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Article *in* Journal of Obstetrics and Gynaecology Research · October 2019

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THE JOURNAL OF
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doi:10.1111/jog.14100 J. Obstet. Gynaecol. Res. 2019

Screening of depression in overweight and obese pregnant women and its predictors

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Abstract

Aim: The aim of this study was to investigate the screening result of depression and its predictors in overweight and obese pregnant women in second and third trimester of pregnancy.

Methods: The present cross-sectional study was carried out on 232 overweight or obese pregnant women older than 18 years in the second and third trimesters of pregnancy. Edinburgh Postnatal Depression Scale questionnaire, the International Physical Activity Questionnaire and the Food Record were used. Independent *t*-test, Man–Whitney *U*, Pearson and Spearman correlation test, independent *t*-test, one-way analysis of variance and, multivariate linear regression were applied for data analysis using SPSS 21.

Results: The results of the study showed that the mean (standard deviation) score of depression was 10.1 (4.4), and it was similar in both overweight and obese women ($P = 0.784$). Median (quartile 25–75) of physical activity was 891.0 (495.0–1336.0) metabolic equivalent of task -min/week. The total physical activity in obese women was statistically higher than overweight ones ($P = 0.032$). In linear regression model, the variables of parity, body mass index, physical activity education, protein, fat, oleic acid, monounsaturated fatty acids, potassium, magnesium, and zinc were the strong predictors of depression, and along with the others explained the 80% of variances.

Conclusion: Considering the fact that nearly one-third of overweight and obese women in the present study were positive for depression screening, it is important to pay attention to strong predictors of depression in these women.

Key words: depression, obesity, overweight, predictors, pregnancy.

Introduction

Obesity is one of the most important challenges of the 21st century (https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight) with increasing rate of prevalence in both developed and developing countries.[1] According to the world health organization (WHO) report, in 2016, more than 1.9 billion adults (18 years and older) were overweight in which of these over 650 million (representing 13 percent of the world's adult population) were obese (https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight). Both overweight and obesity are increasing rapidly in pregnancy too. Twenty percent of US pregnant women are obese at the first trimester of pregnancy.[2] In a study conducted in Urmia city of Iran, the prevalence of overweight and obesity at the onset of pregnancy was 30% and 12%, respectively.[3] Obese people are about 25% more likely to experience a mood disorder like depression compared with those who are not obese. Behavioral

Received: March 19 2019.
Accepted: August 14 2019.
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consequences of an obese appearance, ranging from poor self-image, low self-esteem, to social isolation are varied.[4–6] The results of meta-analysis showed obese women had higher odds of antenatal anxiety (odds ratio 1.41, 95% confidence interval 1.10–1.80),[7] higher odds of elevated depression symptoms at the beginning of pregnancy in comparing to normal-weight women in both the prenatal and postpartum periods (43% and 30% increased odds respectively), as well as an increased risk of other mental disorders including postpartum anxiety, eating and bipolar disorder.[7]

Negative effects of prenatal depression on mothers include poor sleep, postnatal depression, paternal depression and shorter gestational age. Negative effects on infants include lower birth weight, low maternal responsively, a greater occurrence of asthma, lower Bayley scores, greater right frontal, more difficult temperament, externalizing/internalizing problems.[8]

Several factors including unplanned pregnancy in women with a medical disorder,[9] previous history of depression and any psychiatric treatment, serious physical illness, and casual jobs[10] are some predictors of pregnancy depression. Maternal anxiety, life stress, domestic violence, lack of social support, low income and education, smoking, single status and poor relationship quality are the other predictors that are listed in a systematic review conducted by Lancaster *et al*.[11] Age, marital status, gravidity, previous history of stillbirth, abortions or operative delivery, and not having social support are the other predictors.[12] However, in the developing world, pregnancy depression risk factors are often culturally determined.[13]

Physical activity including participation in sports and exercise are accompanied with beneficial effects on physical health and prevention of a variety of underlying chronic medical conditions as well as treatment for mental health problems.[14,15] Counseling to have a healthy eating at the individual level, by limiting energy intake from total fats and sugars; increasing consumption of fruit and vegetables, as well as legumes, whole grains and nuts; and engage in regular physical activity are effective intervention in some previous literatures.[16]

Since studies have argued that care during pregnancy in obese and overweight pregnant women should be given more attention,[17] on the other hand with regard to high prevalence of depression in these women and the adverse consequences of depression on mothers and infants, as well as given the necessity of determining risk factors of pregnancy depression in various cultures with different dietary habits and life style especially in developing countries such as Iran, and lack of studies that determine the relationship of physical activity and detailed dietary intake with depression in obese or overweight pregnant women, this study aimed to investigate the results of depression screening in overweight and obese pregnant women and its predictors in 2nd and 3rd trimester of pregnancy.

Methods

Study population

The target population included pregnant women older than 18 years, who were in the second and/or third trimesters of pregnancy referred to health centers in Tabriz-Iran. The sample consisted of 232 pregnant women that were overweight or obese (body mass index (BMI) ≥ 25). Eligibility criteria included age over 18 years, being in the second and/or third trimester of pregnancy, singleton pregnancy, willingness to participate in the study, and having health record in health centers. The women were excluded if they had the history of depression[10] and stressful life events in the past month at the start of sampling,[18] history of hospitalization in current pregnancy,[19] or if they followed the special diet (according to the mother's statement), addiction or habitual use of alcohol and drugs,[20] history of infertility and using fertility methods,[21] history of death of close relatives,[18] divorce and other acute emotional problems during the past 3 months,[20] and lack of physical health.

Study design

The present cross-sectional study was carried out after obtaining permission from the Ethics Committee of the Vice-Chancellor of Research and Technology of Tabriz University of Medical Sciences from April 2015 to March 2016 (code: IR.TBZMED.REC.1396.382). Random cluster sampling was used for selecting women. First, one-fifth of the centers (16 centers) selected randomly among all health centers in Tabriz (80 health centers). In the next step, sampling was purposed-based. In such a way that the researcher went to the selected centers and listed all overweight or obese pregnant women in the second and third trimesters and invited them through contact numbers to participate in the study after investigating the eligibility criteria. In the first meeting, the study objectives and method of doing it were explained to the eligible participants, and the informed consent was given to sign and voluntary participation and confidentiality of the information were emphasized. In order to ethical considerations, nutritional and physical activity advices were

provided by the research team, and they were informed about the results of this research.

To calculate the sample size based on the relationship between physical activity and pregnancy depression in obese women, information from the study of Claesson *et al*.[22] was used. Considering the mL = 4.6, sdL = 3.7 (mean value of Edinburgh Postnatal Depression Scale [EPDS] among obese physical active pregnant women in the third trimester of pregnancy); m^2 = 6.9, standard deviation (SD)2 = 5.1 (mean value of EPDS among obese physical inactive pregnant women in the third trimester of pregnancy) and considering the 95% confidence interval level, the test power of 80%, the sample size was calculated 145 women and considering design effect of 1.5, the minimum required sample size was 232.

To calculate the pre-pregnancy BMI, participants' weight in recent pre-conception care or first trimester in the case of absence, was recorded and if no weight was recorded, self-reported weight by the participant was considered. Heights were measured using a tape measure mounted on the wall at health centers. According to WHO classification, pre-pregnancy BMI was classified as underweight (BMI less than 18.5), normal (BMI between 18.5 and 24.9), overweight (BMI between 25.0 and 29.9), obese class 1 (BMI between 30.0 and 34.9), obese class 2 (BMI between 35.0 and 39.9), and obese class 3 (BMI greater than 40.0).[23]

Data collection instruments

Demographic, midwifery, EPDS, the International Physical Activity Questionnaire (IPAQ) and the food record were used in the present study.

The demographic and midwifery questionnaire consisted of two parts. The first part included questions about the birth date and marriage history, pre-pregnancy weight, height, education level of the women and their wife, the individual's and wife's employment status, the income and living conditions, receiving training about physical activity and nutrition during gestation, and so on. The second part of the questionnaire was about midwifery information that included questions about the number of pregnancies and delivery, the history of abortion and the history of fetal or neonatal death, preterm labor, and abnormal infant.

The validity of the demographic questionnaire was determined using face and qualitative content validity.

Food record form

In this study, food intake was measured by the food record form or album. This form is often used in outpatient clinics. The food record form or food album is the standard form for food intake. Since the food and the amounts consumed during the use are recorded in this method, the memory or short-term error is minimized. In this method, the nutrients received by the registered participants as detailed information on the 3-day food recipe containing all the food and drink consumed by the participants during the one non-working and two working days,[24] using the Nutritionist IV Software (First Databank) was evaluated for Iranian foods in terms of calorie intake, carbohydrate, fat, and micronutrients, etc.

International Physical Activity Questionnaire

The questionnaire, which was created in 1998 in Geneva, is a tool for measuring physical activity. This questionnaire has been used in various studies in Iran, and its validity and reliability have been confirmed.[25] The questionnaire is made up of two long-form scale (31 questions) and short-form (7 questions). In this study, a short-form questionnaire containing seven questions (two questions related to vigorous physical activity, two questions related to moderate physical activity, two questions related to low physical activity and one question related to sitting), was used. Questions are about the time that a person has been active in physical activity during the last 7 days. Vigorous activities refer to activities that have high levels of physical activity and cause more intense breathing than normal. The method of scoring it, is that activities such as aerobics, high-speed biking, mountain climbing and basketball, which require more than six calories per minute, are called sever or intense physical activity, and moderate physical activity is considered to be volleyball, badminton, room cleaning and walking, which require three to six calories per minute. In addition, any activity with duration of less than 10 min is deleted. The total of activities in the last 7 days was carried out in accordance with the IPAQ instruction. Minutes of physical activity per week are calculated based on the total physical activity of the individual in terms of metabolic equivalent of task (MET)-min/week unit last week. To calculate the total body activity per week, the walking amount (MET × minute × day) should be summed with the average physical activity (MET × min × day) and the severe physical activity (MET × min × day) in the last week. People with less than 600 kcal of energy per week of physical activity, as low physical activity, and those who consume between 600 and 3000 kcal of energy per week, use moderate physical activity and use more than 3000 kcal of energy per week as a vigorous physical activity.[26] Persian translation of IPAQ has

been validated.[27] The reliability of this questionnaire was reported 0.86, which indicates the desirable reliability of the questionnaire.[28] Validity and reliability of IPAQ have been confirmed in 12 countries by Craig *et al*.[29]

Metabolic equivalent of task

MET is a unit used to estimate energy consumption of physical activity. The value of one MET is approximately equivalent to the amount of required energy per kg/h in rest in a person. All physical activity can be categorized as a multiple of energy in rest. In this questionnaire (IPAQ), MET of walking is considered 3.3, for average physical activity is 4, and for severe physical activity is 8.

Edinburgh Postnatal Depression Scale

Edinburgh Postnatal Depression Scale is a scale for determine the pregnancy and post-natal depression. This questionnaire was developed by Cox *et al*. in 1978 and revised in 1994.[30] This tool has 10 quadruple questions. For some questions, options range from low to high degree of depression (Question number 1, 2 and 4) and in some other from high intensity to low (Question number 3, 5, 6, 7, 8, 9 and 10) are arranged. Each question has a score of 0–3, and the overall score is between 0 and 30. The participant chooses answers that she has felt for the past week. A score of 12 acceptable cutoff points for identifying women with major depression (with a sensitivity of 86% and 78%, and a positive predictive value of 73%) are in clinical settings which has been validated by Montazeri *et al*. study in Iran. The validation score is 70% based on Cronbach's alpha and 80% of the internal consistency of the test.[31] If the sum of scores is less than 12, the person is not depressed, and if the sum of scores is greater than or equal to 12, the person is depressed. The participants with depression scores higher than 23 were referred to a psychiatric.[18,32]

Statistical analysis

Data were analyzed using SPSS software (SPSS 21, SPSS Inc.). To determine the normal distribution of continuous variables, we used Kolmogorov–Smirnov test. To

Table 1 Baseline demographic data of overweight and obese pregnant women (n = 232)

General characteristics	n (%)	General characteristics	n (%)
Age (years)		Gravida	
18–25	63 (27.3)	1	86 (37.9)
26–35	130 (56.3)	2–3	125 (55.0)
≥36	38 (16.4)	4–5	16 (7.0)
Mean (SD)	30.1 (5.6)	Husband education	
Education		Primary	26 (11.2)
Primary	27 (11.6)	Secondary	41 (17.7)
Secondary	27 (11.6)	High school	22 (9.5)
High school	15 (6.5)	Diploma	75 (32.3)
Diploma	89 (38.4)	Academic	67 (28.9)
Academic	74 (31.9)	Husband job	
Body mass index (kg/m^2)		Unemployed	4 (1.7)
overweight	181 (78.0)	Worker	55 (24.0)
Obese	51 (22.0)	Employee	59 (25.8)
Mean (SD)	27.9 (4.1)	Private sector	59 (25.8)
Pre-pregnancy weight (kg)	71.9 (11.1)	Other	52 (22.7)
Gestational age (weeks)	25.2 (8.2)	Residential status	
Participant job		Private	106 (45.7)
Housewife	204 (90.3)	Rent	75 (32.3)
Working outside	22 (9.7)	With parent	8 (3.4)
Para number		With husband parent	39 (16.8)
0	93 (41.2)	History of abortion	43 (18.9)
1	91 (40.3)	History of neonatal death	0 (0.0)
2–3	42 (18.6)	History of IUFD	6 (2.7)
Family income		History of preterm labor	3 (1.3)
Income < outcome	70 (30.4)	Wanted pregnancy	174 (76.7)
Income = outcome	131 (57.0)	Physical activity education	84 (36.8)
Income > outcome	29 (12.6)	Nutrition education	134 (58.3)
Sport class attendance	11 (4.8)	Life style education	40 (17.5)

IUFD, intrauterine fetal death.

Table 2 Mean (SD) of Edinburgh postnatal depression score and frequency of depression

Variable	Total (n = 232)	Obese (n = 51)	Overweight (n = 181)	P-value
EPDS* mean (SD)	10.1 (4.4)	10.0 (4.6)	9.8 (4.0)	0.784*
Presence of depression (EPDS ≥ 12) n (%)	62 (30.4%)	15 (30.6%)	47 (30.3%)	1.000**

*Independent samples t-test; **Fisher's exact test. EPDS: Edinburgh postnatal depression score.

describe demographic and midwifery characteristics, physical activity and nutritional status, descriptive statistics including frequency distribution and percentage, as well as central indexes and dispersion such as mean and standard deviation (SD) were used.

To compare the mean (SD) score of depression (with normal distribution) and Median (minimum, maximum) of physical activity (without normal distribution) between obese and overweight women, independent t-test for parametric cases or Mann–Whitney U statistics for non-parametric cases were used. To examine the relationship between total physical activity per week, nutritional status and continuous general characteristics with depression score, Pearson and Spearman correlation tests were used. Comparison of depression score in different categories of general characteristics was carried out by independent t-test and one-way analysis of variance. Then to determine the predictors of depression score, all variable with $P < 0.2$ were entered to multivariate linear regression model with Backward strategy. This was also carried out to measure variance of the dependent variables, which can be explained by the independent variables. Before conducting multivariate analysis, the assumptions of the regression including normality of the residuals, homogeneity of the residual variance, multicollinearity of independent variables and independence of the residuals were studied. $P < 0.05$ was considered as statistically significant.

Results

The results of the study showed that the mean (SD) age of participants was 30.1 (5.6) in which over the 50% of them were in the category of 26–35 years old. Considering education, one-third of participants (38.4%) had diploma. Majority of women in the present study were overweight (78%) and the others were obese. The mean (SD) gestational age was 25.2 (8.2) weeks. Majority of them (%90.3) were housekeeper. More than half of them had family income equal to outcome and were gravida 2–3.

Table 3 Median (Q25-75) of physical activity in overweight and obese pregnant women

Variable	Total (n = 212)	Obese (n = 51)	Overweight (n = 161)	P value*
Total physical activity (MET-min/week)	891.0 (495.0–1336.0)	1039.5 (693.0–1858.5)	808.5 (445.5–1237.5)	0.032
Low physical activity (MET-min/week)	797.5 (445.5–1039.5)	891.0 (445.5–1039.5)	742.5 (445.5–1039.5)	0.635
Moderate physical activity (MET-min/week)	0.0 (0.0–0.0)	0.0 (0.0–360.0)	0.0 (0.0–0.0)	0.570
Vigorous physical activity (MET-min/week)	0.0 (0.0–0.0)	0.0 (0.0–0.0)	0.0 (0.0–0.0)	0.226

*Analyzed by Mann–Whitney U test. MET, metabolic equivalent of task.

Table 4 Frequency of mild, moderate, and severe physical activity in overweight and obese pregnant women

Physical activity		Total n (%)	Obese n (%)	Overweight n (%)	P value* n (%)
Low	Yes	218 (94.0)	55 (96.5)	163 (93.2)	0.546
	No	3 (1.3)	0 (0.0)	3 (1.7)	
	Not sure	11 (4.7)	2 (3.5)	9 (5.1)	
Moderate	Yes	49 (21.1)	16 (28.1)	33 (18.7)	0.392
	No	183 (78.9)	41 (71.9)	142 (81.1)	
Vigorous	Yes	13 (6.5)	6 (10.5)	9 (5.1)	0.206
	No	217 (93.5)	51 (89.5)	166 (94.9)	

*Fisher's exact test.

Approximately 77% had wanted pregnancy and near to 20% had a history of abortion. Physical activity, life style and nutritional education were given for 36%, 17% and 58% of participants, respectively. However, only 5% had participated in sport classes (Table 1).

The results of EPDS revealed that the mean (SD) score of depression was 10.1 (4.4), and it was similar in both overweight and obese women (Table 2).

Median (Quartile 25–75) MET-min/week of total physical activity was 891.0 (495.0–1336.0).

It was compared in overweight and obese pregnant women using Mann–Whitney test and revealed that the total physical activity in obese women was statistically higher than overweight ones ($P = 0.032$). Although, the subtype of low, moderate and vigorous activity were not statistically significant (Table 3). Frequency of three types of physical activity in obese and overweight women has been indicated in Table 4.

For determine the predictors of depression in overweight and obese pregnant women we used linear regression model. All variables with $P < 0.2$ were included with backward method in this model.

Table 5 Predictors of depression in obese and overweight pregnant women

Variable	Depression β (CI 95%)*	*P* value*
Parity number (reference group: 2)		
0	−5.138 (−9.619 to −0.657)	0.001
1	0.164 (0.100 to 0.232)	0.026
BMI	0.468 (0.195 to 0.742)	0.002
Physical activity education	−4.045 (−6.424 to −1.666)	0.002
Protein	0.502 (0.275 to 0.730)	<0.001
Fat	0 0.715 (0.372 to 1.058)	<0.001
Oleic acid	−1.208 (−1.682 to 0.734)	<0.001
LA	−0.366 (−0.744 to 0.012)	0.057
ALA	−9.096 (−15.832 to −2.359)	0.010
PUFA	−0.558 (−0.998 to −0.117)	0.015
MUFA	−1.665 (−2.365 to −0.966)	<0.001
Sodium	0.003 (0.001 to 0.005)	0.016
Potassium	−0.012 (−0.018 to −0.006)	<0.001
Iron	−1.606 (−2.620 to −0.593)	0.003
Magnesium	0.173 (0.100 to 0.247)	<0.001
Zinc	−4.935 (−6.719 to −3.152)	<0.001
Vitamin A	−0.006 (−0.010 to −0.002)	0.002
Vitamin D	−0.747 (−1.544 to 0.051)	0.065
Daily fiber	0.958 (0.453 to 1.462)	0.001
Adjusted R^2		0.798

*Multivariate linear regression model. All variable with $P < 0.2$ were entered to model with Backward strategy. ALA, α-linolenic acid; BMI, body mass index; LA, linoleic acid; MUFA, monounsaturated fatty acid; PUFA, polyunsaturated fatty acid.

The results showed that among the strong predictors of depression, BMI had positive correlation but receiving physical activity education during pregnancy had negative correlation. Parity zero had negative but parity one had positive correlation compared to para two. Among nutrients: protein, fat, magnesium had positive versus oleic acid, monounsaturated fatty acids (MUFA), potassium and zinc had negative significant correlation with depression (Table 5).

Discussion

In the present study, the frequency of depression in obese and overweight women was approximately 30%. According to Salehi *et al*., depression at the second and third trimesters in obese women was 33.3% and 28.8%, respectively, which is consistent with the results of present study.[18]

In this study, we observed a significantly positive correlation between depression score and BMI during second and third trimester of gestation. The risk of depression in all trimmers of pregnancy in obese women was higher than normal weight in their study, so that the risk of depression was 3.25-fold in the first trimester and 3.29-fold in the second trimester of pregnancy for classes 2–3 obesity greater than normal weight.[18] According to the Rezaee study, there was a positive correlation between BMI and depression symptoms.[13] In the study of Bodnar *et al*., there was a strong and positive association between pre-pregnancy BMI and the risk of severe depression during pregnancy.[33]

The results of this study showed that median (quartile 25–75) total physical activity was 891.0 (495.0–1336.0) MET-min/week in studied women that is classified as moderate. Total physical activity in obese women was significantly higher than overweight women. Inter-quartile range of total physical activity in obese women was wider than overweight women. More than half of the participants in the study received nutritional education and 36.8% of the participants received physical activity education during pregnancy. Guelinckx *et al*. examined the impact of two types of lifestyle interventions based on a brochure or on active education on dietary habits, physical activity and weight gain in obese pregnant women. The results of this study revealed that both types of interventions improve the nutritional habits of obese women during pregnancy but have no effect on physical activity and weight gain.[34] In a study by Hui *et al*., the lifestyle intervention programs

including trainer-led group exercise sessions, instructed home exercise and dietary counseling compared to control group increased physical activity and decreased carbohydrate intake and gestational weight gain in pregnant women with normal, but not above normal, pre-pregnancy BMI.[35]

Most studies in this area have examined the effect of nutritional and physical activity interventions on gestational weight gain and did not address the level of physical activity. In a systematic review that reported the impact of various interventions on gestational weight gain and pregnancy outcomes, it was found that dietary and lifestyle interventions in pregnancy can reduce maternal gestational weight gain.[36]

According to the sub-group analysis between overweight and obese women on physical activity education, higher percent of obese in comparison to overweight women received this education. Therefore, it can be said that receiving more physical activity education during pregnancy in obese women in this study may led to their efforts to increase the level of physical activity.

In the present study, parity was one of the relatively powerful predictors of depression; So that nulliparity was associated with lower depression score. In the Melo study,[37] multiparity has been mentioned as one of the independent factors associated with antepartum depression. In addition, in a study by Milgrom,[38] having already more than two children was reported as one of the postpartum depression risk factors, which seems to be consistent with the results of our study.

Maternal depression is a serious mental issue that can have a negative impact on the lives of women. Hormonal influence, neurotransmitter function and nutritional deficiencies due to malnutrition or poor nutrition are among the biological factors contributing to the pathophysiology of maternal depression. Several studies have shown the correlation between nutrition and depression.[39] In this study, Zinc reduced the occurrence of depression strongly. A study conducted by Solati showed that zinc monotherapy improved mood in overweight or obese women, which is consistent with the results of present study.[40] It is believed that zinc can influence serotonin uptake and thus affect depression. A number of studies have reported a credible correlation between inadequate iron intake and mood.[39] In the Hidese *et al*. study a significant association was found between iron-deficiency anemia and depression.[41] In our study, iron in the diet reduced the risk of depression.

The correlation between essential fatty acids and mood has been studied in various studies. Essential fatty acids are polyunsaturated fatty acids (PUFAs), classified into two groups: linoleic acid (n-6) and α-linolenic acid (n-3).[39] In the study of Sánchez-Villegas *et al*., a weak and reverse dose-dependent relationship between PUFA and MUFA and risk of depression was reported. In addition, a detrimental relationship was found between trans-unsaturated fatty acids and the risk of depression.[42] In our study, there was a reverse and relatively weak relationship between PUFA and MUFA and presence of depression. Several studies have reported a positive relationship between low n-3 fatty acids levels and high incidence of maternal depression. It is believed that there is an association between low n-3 levels or a high n-6 level with depression.[39,43] Some other studies focused on n-6/n-3 ratio. For example, in the Pinto study, there was no association between n-6 levels and depression symptoms, but a higher n-6/n-3 ratio at each pregnancy trimester was associated with higher odds of depression. There is more consistency between the results of recent study and the results of our study. n-3 fatty acids reduce the secretion of inflammatory cytokines. n-3 fatty acids show an anti-inflammatory effect, while n-6 shows pro-inflammatory effect. PUFA modifies important monoamine neurotransmitters, such as serotonin and dopamine, which are involved in the pathophysiology of depression and other mental disorders.[44]

Wolfe *et al*. study reported that increased oleic acid intake has been associated with reduced risk of depression in women.[45] Our study results are consistent with the results of this study.

The results of current study indicated physical activity education was a predictor for reducing the depression score. The effect of physical activity and exercise on the reduction of depression and increasing the mental health during pregnancy and after pregnancy has been documented in numerous studies.[46] Physical activity may serve as another protective factor for obesity and depression. Thus, it is important to recognize the barriers and facilitators to engagement in physical activity.[47] But we did not find a study that examined the impact of physical activity education on depression.

This study was one of the few studies that evaluated depression predictors associated with nutritional status and physical activity during pregnancy among obese and overweight women. In addition, food intake, depression and physical activity in this study

were screened using standard tools such as EPDS, Food Record and IPAQ. Despite these strong points, this study had some limitations; it was a cross-sectional study, so the relationship between depression and socio-demographic characteristics, physical activity and nutritional status does not necessarily indicate a cause–effect relationship. Pre-pregnancy weight in all women was not recorded in the pre-conception care; therefore, the weight in the first trimester was used for estimation of BMI. Moreover, sub-group analysis based on BMI need more sample size for confirmation. Also, we cannot generalize the findings of this study to the women who had high risk pregnancy, those with increased risk of development mood disorders such as history of depression, presence of some problems including hospitalization in the current pregnancy, occurrence of recently stressful life events, history of infertility, addiction, special diet or contraindications for physical activity in this pregnancy. It is suggested to conduct more researches for confirmation the strong predictors of depression in overweight and obese pregnant women. It is highly recommended using specific physical activity during pregnancy questionnaire (PPAQ) in future researches.[48]

Considering the fact that nearly one-third of overweight and obese women in present study were positive for depression screening, it is important to pay attention to strong predictors of depression in these women and to provide necessary measures for prevention of it through educational programs and improve physical activity and nutritional habits especially from preconception period to promote the long-term wellbeing of mothers and babies. In order to promoting mental and physical health of pregnant women, conducting future interventional researches in preconception period with the aim of achieving normal BMI through educational interventions regarding physical activity and healthy nutrition seems necessary.

Acknowledgments

Hereby, the authors would like to thank all the participants in the study, the staff of health centers and Research and Technology Deputy of Tabriz University of Medical Sciences that helped us financially.

Disclosure

None declared.

References

1. Oteng-Ntim E, Varma R, Croker H, Poston L, Doyle P. Lifestyle interventions for overweight and obese pregnant women to improve pregnancy outcome: Systematic review and meta-analysis. *BMC Med* 2012; **10**: 47.
2. Fisher SC, Kim SY, Sharma AJ, Rochat R, Morrow B. Is obesity still increasing among pregnant women? Prepregnancy obesity trends in 20 states, 2003-2009. *Prev Med* 2013; **56**: 372–378.
3. Nouri-Saeidlou S, Babaei F. Prevalence of Obesity and Overweight in pregnant women at beginning and end of pregnancy and Associated Factors in Urban Adults from West Azerbaijan International congree of mother's and child's obesity 2016.
4. Nemiary D, Shim R, Mattox G, Holden K. The relationship between obesity and depression among adolescents. *Psychiatr Ann* 2012; **42**: 305–308.
5. Schwartz MB, Brownell KD. Obesity and body image. *Body Image* 2004; **1**: 43–56.
6. Friedman MA, Brownell KD. Psychological correlates of obesity: Moving to the next research generation. *Psychol Bull* 1995; **117**: 3–20.
7. Molyneaux E, Poston L, Ashurst-Williams S, Howard LM. Obesity and mental disorders during pregnancy and postpartum: A systematic review and meta-analysis. *Obstet Gynecol* 2014; **123**: 857–867.
8. Field T. Prenatal depression risk factors, developmental effects and interventions: A review. *J Pregnancy Child Health* 2017; **4**: 301.
9. Benute GR, Nomura RM, Reis JS, Fraguas Junior R, Lucia MC, Zugaib M. Depression during pregnancy in women with a medical disorder: Risk factors and perinatal outcomes. *Clinics (Sao Paulo, Brazil)* 2010; **65**: 1127–1131.
10. Pereira PK, Lovisi GM, Pilowsky DL, Lima LA, Legay LF. Depression during pregnancy: Prevalence and risk factors among women attending a public health clinic in Rio de Janeiro, Brazil. *Cad Saude Publica* 2009; **25**: 2725–2736.
11. Lancaster CA, Gold KJ, Flynn HA, Yoo H, Marcus SM, Davis MM. Risk factors for depressive symptoms during pregnancy: A systematic review. *Am J Obstet Gynecol* 2010; **202**: 5–14.
12. King NM, Chambers J, O'Donnell K, Jayaweera SR, Williamson C, Glover VA. Anxiety, depression and saliva cortisol in women with a medical disorder during pregnancy. *Arch Womens Ment Health* 2010; **13**: 339–345.
13. Rezaee R, Framarzi M. Predictors of mental health during pregnancy. *Iran J Nurs Midwifery Res* 2014; **19**: S45–S50.
14. Kyu HH, Bachman VF, Alexander LT *et al*. Physical activity and risk of breast cancer, colon cancer, diabetes, ischemic heart disease, and ischemic stroke events: Systematic review and dose-response meta-analysis for the global burden of disease study 2013. *BMJ* 2016; **354**: i3857.
15. Harvey SB, Hotopf M, Overland S, Mykletun A. Physical activity and common mental disorders. *Br J Psychiatry* 2010; **197**: 357–364.
16. Lindsay KL, Heneghan C, McNulty B, Brennan L, McAuliffe FM. Lifestyle and dietary habits of an obese pregnant cohort. *Matern Child Health J* 2015; **19**: 25–32.
17. Chen C, Xu X, Yan Y. Estimated global overweight and obesity burden in pregnant women based on panel data model. *PloS One* 2018; **13**: e0202183-e.

18. Salehi-Pourmehr H, Mohammad-Alizadeh S, Jafarilar-Agdam N, Rafiee S, Farshbaf-Khalili A. The association between pre-pregnancy obesity and screening results of depression for all trimesters of pregnancy, postpartum and 1 year after birth: A cohort study. *J Perinat Med* 2017; **46**: 87–95.
19. Brandon AR, Trivedi MH, Hynan LS *et al*. Prenatal depression in women hospitalized for obstetric risk. *J Clin Psychiatry* 2008; **69**: 635–643.
20. Biaggi A, Conroy S, Pawlby S, Pariante CM. Identifying the women at risk of antenatal anxiety and depression: A systematic review. *J Affect Disord* 2016; **191**: 62–77.
21. Yanikkerem E, Ay S, Mutlu S, Goker A. Antenatal depression: Prevalence and risk factors in a hospital based Turkish sample. *J Pak Med Assoc.* 2013; **63**: 472–477.
22. Claesson M, Klein S, Sydsjö G, Josefsson A. Physical activity and psychological well-being in obese pregnant and postpartum women attending a weight-gain restriction programme. *Midwifery* 2014; **30**: 11–16.
23. Panicker JN, de Seze M, Fowler CJ. Rehabilitation in practice: Neurogenic lower urinary tract dysfunction and its management. *Clin Rehabil* 2010; **24**: 579–589.
24. Mahan LK, Raymond JL. Food and the nutrition care process. In Mahan LK, Raymond JL (eds). *Krause's food & the nutrition care process*. St. Louis, Missouri: Elsevier, 2017.
25. Hazavehei SMM, Asadi Z, Hassanzadeh A, Shekarchizadeh P. Comparing the effect of two methods of presenting physical education Π course on the attitudes and practices of female students towards regular physical activity in Isfahan University of Medical Sciences. *Iranian Journal of Medical Education* 2008; **8**: 121–131.
26. Ainsworth BE, Haskell WL, Whitt MC *et al*. Compendium of physical activities: An update of activity codes and MET intensities. *Med Sci Sports Exerc* 2000; **32**: S498–S504.
27. Moghaddam MB, Aghdam FB, Jafarabadi MA, Allahverdipour H, Nikookheslat SD, Safarpour S. The Iranian version of International Physical Activity Questionnaire (IPAQ) in Iran: Content and construct validity, factor structure, internal consistency and stability. *World Appl Sci J* 2012; **18**: 1073–1080.
28. BashiriMoosavi F, Farmanbar R, Taghdisi M, AtrkarRoshan Z. Level of physical activity among girl high school students in Tarom county and relevant factors. *Iranian J Health Educ Health Promot* 2015; **3**: 133–140.
29. Craig CL, Marshall AL, Sjostrom M *et al*. International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc* 2003; **35**: 1381–1395.
30. Cox JL, Holden JM, Sagovsky R. Detection of postnatal depression. Development of the 10-item Edinburgh postnatal depression scale. *British J Psychiatr* 1987; **150**: 782–786.
31. Montazeri A, Torkan B, Omidvari S. The Edinburgh postnatal depression scale (EPDS): Translation and validation study of the Iranian version. *BMC Psychiatry* 2007; **7**: 11.
32. Kamalifard M, Yavarikia P, Kheiroddin JB, Pourmehr HS, Iranagh RI. The effect of peers support on postpartum depression: A single-blind randomized clinical trial. *J Caring Sci* 2013; **2**: 237–244.
33. Bodnar LM, Wisner KL, Moses-Kolko E, Sit DK, Hanusa BH. Prepregnancy body mass index, gestational weight gain and the likelihood of major depression during pregnancy. *J Clin Psychiatry* 2009; **70**: 1290–1296.
34. Guelinckx I, Devlieger R, Mullie P, Vansant G. Effect of lifestyle intervention on dietary habits, physical activity, and gestational weight gain in obese pregnant women: A randomized controlled trial. *Am J Clin Nutr* 2009; **91**: 373–380.
35. Hui AL, Back L, Ludwig S *et al*. Effects of lifestyle intervention on dietary intake, physical activity level, and gestational weight gain in pregnant women with different pre-pregnancy body mass index in a randomized control trial. *BMC Pregnancy Childbirth* 2014; **14**: 331.
36. Thangaratinam S, Rogozińska E, Jolly K *et al*. Effects of interventions in pregnancy on maternal weight and obstetric outcomes: Meta-analysis of randomised evidence. *BMJ* 2012; **344**: e2088.
37. Melo EF Jr, Cecatti JG, Pacagnella RC, Leite DF, Vulcani DE, Makuch MY. The prevalence of perinatal depression and its associated factors in two different settings in Brazil. *J Affect Disord* 2012; **136**: 1204–1208.
38. Milgrom J, Gemmill AW, Bilszta JL *et al*. Antenatal risk factors for postnatal depression: A large prospective study. *J Affect Disord* 2008; **108**: 147–157.
39. Leung BM, Kaplan BJ. Perinatal depression: Prevalence, risks, and the nutrition link—A review of the literature. *J Am Diet Assoc* 2009; **109**: 1566–1575.
40. Solati Z, Jazayeri S, Tehrani-Doost M, Mahmoodianfard S, Gohari MR. Zinc monotherapy increases serum brain-derived neurotrophic factor (BDNF) levels and decreases depressive symptoms in overweight or obese subjects: A double-blind, randomized, placebo-controlled trial. *Nutr Neurosci* 2015; **18**: 162–168.
41. Hidese S, Saito K, Asano S, Kunugi H. Association between iron-deficiency anemia and depression: A web-based Japanese investigation. *Psychiatry Clin Neurosci* 2018; **72**: 513–521.
42. Sánchez-Villegas A, Verberne L, De Irala J *et al*. Dietary fat intake and the risk of depression: The SUN project. *PLoS One* 2011; **6**: e16268.
43. Mischoulon D, Fava M. Docosahexanoic acid and ω-3 fatty acids in depression. *Psychiatric Clin North America* 2000; **23**: 785–794.
44. Pinto TJ, Vilela AA, Farias DR *et al*. Serum n-3 polyunsaturated fatty acids are inversely associated with longitudinal changes in depressive symptoms during pregnancy. *Epidemiol Psychiatr Sci* 2017; **26**: 157–168.
45. Wolfe AR, Ogbonna EM, Lim S, Li Y, Zhang J. Dietary linoleic and oleic fatty acids in relation to severe depressed mood: 10 years follow-up of a national cohort. *Prog Neuro-Psychopharmacol Biol Psychiatry* 2009; **33**: 972–977.
46. Davenport MH, McCurdy AP, Mottola MF *et al*. Impact of prenatal exercise on both prenatal and postnatal anxiety and depressive symptoms: A systematic review and meta-analysis. *Br J Sports Med* 2018; **52**: 1376–1385.
47. Schneider KL, Baldwin AS, Mann DM, Schmitz N. Depression, obesity, eating behavior, and physical activity. *J Obes* 2012; **2012**: 517358.
48. CHASAN-TABER L, SCHMIDT MD, ROBERTS DE, Hosmer D, Markenson G, FREEDSON PS. Development and validation of a pregnancy physical activity questionnaire. *Med Sci Sports Exerc* 2004; **36**: 1750–1760.

