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Association of Gestational BMI Change with Depression During Pregnancy and the Postpartum Period

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ABSTRACT

High Body Mass Index (BMI) represents a significant global health challenge. This study aimed to investigate the relationship between gestational weight gain and depression during pregnancy and the postpartum period. Conducted as a descriptive-analytical study, it involved 115 pregnant women attending Shahid Akbar Abadi Hospital in Tehran. Data were collected using a demographic questionnaire and the Edinburgh Postnatal Depression Scale, both before during pregnancy, and the postpartum period. Data were analyzed using SPSS software, Pearson correlation, linear regression, and multivariate regression tests. A correlation was identified between changes in body mass index during pregnancy and maternal depression levels. The results of the logistic regression analysis indicated a significant association between increased body mass index during pregnancy and the likelihood of developing mental health disorders. These findings underscore the changes in body mass index during pregnancy, particularly in the third trimester, are associated with an elevated risk of maternal depression. Targeted interventions focusing on weight management and body image improvement may play a critical role in mitigating the risk of developing mental disorders.

Keywords: Body mass index; Pregnancy; Depression; Weight gain; Mental Health

Introduction

The rise in Body Mass Index (BMI) represents a global health challenge with an increasing prevalence. Unhealthy dietary habits and sedentary lifestyles are the primary contributors to BMI, posing significant health risks across all age groups, especially women, which are further amplified during pregnancy. The World Health Organization (WHO) describes obesity as an epidemic with a higher prevalence among women compared to men. There has been a significant increase in the incidence of overweight and obesity among pregnant women over the past four decades. BMI and gestational weight gain are the critical indicators of nutritional status before and during pregnancy [1-3].

The pregnancy-related obesity is characterized by a BMI exceeding 29, as women with a BMI between 26-29 are considered to have excessive weight gain. In addition, women with a BMI below 19.8 are classified as underweight, and those with a BMI between 19.8 and 26 are categorized as having a normal weight [4]. Although the American College of Obstetricians and Gynecologists (ACOG) in 2013 recommended pre-pregnancy counseling for women with overweight (BMI 25 to <30)

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and obesity (BMI ≥30), there is not adequate information for conducting such counseling. Moreover, only a minority of women actively attempt to lose weight before pregnancy. Research indicated that maternal obesity increases the risk of fetal death, preterm delivery, and neonatal mortality. Additionally, the average cost of prenatal and postnatal care for obese women is higher than that of those with normal weight [5]. According to the National Institutes of Health (NIH), a 10% reduction in body weight is recommended for obese women planning pregnancy as the primary goal for achieving the benefits of a safe pregnancy. However, comprehensive scientific evidence on the implications and outcomes of such interventions is still lacking.

Obesity can adversely affect ovulation quality, fertility, and pregnancy complications, including elevated blood pressure, increased risk of preeclampsia, gestational diabetes, macrosomia, higher rates of cesarean section, dystocia, and prolonged neonatal hospitalization exceeding 48 hours in the NICU. Furthermore, obesity can contribute to anemia in obese mothers and their newborns through elevated levels of interleukin-1 and interleukin-6, key regulators of inflammation and hepcidin expression. The epidemiological data indicated that infants and children born to obese women are more likely to develop chronic diseases such as asthma and diabetes [4, 6–8].

A limited number of studies examined the impact of maternal obesity on neonatal iron status. Hepcidin, a key regulator of iron homeostasis, is overexpressed in obesity, and studies demonstrated a correlation between obesity and lower serum iron levels [9]. It was estimated that 38.9 million pregnant women worldwide were overweight, of whom 14.6 million were classified as obese [10]. About one in seven women experiences depression during the first year postpartum [11–13]. Despite extensive awareness of the physical health risks of maternal and neonatal obesity, limited information is available regarding obesity-related psychological and emotional consequences. Furthermore, psychosocial determinants associated with antepartum depression and anxiety in pregnant women with high BMI remain poorly understood, posing a significant concern [14].

Pregnancy can induce a significant psychological stressor for many women, regardless of their body weight, and approximately 10% of pregnant women commonly experience mental health disorders [15]. Obese women are more likely to face psychological and emotional distress compared to those with a normal body weight [16]. The majority of pregnant women with a high BMI report feelings of humiliation, discomfort, and anxiety during medical check-ups due to their body size [17, 18].

Mental health issues during pregnancy can lead to serious consequences for women and their infants and families, including poor adherence to prenatal care, engagement in high-risk health behaviors, and an increased likelihood of postpartum depression [19]. The coexistence of obesity and common mental disorders (CMD), such as depression and anxiety during pregnancy, can elevate the risk of obstetric complications. To date, research investigating the relationship between pre-pregnancy obesity and pregnancy-related CMD remains limited, with inconclusive findings regarding the direction of causality between obesity and mental health issues. However, some studies demonstrated a positive correlation between pre-pregnancy obesity and the prevalence of CMD during pregnancy [18, 20].

Despite the existing evidence to guide policymakers and clinical practices, allowing physicians to tailor pregnancy care to the specific mental health needs of pregnant women with high BMI, further research is needed, as numerous psychological determinants threaten the mental and

emotional health of pregnant women with elevated BMI [21]. Furthermore, information regarding the impact of weight gain and psychological outcomes in pregnant women from developing countries is limited [18]. Given that both high and low maternal BMI can contribute to the development of various complications, pregnancy in women with abnormal weight should be considered high-risk to prevent related complications [22]. Accordingly, the present study aimed to examine the association of gestational BMI change with depression during pregnancy and the postpartum period to address the challenges faced by pregnant women.

Materials and Methods

This descriptive-analytical study was performed on all women aged 15-49 who attended the clinic of Shahid Akbarabadi Teaching and Treatment Hospital who were planning to become pregnant in 2022. A convenience sampling method followed the inclusion and exclusion criteria until the required sample size was achieved. Based on the study of Holton et al. and considering a 95% confidence interval (α=0.05), power = 90%, and a correlation coefficient of 0.3 (r=0.3) between BMI and depression, the sample size was estimated to be 115 pregnant women.

The inclusion criteria consisted of women aged 15–49 years with no history of traumatic events during pregnancy or in the preceding year, no prior diagnosis of depression (based on the Edinburgh Postnatal Depression Scale), and no underlying issues such as addiction, being the head of the household, having a spouse with addiction, experiencing marital separation, widowhood, domestic abuse, financial or family difficulties, or the use of antidepressant medications. Additional criteria included no family history of depressive disorders among first-degree relatives, no history of violence or sexual assault, absence of unintended pregnancies or pregnancies resulting from sexual assault, being Iranian, no history of suicide attempts or self-harm, and no involvement in demanding or high-stress occupations.

The exclusion criteria included the development of a severe psychological disorder after diagnosis, acute viral or infectious diseases such as COVID-19, individuals at risk of suicide as assessed by the Nurses' Global Assessment of Suicide Risk (NGASR) criteria, and trauma-related injuries, experiencing a significant adverse event during the study such as divorce, the loss of a child, family members, or relatives, or any event impacting their mood or psychological well-being. Additional exclusion factors included participation in other counseling or behavior modification programs for lifestyle change and hospitalization for more than one week.

After receiving ethical approval from the Ethics Committee of Lorestan University of Medical Sciences, completing the legal and administrative procedures, and obtaining permission from the Deputy for Research and Technology of Tehran University of Medical Sciences, the researcher attended the gynecology and obstetrics clinic at Shahid Akbarabadi Teaching and Treatment Hospital. The eligible participants meeting the inclusion criteria were identified, and the written informed consent form was obtained.

This cross-sectional study was conducted on 115 women aged 15 -49 years, screened based on inclusion criteria after referring to the gynecology and obstetrics clinic, and further evaluated using the Edinburgh Postnatal Depression Scale (EPDS). The subjects were categorized into groups based on their pre-pregnancy BMI (underweight, normal weight, overweight, and obese), and the EPDS was completed for each subject. The depression and anxiety levels were assessed during pregnancy, delivery, and postpartum, and the data were analyzed using SPSS software version 22.

The groups were assessed based on pre-pregnancy BMI and, subsequently, the association between BMI and the severity of depression among pregnant women using the Edinburgh Postnatal Depression Scale (EPDS) during pregnancy, antenatal, delivery, and

postpartum. The sociodemographic and clinical questionnaire included variables such as patient identification code, contact information, age, marital status, number of children, educational level, household composition, residential location, occupation, waist circumference, weight, body mass index, prior hospitalization and surgical history, physical illness history, psychiatric and psychological disorder history, among other relevant factors.

Edinburgh Postnatal Depression Scale (EPDS)

This scale was developed to assist healthcare professionals in identifying mothers suffering from postpartum depression. The scale consisted of 10 short statements, and mothers selected one of four possible answers describing their feelings over the past week. Most mothers could easily complete the scale in less than five minutes. Responses were scored on a scale of 0 - 3 based on the symptom severity. The total score was calculated by summing the scores of all 10 items. Mothers scoring above 12 or 13 were likely to suffer from depression and were advised to seek medical care. A healthcare professional performed a thorough clinical examination to confirm the diagnosis and develop a treatment plan. The scale indicates the mother's feelings during the past week, and the assessment should be repeated after two weeks if necessary.

After data collection and entry into SPSS software version 22, descriptive statistics were applied to describe the data, including measures of central tendency and dispersion for quantitative variables and frequencies and percentages for qualitative variables. To examine the relationship between BMI and depression score, the normality of the data distribution was first assessed using the Kolmogorov-Smirnov test. Pearson correlation, univariate, and multivariate linear regression analyses were employed if the data were normally distributed. For non-normally distributed data, the appropriate non-parametric tests were used. A significance level of $p<0.05$ was considered for all tests.

In the present study, in addition to obtaining the required authorization letters, the ethical considerations were meticulously observed, including securing approval for the research proposal and obtaining ethical approval (Ethics Code: IR.LUMS.RES.1401.061) from the Ethics Committee of Lorestan University of Medical Sciences, obtaining written informed consent from all subjects after introducing the researcher and explaining the study objectives, ensuring the subjects' willingness to participate in the study, and conducting the study and collecting data by scientific methods, legal frameworks, and cultural norms, ethical codes approved by the Ministry of Health and Medical Education as well as treatment, and medical education, religious and spiritual principles.

Results

A total of 115 subjects with a mean age of 29 ± 0.6 years and a mean BMI of 29.01 ± 6.21 kg/m² were included in the study. Table 1 displays the distribution of BMI and demographic characteristics based on the median changes in BMI during pregnancy.

Subjects were divided into the groups of BMI changes less than the median (4.88 kg/m²) and BMI changes greater than or equal to the median. The results indicated no significant difference between the two groups in terms of age, height, pre-pregnancy weight, number of miscarriages, reason and type of cesarean section, type of vaginal delivery, number of pregnancies, and deliveries. However, a significant difference was observed in ABO blood groups The group with BMI changes greater than the median had a higher percentage of subjects with blood types A and B. In contrast, the group with BMI changes below the median had more subjects with blood type O.

Table 1. The subjects' characteristics based on the median BMI changes

Variables		BMI changes	
		<Median (4.88 kg/m²)	≥ Median (4.88 kg/m²)
Number of abortions	0	46 (80.7%)	42 (72.4%)
	1	8 (14%)	12 (20.7%)
	2	2 (3.5%)	3 (5.2%)
	3	1 (1.8%)	1(1.7%)
Blood Groups	A	13 (22.8%)	23 (37.9%)
	B	13 (22.8%)	20 (34.5%)
	AB	3 (5.3%)	0 (0.0%)
	O	28 (49.1%)	16 (27.6%)
Reason for Cesarean Section	No cesarean section	36 (63.2%)	40 (69%)
	Non-emergency	6 (10.5%)	3 (5.2%)
	Emergency	15 (26.3%)	15 (25.9%)
Type of Cesarean Section	No cesarean section	36 (63.2%)	39 (67.2%)
	Performed	21 (36.8%)	19 (32.8%
Vaginal Delivery	No	27 (64.9%)	42 (70.7%)
	Yes	20 (35.1%)	17 (29.3%)
Number of deliveries	Primiparous	16 (28.1%)	25 (43.1%)
	Multiparous	41 (71.9%)	33 (56.9%)
Number of pregnancies	1	16 (28.1%)	20 (34.5%)
	2	11 (19.3%)	21 (36.2%)
	3	11 (19.3%)	4 (6.9%)
	3>	6 (10.5%)	13 (22.4 %)

Table 2. Determining the correlation between pre-pregnancy BMI and depression, stress, and anxiety levels among mothers

Outcome	Depression
Pre-pregnancy BMI	Pearson Correlation Coefficient: 0.09
P-value	0.33

Table 3. The logistic regression analysis for increasing BMI during pregnancy (medians) and the odds ratio of mental health disorders

Outcome	Model 1 (a)		Model 2 (b)	
	P	Odds Ratio (95% Confidence Interval)	Odds Ratio (95% Confidence Interval)	P
Depression	0.01	2.25 (1.06 -4.76)	2.94 (1.23 – 7.05)	0.03

a: Unadjusted model; b: Adjusted model for age, number of deliveries, history of miscarriage, and cesarean section

Overall, except for ABO blood groups, no significant difference in other demographic and obstetric features was found between the groups

There was no correlation between pre-pregnancy BMI and depression level in mothers. The Pearson correlation coefficient for depression was 0.09 with p = 0.33, indicating a weak and statistically non-significant relationship between pre-pregnancy BMI and depression among mothers (Table 2).

The study examined the relationship between BMI changes during the third trimester (≥37 weeks) relative to pre-pregnancy level and mental health outcomes. The logistic regression analysis revealed an association between increased BMI during pregnancy (a median of 4.88 kg/m² as the cutoff point) and the likelihood of developing mental health disorders, including depression, anxiety, and

stress. The results indicated that women with BMI enhancement above the median were significantly more likely to experience depression compared to those with BMI enhancement below the median. Additionally, individuals with the highest BMI increase faced a 2.94-fold greater risk of developing depression. Further, the excessive BMI increase during pregnancy can substantially raise the risk of depression among pregnant women, indicating the importance of monitoring BMI changes in pregnant women and providing appropriate counseling for its management.

Discussion

This study aimed to examine the effect of median changes in pregnant women's BMI compared to their pre-pregnancy BMI on mental health outcomes. The results demonstrated that regardless of pre-pregnancy BMI categories (normal, overweight, or obese), women with greater BMI changes during pregnancy faced a considerably higher risk of depression. In addition, increased BMI during pregnancy can directly and adversely influence the mental health of pregnant women. The results of early studies illustrated that excessive weight gain during pregnancy is associated with an elevated risk of mental health disorders. In the same vein, a large-scale study involving 1,170 pregnant women identified weight gain during pregnancy as an independent predictor of increased postpartum depressive symptoms [23]. Another study reported that pregnant women with higher BMI are more likely to experience stress and anxiety [24].

Moreover, Cotton et al. revealed that increased BMI during pregnancy is associated with a higher risk of pregnancy complications, including depression, which is consistent with the findings of the present study [18]. However, given the various influencing factors, further research is necessary to evaluate the relationship between pregnant women's BMI relative to their pre-pregnancy BMI and their mental health outcomes and identify other contributing factors such as socioeconomic status and social support.

Multiple biological and psychological mechanisms determine the relationship between BMI and mental health. The inflammation and dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis can act as common factors contributing to both depression and obesity [25]. Additionally, chronic stress associated with body image issues resulting from obesity could significantly contribute to the development of depressive disorders [26].

The findings of this study highlight that BMI changes during pregnancy are especially associated with an increased risk of maternal depression during the third trimester. Therefore, addressing BMI status in pregnant women and providing necessary counseling for its management can significantly contribute to their mental health improvement. Targeted interventions focusing on weight management and body image improvement can play a crucial role in reducing the risk of developing psychological disorders in this population.

Conclusion

Mental health management during pregnancy is crucial for both the mother and the developing fetus. The present study results revealed the significant and negative effect of excessive BMI enhancement during pregnancy on maternal mental health. Although pre-pregnancy obesity may not necessarily be associated with higher depression levels during pregnancy, understanding these relationships can assist healthcare providers in developing targeted interventions to support the mental well-being of pregnant women. These findings highlight the need for educational and supportive programs for both pregnant women and healthcare providers, including counseling on weight management, enhancing body image, and stress-coping techniques. Additionally, addressing socioeconomic factors influencing maternal mental health is essential. Evidence illustrated that BMI

changes are associated with an increased risk of antenatal depression and body dissatisfaction. Ultimately, this study underscores the importance of targeted measures for weight management and mental health improvement, which can play a critical role in reducing the risk of psychological disorders among pregnant women. Given the importance of mental health during pregnancy, healthcare providers should prioritize BMI changes and implement appropriate interventions to support mothers effectively.

Limitations

The limitations of this study include the possibility of patient absenteeism during the follow-up visits due to the COVID-19 pandemic, mitigated through telephone follow-ups, reliance on self-reported data for outcome assessments, and potential dishonesty in subjects' response, addressed by explaining the objectives of the study and emphasizing the impact of the results on women's health.

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Conflict of Interests

The authors declare that they do not have any conflict of interests.

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