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Association of Maternal Body Mass Index with Adverse Maternal and Prenatal Outcomes

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Abstract

***Background*:** The present study aimed to determine association between abnormal maternal body mass index and adverse maternal/prenatal outcomes

***Materials and Methods*:** In this descriptive-correlation study 8270 pregnant women referred to rural and urban health centers of Ardabil district (from Mar 2009 to Dec 2010) were studied. Data were collected from prenatal healthcare records using a self designed questionnaire. Women with twin pregnancy, less than 18 and above 35 of age, and women with systemic or chronic disease were excluded from the study. The variables examined in this study include, demographic information (e.g. age, social and economy status, and literacy), present pregnancy information (e.g. parity, hemoglobin level, gestational diabetes, preeclampsia) and prenatal information (e.g. preterm delivery, low birth weight, and congenital malformation). Data were analyzed through Kruscal wallis, chi-square, and logistic regression tests using SPSS-16.

***Results*:** Eight point two, 25 and 15.4% pregnant of women were underweight, overweight, and obese, respectively. Obese women were at increased risk for macrosomia (OR=1.820, CI: 1.345-2.447, p=0.001), unwanted pregnancy (OR= 1.436, CI: 1.198-1.720, p=0.001), pregnancy induced hypertension (OR= 1.633, CI: 1.072-2.486, p=0.022), preeclampsia (OR= 4.666, CI: 2.353-9.2550, p=0.001), and still birth (OR= 2.602, CI: 1.306-5.184, p=0.007). However, the risk of low birth weight delivery in underweight women were 1.6 times higher than the normal cases (OR= 1.674, CI: 0962-2.912, p=0.068).

***Conclusion*:** Considering high prevalence of abnormal maternal body mass index and its associated adverse maternal and prenatal outcomes; consultation before pregnancy is recommended in order to achieve normal body mass index and reduce the relevant complications.

Introduction

Body mass index is a determinant of excess body fat status, which is calculated as body weight in kilograms divided by height in meters squared [1, 2]. WHO and the national institutes of health define underweight as a body mass index ≤18.5 kg/m^2, normal weight as a BMI of 18.5-24.9 kg/m^2, overweight as a BMI of 25-29.9 kg/m^2, and obesity as a BMI of ≥30 kg/m^2 [2, 3].

Women's overall health is influenced by body weight [1]; a women's risk of disease rises in proportion to the increase in body weight [4]. During pregnancy and childbirth, greater body weight is associated with an elevated risk of hypertensive disorders, gestational diabetes, cesarean birth, fetal macrosomia, thromboembolic disease, stillbirth, perinatal death, preterm delivery and fetal birth defect [5, 6].

The effect of being underweight in pregnancy on obstetric performance is less clear. While some have found increased incidences of preterm delivery, low birth weight, and increased prenatal loss in these women, others have reported a protective effect of maternal underweight on certain pregnancy complications and interventions [7]. It is clear that women with abnormal body mass index require more healthcare resources during pregnancy than women of normal body weight and hence increase pressure on our health care system. Therefore, it is of public health importance to study the impact of maternal body mass index on adverse pregnancy and birth outcomes.

There are earlier studies that have investigated the impact of maternal body mass index on selected obstetric outcomes in Islamic Republic of Iran, but most of them were limited to one or two maternal BMI classes or were performed in a small sample size [8-11].

The objective of the present study was to thoroughly assess, in a large retrospective data, adverse obstetric and neonatal outcomes over the maternal BMI strata.

Materials and Methods

In this descriptive correlational study, the population included all the women having pregnancy from March

2009 to December 2010 coming to urban and rural health centers in Ardabil. All in all, 8270 women who ended their pregnancy due to abortion, preterm delivery, still birth and delivery at term were included in the study. The data were collected through examining the recorded personal profiles and filling out a questionnaire.

Those women whose heights and weights were not recorded in their personal profiles and the ones who did not receive pregnancy care were excluded from the study .Individuals aged less than 18 and above 35 and those having diseases such as coronary, pulmonary, thyroid, asthma and multiple pregnancies were alsop excluded from the study. Data were collected through a researcher-made questionnaire by 10 trained midwives.

The questionnaire included 95 questions, of which 8 were on maternal demographic information (maternal age, socioeconomic status, educational level). 70 questions were about the women's current pregnancy characteristic (high blood pressure, preeclampsia, anemia, the way of delivery, pregnancy diabetes, urinary infection, unwanted pregnancy, hyperemesis gravidarum), and finally 17 questions were about newborn characteristic (birth weight, age of birth, having jaundice, hospitalization). The validity of the questionnaire was verified through content validity approach by three professors of Ardabil University of Medical Sciences.

All the pregnant women coming to Ardabil health centers for prenatal care, generally will receive maternal integrated care with an interval of one to two months based on the guidelines provided by Iranian Ministry of Health. Pregnancy tests of hemoglobin, hematocrit, complete urine analysis, glucose tolerance tests (GCT, GTT) will be taken during 26-30 weeks of pregnancy and the results are recorded in their profiles. Diagnosis of anemia, pregnancy diabetes, preeclampsia, unwanted pregnancy, and high blood pressure were done according to ministerial guidelines of integrated care. Hemoglobin levels of under 11 g/dl during 6-10 weeks of pregnancy and under 10.5 g/dl during 26-30 weeks were considered as anemia. Having urinary infection was taken in the form of bacterial growth more than 100,000 organisms per ml in the urine culture.

The lack of tendency of one or both of the parents to have a baby and unwanted pregnancy were recorded in the health profiles. Systolic blood pressure of 140 and/or higher and diastolic blood pressure of 90 and higher in a mother who had previously normal blood pressure were considered as an increase in the rate of general blood pressure. The same phenomenon plus the positive test of urinary protein was taken as an indicator of preeclampsia. If the mother had previous hospitalization due to serious pregnancy vomiting, it was also accounted for hyperemesis gravidarum. If the result of GCT test was 140 mg/dl or higher, fasting blood sugar test and one-hour, two-hour and three-hour GTT was requested. If the results of two of those four tests were unusual, having diabetes was put forward [12].

In order to calculate maternal BMI, the height and weight of the first three months of pregnancy were used. As in the health system of Iran, classification of BMI during pregnancy care is performed according to guidelines of Ministry of Health, the classification of BMI in line with the above-mentioned guidelines was done in the form of thin BMI (<19.8 kg/m^2), normal weight (the BMI from 19.8 to 26 kg/m^2), overweight (the BMI between 26.1 and 29.9) and obese (≥30 kg/m^2) [13]. This classification is a little bit different from the one proposed by WHO.

Due to large sample size of the present study and the recorded data in the profiles, our access to each subject to have a written or oral agreement was not possible. The researchers were committed to keep confidential the personal profiles of the subjects. The data after collection and classification were analyzed through inferential and descriptive statistical tests of chi square, Kruskal-Wallis and logistic multiple regression using SPSS-16. The *p*-value was set at lesser or equal to 0.05.

Results

Based on the classification of BMI, 675 (8.2%) of the subjects were thin, 4252 (51.4%) normal, 2069 (25%) slightly overweight, and 1274 (15.4%) were obese. Different groups of BMI had statistically significant relationship with education, socioeconomic class, age and place of residence. The prevalence of obese BMI was more in women with low education, higher socioeconomic class, the age over 25 and those living in urban areas (Table 1).

Different classifications of BMI had statistically significant relationship with pregnancy diabetes, preeclampsia, high blood pressure, caesarian delivery, abortion, still birth, and unwanted pregnancy. The rate of nuliparity, prim gravidity and anemia in women with thin BMI was higher. In addition, the frequency of multiparity, diabetes, high blood pressure, preeclampsia, caesarian, abortion, still birth and unwanted pregnancy was high in women with the overweight and obese conditions. There was not any statistically significant relationships between maternal BMI and urinary infection, hyperemesis gravidarum, spotting and bleeding, leakage, poly-hydramnion, blood type and the maternal Rh (Table 2).

Different categories of BMI did have statistically significant relationships with low birth weight, macrosomia and newborn's gender. The rate of preterm delivery and low birth weight in women with thin BMI was more frequent.

The frequency of macrosomia, congenital malformations and non-successful breastfeeding was high in women with overweight and obese body mass index. High rate of female and male genders were observed in newborns' of women with thin BMI and overweight and obese women, respectively (Table 3). Based on the results of logistic regression, the probability of fetal macrosomia in overweight women was 1.5 times and 2 times in fat ones. The odds of caesarian delivery were 1.7 fold in overweight women and 2 fold in obese ones.

The chance of unwanted pregnancy in fat women was 1.6 times, having high blood pressure in overweight and

obese groups were 2.5-3 times, respectively. The likelihood of fetus being male in women who were slightly overweight and obese was 1.2 times. The risk of preeclampsia was 3 fold in overweight and 4.5 times in obese women, the probability of still birth was 2.6 times in obese women and the odds of low birth weight was 1.6 fold higher in thin ones. The probability of having anemia decreased with increasing BMI and declined with decreasing BMI regarding fetal macrosomia and caesarian delivery (Table 4).

Table 1. Maternal demographic characteristics for the four BMI categories

General characteristics \ Maternal body mass index		Under weight N(%)	Normal N(%)	Overweight N(%)	Obese N(%)	*p*-Value
Maternal education	Secondary ≥	343(50.9)	2175(51.6)	1051(51.4)	736(58.2)	0.001
	High school ≤	330(49.1)	2040(48.4)	994(48.6)	529(41.8)	
Social class	Middle and low	552(83)	3334(79.9)	1557(76.7)	948(75.9)	0.001
	High	113(17.0)	840(20.1)	473(23.3)	301(24.1)	
Maternal age	18-25	520(77.4)	2514(59.4)	885(43.0)	411(32.4)	0.001
	26-30	121(18.0)	1194(28.2)	704(34.3)	483(38.0)	
	30-35	31(4.6)	525(12.4)	469(22.8)	376(29.6)	
Area of resident	Urban	564(83.7)	3528(83.0)	1820(88.0)	1132(88.9)	0.001
	Rural	110(16.3)	724(17.0)	249(12.0)	142(11.1)	

Table 2. Present pregnancy characteristics based on BMI categories

Body Mass Index maternal variables		Under weight		Normal		Over weight		Obese		*p*-Value
		N	%	N	%	N	%	N	%	
Gravidity	1	466	70.8	2336	56.1	765	37.9	336	26.9	0.001
	2	144	21.9	1274	30.6	788	39.0	492	39.4	
	3	37	5.6	384	9.2	311	15.4	274	21.9	
	4	9	1.4	108	2.6	109	5.4	102	8.2	
	5≤	2	0.3	62	1.5	45	2.2	45	3.6	
Parity	0	111	38.9	611	26.1	225	16.0	108	11.1	0.001
	1	140	49.1	1307	55.8	831	59.2	571	58.7	
	2≤	34	11.9	425	18.1	347	24.7	293	30.1	
Urinary tract infection	yes	213	32.7	1313	32.1	653	32.6	387	31.5	0.921
	no	439	67.3	2778	67.9	1352	67.4	842	68.5	
Hemoglobin level in 6-10 week of gestation	11>	32	4.8	216	5.2	75	3.7	52	4.2	0.052
	11≤	630	95.2	3903	94.8	1944	96.3	1176	95.8	
Hemoglobin level in 26-30 week of gestation	10.5>	84	17.0	476	15.5	179	13.2	105	12.0	0.001
	10.5≤	410	83.0	2588	84.5	1289	87.8	771	88.0	
Gestational diabetes	Yes	6	0.9	35	0.8	27	1.3	21	1.7	0.050
	No	659	99.1	4134	99.2	1998	98.7	1224	98.3	
Preeclampsia	Yes	1	0.2	14	0.3	20	1.0	21	1.7	0.001
	No	665	99.8	4181	99.7	2024	99.0	1243	98.3	
Hypertension	Yes	5	0.7	27	0.6	27	1.3	20	1.6	0.005
	No	665	99.3	4183	99.4	2018	98.7	1243	98.4	
Hyperemesis Gravidarum	Yes	56	8.4	350	8.3	155	7.6	93	7.4	0.585
	No	614	91.6	3859	91.7	1896	92.4	1171	92.6	
Cesarean	Yes	184	38.6	1459	49.1	871	60.7	590	67.4	0.001
	No	293	61.4	1512	50.9	563	39.3	285	32.6	
Bleeding or spotting	Yes	19	2.8	130	3.1	64	3.1	29	2.3	0.496
	No	648	97.2	4074	96.9	1970	96.9	1227	97.7	
Abortion	Yes	4	0.6	54	1.3	31	1.5	28	2.2	0.023
	No	665	99.4	4158	98.7	2023	98.5	1238	97.8	
Still birth	Yes	1	0.3	18	0.4	13	0.6	16	1.3	0.006
	No	669	99.7	4190	99.6	2039	99.4	1249	)98.7	
Leakage	Yes	15	2.3	76	1.8	35	1.7	11	0.9	0.081
	No	650	97.7	4124	98.2	2007	98.3	1247	99.1	
Oligohydramnios	Yes	2	0.5	15	0.6	6	0.5	4	0.6	0.979
	No	396	99.5	2369	99.4	1130	99.5	664	99.4	
Unwanted pregnancy	Yes	27	4.0	156	3.7	94	4.6	77	6.1	0.003
	No	646	96.0	4080	96.3	1968	95.4	1191	93.9	
Blood group	A	245	36.7	1527	36.9	713	35.2	471	37.8	0.226
	B	141	21.1	765	18.5	399	19.7	222	17.8	
	AB	32	4.8	289	7.0	158	7.8	88	7.1	
	O	249	37.3	1555	37.6	754	37.3	466	37.4	
Rh	Positive	593	90.0	3656	89.2	1781	89.1	1067	86.7	0.060
	Negative	66	10.0	442	10.8	218	10.9	164	13.3	

Table 3. Neonatal characteristics based on BMI categories

Maternal variables / Body mass index		Under weight		Normal		Over weight		Obese		*p*-Value
		N	%	N	%	N	%	N	%	
Gestational age	Term	381	93.4	2407	95.2	1174	95.8	692	96.2	0.141
	Preterm	27	6.6	122	4.8	52	4.2	27	3.8	
Low birth weight	2500>	21	5.6	83	3.5	25	2.2	20	3.0	0.010
	2500≤	354	94.4	2298	96.5	1122	97.8	644	97.0	
Macrosomia	Yes	20	5.3	204	8.6	151	13.2	101	15.2	0.001
	No	355	94.7	2177	91.4	996	86.8	563	84.8	
Jaundice	Yes	230	56.7	1474	58.4	704	57.9	432	59.5	0.808
	No	176	43.3	1048	41.6	511	42.1	294	40.5	
Hospitalization	Yes	31	7.6	183	7.1	73	6.0	49	6.7	0.521
	No	377	92.4	2378	92.9	1152	94.0	680	93.3	
Cause of hospitalization	Jaundice	10	35.7	79	43.4	33	42.3	23	51.1	0.730
	Prematurity	8	28.6	3	10.7	11	6.0	5	6.4	
	Breathing distress	3	10.7	11	6.0	5	6.4	1	2.2	
	Others	7	25.0	49	26.9	21	26.9	15	33.3	
Congenital malformation	Yes	3	0.7	22	0.9	16	1.3	8	1.1	0.580
	No	402	99.3	2547	99.1	1221	98.7	725	98.9	
Breast feeding	Yes	409	98.8	2554	98.6	1228	98.6	724	98.0	0.560
	No	5	1.2	35	1.4	18	1.4	15	2.0	
Neonatal sex	Female	210	51.6	1254	49.2	537	43.9	329	45.4	0.004
	Male	197	48.4	1294	50.8	658	56.1	396	54.6	

Table 4. Demonstrates the relative risks of maternal and neonatal outcome for the BMI categories

Variables	Under weight	Normal	Over weight	Obese
Macrosomia	*p*=0.019 OR=0.498 CI=(0.890-0.278)	1	*p*=0.008 OR=1.427 CI=(11.099-1.854)	*p*=0.001 OR=1.820 CI=(1.354-2.447)
Cesarean	*p*=0.011 OR=0.724 CI=(0.564-0.930)	1	*p=0.001* OR=1.739 CI=(1.473-2.053)	*P=0.001* OR=2.141 CI=(1.737-2.638)
Gestational diabetes	*p*=0.195 OR=2.107 CI=(0.683-6.498)	1	*p*=0.065 OR=2.011 CI=(0.956-4.231)	*p=0.139* OR=1.916 CI=(0.810-4.529)
Unwanted pregnancy	*p*=0.872 OR=0.950 CI=(0.510- 1.771)	1	*p*=0.474 OR=1.151 CI=(0.783-1.693)	*p*=0.022 OR=1.633 CI=(1.072-2.486)
Hypertension	*p*=0.764 OR=1.211 CI=(0.347- 4.222)	1	*p*=0.011 OR=2.499 CI=(1.231-5.072)	*p=0.006* OR=3.011 CI=(1.372-6.604)
Hemoglobin < 10.5	*p*=0.842 OR=0.966 CI=(0.687-1.357)	1	*p*=0.002 OR=0.678 CI=(0.532-0.864)	*p*=0.007 OR=0.661 CI=(0.490-0.893)
Abortion	*p=0.019* OR=0.498 CI=(0.890-0.278)	1	*p*=0.008 OR=1.427 CI=(1.099-1.854)	*p=0.001* OR=1.820 CI=(1.354-2.447)
Male sex	*p*=0.011 OR=0.724 CI=(0.564-0.930)	1	*p*=0.001 OR=1.739 CI=(1.473-2.053)	*p=0.001* Or=2.141 CI=(1.737-2.638)
Low birth weight	*p*=0.195 OR=2.107 CI=(0.683-6.498)	1	*p*=0.065 OR=2.011 CI=(0.956-4.231)	*p=0.139* OR=1.916 CI=(0.810-4.529)
Preeclampsia	*p*=0.872 OR=0.950 CI=(0.510-1.771)	1	*p*=0.474 OR=1.151 CI=(0.783-1.693)	*p=0.022* OR=1.633 CI=(1.072-2.486)
Still birth	*p*=0.764 OR=1.211 CI=(0.347-4.2222)	1	*p*=0.011 OR=2.499 CI=(1.231-5.072)	*p*=0.006 OR=3.011 CI=(1.372-6.604)

Discussion

In this study, the thin, overweight and obese BMI in subjects were 8.2, 25 and 15.4%, respectively. In total, 48.6% of those women had abnormal BMI which shows high prevalence of abnormal BMI in the subjects of the study. Overweighed and obese women had low level of education and belonged to higher socioeconomic class and aged group. The results of our study are in line with the findings of El-Gilany et al. and Chen et al. [6, 14]. In the present study, an increase in the number of pregnancy and delivery correlated with an increase in BMI (*p*=0.001) being in agreement with the results of some other studies [14-16].

The maximum frequency of anemia observed in women with thin BMI. The more BMI, the less frequency of anemia, as 17% of women with thin BMI and 12% with fat BMI had anemia during 26-30 weeks of pregnancy.

The results of logistic regression indicated that the odds of developing anemia in women with overweight and fat BMI was less than 1 and it is even less compared with normal women. Since all the women with high BMI belonged to higher socioeconomic class, access to good diet might be the reason for their decrease in anemia. These results concur with the findings of Sebire et al. but are in contrast to El-Gilany et al. findings [6, 16].

Obesity has been recognized as a risk factor of insulin resistance and type 2 diabetes [17-19]. On the other hand, normal pregnancy develops another form of insulin resistance in the body. Therefore, it increases 40-50% during normal pregnancy, which in turn, increases the probability of having pregnancy diabetes in overweight and fat women [2]. Although the differences were not statistically significant, however, the frequency of pregnancy diabetes increased with increasing the BMI (i.e. 0.9% in thin, 1.3% in overweight and 1.7% in fat women) in present study. In the Heinrich et al. study, the chance of developing pregnancy diabetes in fat women was as four times high as that of normal ones [4]. In a study by Sakamto et al., the frequency of gestational diabetes did not have any significant relationship with different levels of BMI and the probability of gestational diabetes was the same for both thin and fat women [20].

Obesity is accompanied by dyslipidemia and chronic oxidative inflammatory which may cause endothelial damage and then preeclampsia [20]. In a number of studies, the odds of having preeclampsia and high blood pressure in women with slightly overweight and fat BMI was significantly high [2, 6, 14, 16]. In our study based on the results of logistic regression, fat and overweight BMI were among the important factors causing high blood pressure and preeclampsia so much so that in fat and overweight women the odds of developing high blood pressure were 2.5 and 3 and preeclampsia were 3 and 4.6 times, respectively.

Different studies confirmed the relationship between high levels of BMI and caesarian. These studies have put forward the accumulation of fat tissues in abdomen and hip of fat women and fetal macrosomia as the causing factors of delivery progress and the increase in caesarian delivery [4, 6, 19, 21, 22]. Similar to these findings, our study showed that fat and overweight BMI is an important risk factor for caesarian. The chance of caesarian in overweight women was 1.7 and in fat ones it was 2 times. Also, the probability of fetal macrosomia in women with overweight and fat BMI was 1.4 and 1.8 times, respectively.

In this study, frequency of abortion and still birth increased with increasing the BMI. The frequency of abortion in thin women was 0.6%, in overweight and fat ones 1.5% and 2.2% respectively. In terms of still birth, the respective values were 0.3, 0.6 and 1.3% respectively. The results of the logistic regression showed that thin and slightly overweight BMI were not important risk factors for still birth. However, the probability of still birth in fat women increased to 2.6 times. The main cause of still birth in women with higher BMI is not yet known. Researchers believe in such factors as high blood pressure, diabetes, atherosclerosis and maternal apnea while sleeping for still birth in fat women [5]. In of Mantakas et al., thin and slightly overweight BMI did not have any effect on still birth delivery. However, it was 2.6 times for fat women being in line with the findings of our study [7]. There was not a significant relationship between maternal BMI and still birth in El-Gilany et al.'s study [6].

In the present study, the frequency of unwanted pregnancy in women with overweight and fat BMI was significantly high so long as the probability of unwanted pregnancy was 1.6 times in fat ones. In Holt et al.'s study, it was also 1.6 for fat women. In a study by Zieman et al., there was a direct relationship between a rise in BMI and failure in contraceptive methods. There was not an increase in the frequency of unwanted pregnancy in overweight women in Kaneshiro et al.'s study [20].

In El-Gilany et al.'s study, the probability of low birth weight in women with thin BMI was 2.3 and with an increase in BMI level, there was a decrease in low birth weight risk [6]. Cedergren et al., Sakamoto et al. and Heinich et al. came up with similar findings [4, 6, 18, 21] which are in agreement with our findings in this study. In our study, the most frequent preterm delivery was observed in women with thin BMI and as BMI increased we observed a decrease in the number of preterm delivery, although the differences were not statistically significant. In Jensen et al., and El-Gilany et al.'s study, there was not statistically significant relationship between BMI and preterm delivery, nevertheless, the frequency of preterm delivery was high in women with thin BMI [6, 23]. Recently, there have been some studies on the relationship between high BMI and preterm delivery. In the studies of Chen et al. and Heinrich et al., the probability of preterm delivery in fat and overweight women was 1.5 fold [4, 14]. Researchers believe that high BMI is a preventative factor for preterm delivery but such disorders as diabetes, preeclampsia and high blood pressure can be accompany with high body mass index leading to preterm delivery [5]. In the present study, the frequency of congenital abnormalities and failure in breastfeeding was higher in women with overweight and fat BMI but it was not statistically significant. In some studies, the relationship between high BMI and inborn irregularity and also nervous disorders has been addressed [24, 25]. In Hazel et al.'s study, unsuccessful breastfeeding was rampant among fat women [26]. The mentioned case studies have been done with large samples and the small number of newborns with congenital malformations in our study might be the cause of this weak relationship.

We found that jaundice, hospitalization and breathing distress in newborns of women with thin BMI to be high but it was not significant. As preterm delivery and low birth weight are more prevalent in women with thin BMI, the findings of the present study are verifiable.

In the present study, for any unknown reason, male gender in women with overweight and fat BMI was significantly higher (odds ratio=1.2). We could not find any research on the relationship between BMI and the

gender of the newborns. Further research is needed in this area.

The results of our study indicated a high prevalence of abnormal BMI in pregnant women and an increase in the risk of maternal and newborn disorders. Although, all the subjects in our study had received adequate pregnancy care, there was an increase in the risk of fetal macrosomia, caesarian delivery, unwanted pregnancy, high blood pressure, preeclampsia and still birth in overweight and obese women and low birth weight in thin ones. The mentioned disorders have a major impact on maternal and newborn mortality rate. Diminishing this process is the main challenge of national health system. Seeking guidance and accessing normal BMI before pregnancy can significantly reduce the mentioned disorders and improve maternal and newborn health.

Some studies have concluded that gaining ideal weight on the part of pregnant women leads to the least amount of maternal and newborn disorders especially in obese women [27]. American Medical Organization has determined the ideal weight gain as 5-9 kg in fat women [2, 28]. But, recent studies have come to the conclusion that such amount of weight gain has changed these days [27]. In the present study, due to lack of access to mothers after delivery, examining the effect of pregnancy weight gain on maternal and newborn was not possible. Further studies on the maternal and fetal disorders and the range of weight variation can help in determining the range of weight gain with little maternal and newborn disorders.

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Authors' Contributions

All authors had equal role in design, work, statistical analysis and manuscript writing.

Conflict of Interest

The authors declare no conflict of interest.

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