001$).

The previous studies displayed that the fetal parameters are affected from the high maternal BMI, gestational diabetes, preeclampsia, and smok-

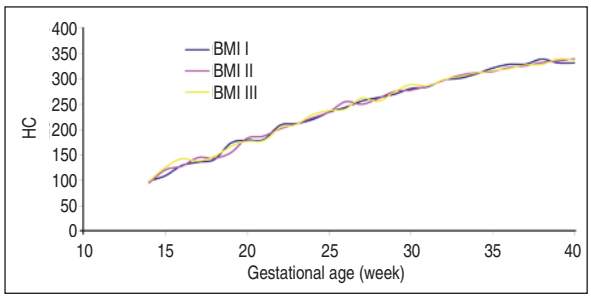

FIGURE 1: HC values of BMI groups for the gestationel weeks.
HC: Head circumference; BMI: Body mass index.
(See color figure at http://jinekoloji.turkiyeklinikleri.com/)

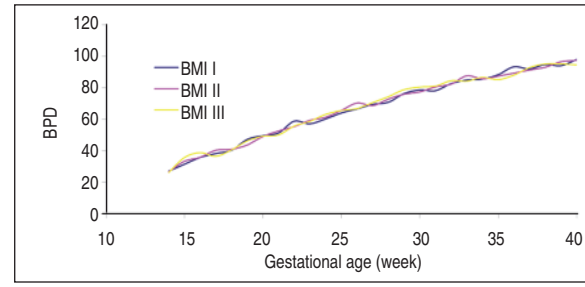

FIGURE 2: BPD values of BMI groups for the gestationel weeks.
BMI: Body mass index; BPD: bi-parietal diameter.
(See color figure at http://jinekoloji.turkiyeklinikleri.com/)

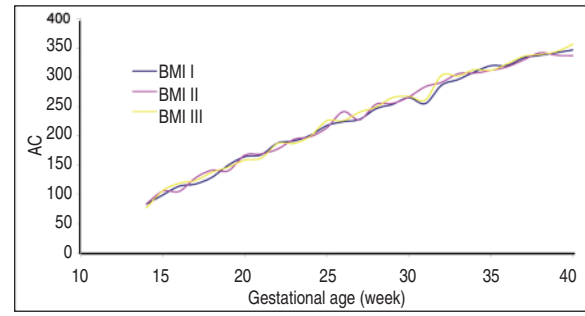

FIGURE 3: AC values of BMI groups for the gestationel weeks.
AC: Abdominal circumference; BMI: Body mass index.
(See color figure at http://jinekoloji.turkiyeklinikleri.com/)

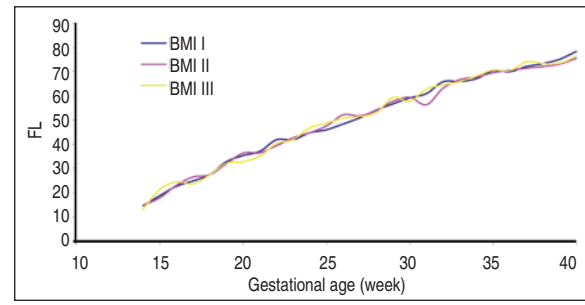

FIGURE 4: FL values of BMI groups for the gestationel weeks.
FL: Femur length; BMI: Body mass index.
(See color figure at http://jinekoloji.turkiyeklinikleri.com/)

ing.[17,18] Such pathological issues may result as the premature births, macrosomic fetuses, stillbirths, prolonged pregnancies, low birth weights and small fetuses for the gestational age.[12,17,18,20] Thus it is crucial to observe the pregnancies in such situations.

We did not use the parameter of fetal weight for evaluating the fetal development. The fetal weight is calculated from the other fetal parameters that are used for evaluating the fetal development, affected from many maternal and fetal factors and the fetal weight at birth is considered as utilizable data in the studies. Thus the fetal weight is not a dependable parameter at all. Since this study is connected with the fetal development, we have used the parameters of HC, BPD and FL where the lengths of bones are measured and which leave very little room for errors thus becoming more dependable parameters.

CONCLUSION

The results of this study showed that those parameters are not affected from the different maternal BMI values. Thus we consider our study as an antecedent one on this matter. It is a requirement that new studies about the pregnant women with different BMI values to observe the maternal obesity affects on the fetal development with larger sample sizes. We assume that the data we have gathered in this study should prove useful for the clinicians for evaluating the fetal development.

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