Association between dietary intake in each trimester during pregnancy and postpartum depression and hypochondriasis

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Research

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Abstract

Background: The aim of the present study was to assess pregnant mothers' nutritional supply in each trimester and psychological status in postpartum with an emphasis on post pregnancy depression disorder and hypochondriasis.

Methods: This was a three-year prospective cohort study that 1319 pregnant women referred to rural health centers in Bandar Abbas, Iran were enrolled. The data were collected using a checklist including socioeconomic and fertility characterize, food frequency questionnaire (FFQ) for measurement of dietary intake, Edinburgh Postnatal Depression Scale (EPDS) to diagnose postpartum depression (PPD), Evans hypochondriasis questionnaire was used to diagnose hypochondriasis.

Results: The finding showed that prevalence of PPD and hypochondriasis were 91(6.8%) and 553(42%), respectively. The results showed that intake of iron, selenium, iodine, folate, vitamin C, B12, EPA in all trimesters and intake of vitamin c in second trimester was significantly associated with PPD ($P<0.05$); as intake of those micronutrients was significantly lower in women with PPD rather than women without that. Moreover**,** our finding showed that intake of iron, iodine, folate, selenium, EPA in all trimesters was significantly associated with hypochondriasis ($P<0.05$); as intake of those micronutrients was significantly lower in women with hypochondriasis rather than women without that.

Conclusions: Considering the pregnancy and lactation are major nutritional stressors to body and our finding in relation between poor nutrition intake of iron, iodine, folate, selenium, EPA, vitamin C and mood disorders (PPD and hypochondriasis), greeter attention to nutritional factors in psychological status during postpartum is warranted.

Background

Psychological disorders are among disabling dysfunctions all over the world and women in partum-post period are at higher risk for them [1]. Postnatal Depression Disorder (PDD) is characterized by sadness, fatigue, irritability, and lack of interest to daily activities [2]. Women suffering from PDD experience feelings like guilt, blame and worthlessness related to birth giving and becoming parent. This may lead to thinking of suicide or hurting the baby. According to the definition provided in Diagnostic and Statistical Manual of Mental Disorders (DSM -IV), PDD begins during four weeks after giving birth [2]. This disorder often remains undiagnosed and uncured due to unawareness of signs and the related stigma [3], and as a result it seems essential to take necessary measurements to diagnose risk factors.

Hypochondriasis or illness anxiety disorder is a disorder that the suffering person considers himself/herself as patient despite the fact that there is no health problem shown in comprehensive medical examinations [4, 5]. Hypochondriasis could result in problems in daily activity and social relations (due to the patient’s expectation of being cured and being paid special attention) and also in occupational failure [6]. Researchers have shown a relation between depression and hypochondriasis [7, 8]; but there is a lack of studies on the prevalence and related factors of hypochondriasis during the

pregnancy and postpartum. For now, the precise etiology of PDD and hypochondriasis is unknown; but it is generally believed that biological, genetic, hormonal, and psychological factors are related with them [9–16]. Nutrients like folic acid, vitamin B12, calcium, zinc, selenium, iron, non-saturated greasy acids are considered as significant factors [11, 14, 17]. Nutrition has been proven to play effective role in preventing mental health disorders; the roles include engaging in synthesis and balancing neurotransmitters and catecholamines, activity of enzymes, cellular and oxidative process, function of receptors ,preserving neural tissue and neural functions which are of great significance in mental health[18, 19].

Pregnant mothers are more vulnerable due to the considerable pressures received by hormonal, metabolic, and physical changes that increase their nutritional needs [20]. Also, nutritional deficiencies due to breast feeding and delay postpartum repletion are more significant in post-partum period and should be paid more attention. Nutrition, in addition to its impact on mental health, have considerable importance, since it can be improved. In developing countries including Iran, women living in disadvantaged and deprived areas are at more risk regarding nutrition. In these regions, sex discrimination has given the women of family the lowest priority for feeding; their foods have not only the lowest quantity but the poorest quality. Hormozgan is one of the disadvantaged and deprived southern provinces in Iran where no studies regarding receiving micronutrients have ever done. According to account of Nutrition Improvement Office of Ministry of health and Treatment of Iran, Hormozgan is one of five provinces in Iran which has an undesirable situation about malnutrition and nutritious safety and the shortage of micronutrients, iron, vitamins within vulnerable groups, particularly pregnant women, is increasing. Unfortunately, there is no study conducted to examine the association between nutritional supply within each trimester and mental status in postpartum period. Considering the importance of public psychological health, the fact that there is no effective treatment offered yet, and regarding abovementioned issues, this research has been designed and conducted to assess pregnant mothers' nutritional supply in each trimester and psychological status in postpartum with an emphasis on postpartum depression disorder and hypochondriasis.

Materials And Methods

Design and data collection

This is a perspective cohort study in 2015–2017 on pregnant women referring to health centers of Bandar-Abbas, Iran. Inclusion criteria were willing to participating in study, single pregnancy, gestational age less than 10 weeks, age 15–40 years, being married, primagravida mother, Iranian nationality, having no history of systemic diseases (diabetes, hypertension, known anemia, and other diseases requiring special diet) before pregnancy, no smoking or drinking alcohol. Exclusion criteria were unwilling to continue the study. Data were collected using a questionnaire. After explaining the objectives of the study and giving assurance about confidentiality of information, written consent forms were obtained. All questionnaires were completed by well-trained researchers. Convenience sampling was used and all pregnant women with inclusion criteria entered the study. The interval of prenatal visits and cares were consistent with National Guideline of Prenatal Care in Iran, as seven visits were given in weeks of 6–10,

16–20, 26–30, 31–34, 35–37, 38–39, and 41 respectively. Dose of iron, folic acid, and multivitamins was recorded precisely all over the pregnancy period. There are no significant different between total dose of iron, folic acid, and multivitamins during pregnant between depression vs. non depressed and hypochondriac vs. non hypochondriac (data not presented).

Measure

1. 1. A check-list was used to collect demographic information (age, education of woman and her husband, job of woman and her husband), socioeconomic status, and BMI.
2. 2. Edinburgh Postnatal Depression Scale (EPDS) was used to diagnose postnatal depression. It was developed by Scottish health centers in Edinburgh and Livingston in 1978 and composed of 10 short statements. Each answer is given a score of 0 to 3 based on Likert scale. The total score is 0–30. A score of more than 12 shows depression [21]. The validity and reliability of this questionnaire is approved in Iran [22]. The questionnaire was completed during 4–6 weeks after giving birth.
3. 3. Evans hypochondriasis questionnaire was used to diagnose hypochondriasis. It was developed by Evans et al in 1978 and composed of 36 questions [23]. Some of them have two options and the others have 5 options. The total score is 0–60. The score of 0–20, 21–40, 41–60 indicate lack of mild hypochondriasis, moderate hypochondriasis; sever hypochondriasis, mild hypochondriasis, moderate hypochondriasis, severe hypochondriasis. The validity and reliability of this questionnaire is approved in Iran [7, 24]. The questionnaire was completed during 4–6 weeks after giving birth.
4. 4. Food frequency questionnaire: dietary intake was measured using a modified food frequency questionnaire (FFQ) based on Iranian dietary questionnaire which contains 168 items. The reliability and validity of the questionnaire are approved in Iran [25]. FFQ included a list of foods with a standard size of a food. Subjects were asked to report the frequency of consumption of each food during the past month on a daily, weekly or monthly basis. The amount of nutritional item consumed was converted to grams using household scales. This dietary information was analyzed using the software Nutrition4 which calculated the amount of energy, macronutrients (carbohydrates, lipid, and protein) and micronutrients (at least 30 micronutrients) including fat soluble vitamins, water soluble vitamins and minerals. The FFQ was completed in the first of each trimester of pregnancy.

Ethics

The study protocol was approved by the ethics review committee of Hormozgan University of medical sciences. Participation was voluntary and they were permitted to discontinue their cooperation. All questionnaires were anonymous and the researcher assured the participants of confidentiality of information. After explaining the purposes of the study, all of them signed a written consent form.

Statistical analysis

Descriptive statistics was used to summarize the quantitative and qualitative variables. Data is presented as mean (standard division) for quantitative variables and number (percent) for qualitative. Analytic

statistics including T-test (for variables with normal distribution based on Kolmogorov-Smirnov test), chi square, and Mann-Whitney were used for inter-group comparison of variables. Food frequency questionnaires were analyzed applying software N4. Other data were analyzed using SPSS 21 (SPSS, Chicago, IL, USA). $P < 0.05$ was considered as significant level.

Results

The study samples

In a three-year period, 1319 women completed full course of the study. Socioeconomic and reproductive characteristics are summarized in Table 1. The results showed that 91(6.8%) women had PPD and 553(42%) had hypochondriasis.

Table 1
Demographic and clinical characterizes of participants

Age *		**24.34 ± 5.55**
Age of husbend *		28.16 ± 6.24
Occupation**	Houswife	1289 (96.9)
	Employed	41 (3.1)
Education *		9.27 ± 4.14
Gestational age*		171.49 ± 114.67
BMI*		23.07 ± 29.29
Hb in 6–10 weeks of pregnancy*		12.79 ± 0.12
HCT in 6–10 weeks of pregnancy*		35.78 ± 4.32
*mean ± SD		
**N(%)		

Table 2
Prevlance of PPD and hypochondriasis

Depression *	No	1239 (93.2)
	Yes	91 (6.8)
Hypochondriasis*	No	766(57.6)
	Marginal	366 (27.5)
	Mild	99(7.4)
	Moderate	56(4.2)
	Severe	10 (0.08)
*N(%)		

Relation Between Dietary Intake And Hypochondriasis

The results showed that intake of iron, iodine, folate, selenium, EPA in all trimesters was significantly associated with hypochondriasis ($p < 0.05$); as intake of those micronutrients was significantly lower in women with hypochondriasis rather than women without that (Table 3–5).

Table 3
Comparison of dietary intake in participants based on hypochondriac status in the first trimester

Variable **	No problem (n = 766)	Problem (n = 553)	P value *
Energy (Kcal/day)	1501.41 ± 96.29	1443.67 ± 95.36	0.23
Protein (% energy)	88.35 ± 64.85	82.82 ± 61.87	0.39
Fat (% energy)	87.06 ± 18.22	83.35 ± 15.55	0.58
Saturated fatty acids (g)	26.72 ± 33.97	25.01 ± 24.17	0.58
Polyunsaturated fatty acids (g)	24.16 ± 14.17	23.55 ± 18.58	0.52
Linoleic acids (g)	22.46 ± 22.11	21.71 ± 17.38	0.21
EPA (g)	0.03 ± 0.002	0.001 ± 0.001	0.001
Sodium (mg/day)	1293.54 ± 98.95	1004.94 ± 15.77	0.06
Iron (mg/day)	49.20 ± 3.78	27.80 ± 6.13	0.001
Magnesium (mg/day)	504.31 ± 38.26	489.90 ± 26.88	0.84
Zinc (mg/day)	13.35 ± 3.75	12.86 ± 2.55	0.59
Manganese (mg/day)	8.81 ± 6.72	8.77 ± 7.89	0.98
Fluoride (µg/day)	1669.37 ± 77.73	1460.16 ± 75.59	0.43
Iodine (µg/day)	0.29 ± 0.42	0.00 ± 0.00	0.001
Vitamin A (µg/day)	1532.33 ± 44.50	1250.79 ± 63.69	0.47
Vitamin E (mg/day)	8.92 ± 7.98	7.96 ± 9.25	0.42
Vitamin B1 (mg/day)	2.14 ± 3.59	1.91 ± 1.36	0.33
Vitamin B3 (mg/day)	26.05 ± 23.95	25.74 ± 18.97	0.85
Folate (µg/day)	483.04 ± 82.27	461.59 ± 47.82	0.04
Carbohydrate (g/day)	380.26 ± 54.02	322.02 ± 10.13	0.60
Calcium (mg/day)	1234.81 ± 12.91	1161.700 ± 16.69	0.81
Phosphorus (mg/day)	1800.16 ± 10.80	1775.22 ± 79.80	0.53
Selenium (mg/day)	1.78 ± 0.05	0.18 ± 0.06	0.03
Vitamin C (mg/day)	400.60 ± 12.18	359.47 ± 62.52	0.33

*T test, **Mean ± SD

Variable **	No problem (n = 766)	Problem (n = 553)	P value *
Vitamin B12 (µg/day)	5.40 ± 0.58	3.82 ± 7.89	0.05
*T test, **Mean ± SD			

Table 4
Comparison of dietary intake in participants based on hypochondriac status in the second trimester

Variable **	No problem (n = 766)	Problem (n = 553)	P value *
Energy (Kcal/day)	1776.64 ± 64.03	1541.72 ± 96.29	0.20
Protein (% energy)	134.93 ± 60.68	107.43 ± 58.53	0.24
Fat (% energy)	104.oo ± 54.53	102.53 ± 70.70	0.88
Saturated fatty acids (g)	27.71 ± 33.21	21.72 ± 42.35	0.20
Polyunsaturated fatty acids (g)	27.41 ± 25.13	26.60 ± 35.58	0.73
Linoleic acids (g)	25.47 ± 23.06	24.13 ± 30.83	0.52
EPA (g)	0.34 ± 3.93	0.01 ± 0.01	0.001
Sodium (mg/day)	1773.88 ± 91.69	1042.43 ± 93.56	0.34
Iron (mg/day)	29.14 ± 27.82	23.81 ± 23.51	0.03
Magnesium (mg/day)	672.52 ± 91.80	612.74 ± 68.77	0.18
Zinc (mg/day)	22.06 ± 12.66	13.67 ± 19.19	0.13
Manganese (mg/day)	9.30 ± 3.69	8.10 ± 7.08	0.18
Fluoride (µg/day)	1871.62 ± 20.08	1513.33 ± 99.90	0.30
Iodine (µg/day)	1.72 ± 5.07	0.07 ± 0.68	0.001
Vitamin A (µg/day)	1998.46 ± 57.64	1455.59 ± 39.94	0.20
Vitamin E (mg/day)	57.76 ± 32.02	11.31 ± 18.78	0.17
Vitamin B1 (mg/day)	3 ± 9.70	2.15 ± 2.42	0.17
Vitamin B3 (mg/day)	39.13 ± 43.13	31.29 ± 40.62	0.39
Folate (µg/day)	889.21 ± 20.23	553.92 ± 86.17	0.02
Carbohydrate (g/day)	579.72 ± 34.54	450.72 ± 90.11	0.29
Calcium (mg/day)	1921.06 ± 53.34	1481.06 ± 80.02	0.40
Phosphorus (mg/day)	1800.16 ± 10.80	1075.22 ± 79.80	0.53
Selenium (mg/day)	0.19 ± 0.16	0.03 ± 0.05	0.01
Vitamin C (mg/day)	444.73 ± 32.15	236.98 ± 32.38	0.23

*T test, **Mean ± SD

Variable **	No problem (n = 766)	Problem (n = 553)	P value *
Vitamin B12 (µg/day)	3.42 ± 0.45	2.93 ± 4.22	0.32
*T test, **Mean ± SD			

Table 5
Comparison of dietary intake in participants based on hypochondriac status in the third trimester

Variable **	No problem (n = 766)	Problem (n = 553)	P value *
Energy (Kcal/day)	1481.37 ± 96.16	1376.51 ± 84.12	0.20
Protein (% energy)	86.94 ± 89.09	78.38 ± 28.29	0.24
Fat (% energy)	89.58 ± 14.15	71.40 ± 10.65	0.28
Saturated fatty acids (g)	57.93 ± 58.14	55.45 ± 37.13	0.48
Polyunsaturated fatty acids (g)	25.92 ± 29.18	21.04 ± 26.36	0.92
Linoleic acids (g)	23.45 ± 6.43	19.37 ± 5.23	0.21
EPA (g)	0.02 ± 0.000	0.01 ± 0.001	0.001
Sodium (mg/day)	3000.43 ± 98.86	2098.90 ± 71.0	0.06
Iron (mg/day)	34.99 ± 2.53	21.82 ± 2.49	0.04
Magnesium (mg/day)	342.87 ± 73.90	388.60 ± 74.83	0.51
Zinc (mg/day)	14.08 ± 4.68	11.17 ± 4.01	0.59
Manganese (mg/day)	9.99 ± 12.61	7.14 ± 5.54	0.48
Fluoride (µg/day)	1996.06 ± 63.84	1278.21 ± 25.61	0.62
Iodine (µg/day)	1.02 ± 1.14	0.08 ± 0.42	0.05
Vitamin A (µg/day)	1977.34 ± 68.04	1790.51 ± 43.01	0.39
Vitamin E (mg/day)	10.78 ± 16.22	7.37 ± 11.99	0.92
Vitamin B1 (mg/day)	3.27 ± 5.65	1.77 ± 2.27	0.35
Vitamin B3 (mg/day)	38.46 ± 6.68	27.17 ± 5.57	0.33
Folate (µg/day)	883.88 ± 69.60	432.60 ± 9.96	0.02
Carbohydrate (g/day)	654.94 ± 13.12	336.22 ± 19.42	0.60
Calcium (mg/day)	1336.72 ± 57.15	1136.97 ± 34.66	0.51
Phosphorus (mg/day)	1522.04 ± 46.40	1497.83 ± 17.93	0.08
Selenium (mg/day)	0.26 ± 0.01	0.09 ± 0.002	0.01
Vitamin C (mg/day)	302.25 ± 17.20	270.93 ± 13.84	0.65

*T test, **Mean ± SD

Variable **	No problem (n = 766)	Problem (n = 553)	P value *
Vitamin B12 (µg/day)	3.65 ± 0.42	3.02 ± 0.63	0. 84
*T test, **Mean ± SD			

Relation Between Dietary Intake And Ppd

The results showed that intake of iron, selenium, iodine, folate, vitamin C, B12, EPA in all trimesters ($p < 0.005$) and intake of vitamin c in second trimester was significantly associated with PPD ($p < 0.005$); as intake of those micronutrients was significantly lower in women with PPD rather than women without that (Table 6–8).

Table 6
Comparison of dietary intake in participants based on PPD status in the first trimester

Variable **	No problem (n = 1228)	Problem (n = 91)	P value *
Energy (Kcal/day)	1576.14 ± 52.57	1223.36 ± 27.52	0.73
Protein (% energy)	101.66 ± 46.24	79.84 ± 61.58	0.39
Fat (% energy)	105.05 ± 22.50	92.33 ± 93.31	0.58
Saturated fatty acids (g)	33.94 ± 23.84	27.36 ± 45.81	0.56
Polyunsaturated fatty acids (g)	24.59 ± 23.58	22.12 ± 17.96	0.32
Linoleic acids (g)	22.46 ± 21.61	20.46 ± 16.76	0.38
EPA (g)	0.02 ± 0.02	0.01 ± 0.01	0.01
Sodium (mg/day)	1910.41 ± 48.05	1588.59 ± 12.65	0. 80
Iron (mg/day)	32.74 ± 82.03	18.30 ± 13.11	0.05
Magnesium (mg/day)	314.60 ± 87.07	326.92 ± 80.19	0.10
Zinc (mg/day)	13.54 ± 29.71	9.46 ± 8.96	0.19
Manganese (mg/day)	8.99 ± 7.96	7.59 ± 3.42	0.90
Fluoride (µg/day)	1667.38 ± 41.42	1167.69 ± 42.49	0.19
Iodine (µg/day)	0.00 ± 0.00	0.03 ± 0.00	< 0.001
Vitamin A (µg/day)	1708.65 ± 31.29	1537.65 ± 56.32	0.16
Vitamin E (mg/day)	9.006 ± 17.26	5.28 ± 4.17	0.07
Vitamin B1 (mg/day)	2.14 ± 3.40	1.56 ± 1.11	0.10
Vitamin B3 (mg/day)	26.21 ± 23.58	23.02 ± 15.14	0.20
Folate (µg/day)	490.98 ± 52.89	346.95 ± 50.62	0.05
Carbohydrate (g/day)	829.13 ± 52.57	696.53 ± 65.24	0.40
Calcium (mg/day)	1221.32 ± 19.20	983.74 ± 40.73	0.20
Phosphorus (mg/day)	1538.73 ± 437.73	1229.32 ± 19.20	0.34
Selenium (mg/day)	0.48 ± 1.43	0.13 ± 0.36	< 0.001
Vitamin C (mg/day)	337.87 ± 87.89	337.46 ± 40.21	0.30
Vitamin B12 (µg/day)	63.59 ± 55.14	34.20 ± 20.63	0.05
*T test, **Mean ± SD			

Table 7
Comparison of dietary intake in participants based on PPD status in the second trimester

Variable **	No problem (n = 1239)	Problem (n = 91)	P value *
Energy (Kcal/day)	1492.88 ± 816.00	1157.72 ± 110.10	0.15
Protein (% energy)	133.22 ± 43.52	84.59 ± 11.01	0.17
Fat (% energy)	105.37 ± 150.00	81.57 ± 95.33	0.13
Saturated fatty acids (g)	66.67 ± 80.33	22.34 ± 28.39	0.40
Polyunsaturated fatty acids (g)	27.32 ± 34.58	19.07 ± 21.27	0.82
Linoleic acids (g)	24.88 ± 34.58	17.55 ± 19.58	0.28
EPA (g)	0.30 ± 3.63	0.009 ± 0.01	0.001
Sodium (mg/day)	1895.04 ± 21.19	1860.60 ± 58.61	0.50
Iron (mg/day)	28.27 ± 53.57	16.65 ± 43.72	0.04
Magnesium (mg/day)	543.20 ± 15.56	474.47 ± 95.77	0.43
Zinc (mg/day)	47.33 ± 77.16	13.34 ± 21.33	0.39
Manganese (mg/day)	9.16 ± 12.94	7.96 ± 9.95	0.38
Fluoride (µg/day)	1727.13 ± 41.25	1642.49 ± 58.20	0.08
Iodine (µg/day)	4.38 ± 0.91	0.00 ± 0.00	< 0.001
Vitamin A (µg/day)	1556.34 ± 64.52	1099.25 ± 42.84	0.56
Vitamin E (mg/day)	12.25 ± 8.26	8.11 ± 10.64	0.39
Vitamin B1 (mg/day)	2.91 ± 9.11	2.04 ± 2.97	0.36
Vitamin B3 (mg/day)	38.31 ± 34.67	29.30 ± 43.99	0.52
Folate (µg/day)	550.03 ± 56.86	522.57 ± 34.42	0.43
Carbohydrate (g/day)	589.11 ± 0.16	569.51 ± 20.33	0.93
Calcium (mg/day)	1591.66 ± 29.43	1436.16 ± 27.13	0.41
Phosphorus (mg/day)	1851.02 ± 33.46	1795.43 ± 30.13	0.28
Selenium (mg/day)	1.60 ± 0.06	0.54 ± 1.69	0.05
Vitamin C (mg/day)	449.26 ± 80.01	305.09 ± 16.83	0.04

*T test, **Mean ± SD

Variable **	No problem (n = 1239)	Problem (n = 91)	P value *
Vitamin B12 (µg/day)	118.92 ± 96.14	90.76 ± 54.96	0.05
*T test, **Mean ± SD			

Table 8
Comparison of dietary intake in participants based on PPD status in the third trimester

Variable **	No problem (n = 1239)	Problem (n = 91)	P value *
Energy (Kcal/day)	1501.31 ± 78.45	1478.67 ± 90.12	0.09
Protein (% energy)	106.85 ± 28.06	96.38 ± 21.11	0.09
Fat (% energy)	103.98 ± 73.78	97.30 ± 45.15	0.58
Saturated fatty acids (g)	32.36 ± 78.88	18.95 ± 34.16	0.10
Polyunsaturated fatty acids (g)	22.64 ± 27.37	12.56 ± 18.33	0.36
Linoleic acids (g)	22.77 ± 14.53	20.82 ± 26.23	0.27
EPA (g)	0.02 ± 0.02	0.009 ± 0.01	< 0.001
Sodium (mg/day)	1534.62 ± 81.65	1296.77 ± 51.22	0.45
Iron (mg/day)	24.61 ± 29.70	19.27 ± 42.36	0.05
Magnesium (mg/day)	390.95 ± 73.52	220.47 ± 38.92	0.11
Zinc (mg/day)	13.80 ± 26.50	10.11 ± 23.20	0.19
Manganese (mg/day)	7.93 ± 7.48	4.11 ± 5.58	0.68
Fluoride (µg/day)	1242.08 ± 61.40	1084.72 ± 93.16	0.78
Iodine (µg/day)	0.39 ± 0.85	0.00 ± 0.00	< 0.001
Vitamin A (µg/day)	1155.61 ± 76.08	1083.79 ± 69.34	0.36
Vitamin E (mg/day)	6.29 ± 3.29	4.05 ± 5.24	0.87
Vitamin B1 (mg/day)	2.10 ± 3.29	1.22 ± 2.14	0.74
Vitamin B3 (mg/day)	29.45 ± 34.51	26.52 ± 63.24	0.53
Folate (µg/day)	510.56 ± 95.49	379.95 ± 65.56	0.05
Carbohydrate (g/day)	308.97 ± 70.39	205.64 ± 38.14	0.81
Calcium (mg/day)	611.08 ± 47.56	522.67 ± 82.77	046
Phosphorus (mg/day)	1228.24 ± 81.26	1048.83 ± 80.50	0.63
Selenium (mg/day)	4.56 ± 0.46	2.28 ± 2.39	0.05
Vitamin C (mg/day)	362.68 ± 30.25	184.65 ± 54.36	0.75
Vitamin B12 (µg/day)	3.45 ± 1.58	1.29 ± .032	0.02
*T test, **Mean ± SD			

Discussion

The present study as the first study in world aimed to assess the association of PPD and postpartum hypochondriasis with intake of micronutrients in each trimester. The results showed that intake of iron, selenium, iodine, folate, vitamin C, B12, EPA in all trimesters and vitamin c in second trimester was significantly lower in women with PPD rather than women without that.

Iron as the main component of hemoglobin of red blood cells is responsible for transporting oxygen. Iron deficiency induces anemia and results in insufficient oxygen delivery to cells [26, 27]. Also, Iron deficiency anemia with decline of hemoglobin concentration increased significantly risk of depression in an independent dose pattern among old population; as, the lower the level of hemoglobin the worse the severity of depression [28]. Further studies in future are needed to determine the optimal and safe dose of iron supplements for depressive pregnant women.

Regarding selenium, recent studies showed depression symptoms in patients with low level of serum selenium that were treated and improved with selenium supplements [29]. Another study showed that selenium supplements during pregnancy declined depression (based on score of Edinburg questionnaire) in 8 weeks post-partum [30]. It is unknown the mechanism of impact of selenium on mood. Selenium is necessary for synthesis and metabolism of thyroid hormones. Little changes in function of thyroid are associated with depression [31]. Selenium deficiency causes thyroid hormone dysfunction that may mediates impact of selenium on depression [31]. Selenium is a main component of antioxidant enzyme glutathione peroxidase that is involved in antioxidant mechanisms and protects nerves of damages and lipoperoxidation [19]. Based on a randomized clinical trial in patients with HIV, the researchers reported that selenium supplement improved depressive mood and quality of life score 20 times [32]. Also, selenium supplement (100–150 microgram per day) for 5–6 weeks improved depressed–dejected mood state and a trend toward improvement in quality of life scores [32] .

Interaction between selenium and iodine in synthesis of thyroid hormones is a significant concern in Iran due to selenium and iodine sufficiency. Iodine sufficiency is a health problem in Iran. After performing the mandatory fortification program in 1991, many children and adults have optimal iodine intake [33]. Unfortunately, the present study showed that insufficient intake and iodine deficiency continues in pregnant women despite implement of mandatory iodine fortification. Selenium deficiency could worsen the consequences of iodine deficiency among this vulnerable group [34]. Iodine is a trace element that is an essential component of thyroid hormones It was shown that hypothyroidism is associated with mood disorders [35, 36], cognitive and affective disturbances [37] and memory impairment [38]. Also the relationship between depression and subliclinical hypothyroidism in animal model was investigated [39].

The present study showed that insufficient intake of some antioxidants is associated with PPD. Antioxidants (vitamin C/ B12, Folate) could be protective as a defense mechanism against PPD [40]. Antioxidants (vitamin C/ B12, Folate) could be protective as a defense mechanism against brain/vascular damages of oxidative stress related to reactive oxygen species (ROS) [40]. Folate and vitamin B12 have fundamental roles in normal function of central nervous system and could regulate

mood through some mechanisms [40]. For example, they are essential for some metabolic process in CNS such as methylation and construction of serotonin and other neurotransmitters, neuroamines, and catecholamines [41, 42]. Also, metabolism of hemosystein depends on sufficient levels of folate and vitamin B12 and the level of hemosystein is a sensitive indicator of deficiency of folate and vitamin B12 [43]. Based on some studies, level of hemosystein is higher and level of vitamin B12 and folate is lower in depressive patients [44]. Higher level of hemosystein could induce a vascular response resulting in depression [45]. A recent meta-analysis showed that folate deficiency is associated with a 55% increased risk of depression disregarding folic acid fortification or method of assessment of folate intake (questionnaire/serum folate measurement) [46]. Also, it was determined that the patients with lower level of folate had weaker response to antidepressants [47, 48]. Several studies indicated improvement of depression symptoms after adding folic acid to antidepressants [49–52]. Previous studies reported that high intake of vitamin B12, selenium, and magnesium was associated with lower depression syndromes in pregnant and non-pregnant women [30, 53–57].

Eicosapentanoic acid (EPA), one of n-3 PUFAs is significant for psychological health. It is mainly/mostly in fish and other sea foods [19]. EPA is a main constructive component of phospholipid membrane and is incorporated into cell membranes in whole body. It determines the biophysical characteristics of membrane of neurons[58]. Fatty acids affect receptors functions, neurotransmitters uptake, and signal transport. Association between EPA, inflammation and vascular disease may have a role in pathogenesis of depression because depression is associated with inflammation and atherosclerosis [59–61]. EPA is a precursor of some prostaglandins and Leukotrienes that are strong vasodilators and inhibitors of platelets aggregation and could decline the risk of vascular diseases [62]. Considering that docosehexaenoic acid (DHA) is essential for normal function of brain and EPA is a significant factor to inhibit inflammation process, a hypothesis poses that increase of fat acids N3 results in improvement of PPD. 1 g/d of EPA has been shown to be an effective adjuvant to antidepressant therapy in resistant depressed patients [63–65]. Peet and Horrobin (2002) determined that addition of low-dose EPA to standard antidepressant therapy in depressed patients achieved a 50% improvement compared to a paraffin placebo with minimal side effects[63]. Therefore, addition of EPA supplementation may be beneficial for the 30–50% of patients resistant to standard depression treatment.

This study indicated that level of iron, iodine, folate, selenium, EPA was lower in hypochondriac participants. Unfortunately, there is no similar study to be compared with the findings of present study. Considering that depression and hypochondriac have significant association [7], deficiency of micronutrients related to hypochondriac or depression could aggravate each other. The present study has some strong points including population-based design, large sample size, and little drop-out rate (only 5 participants) that could prevent selection bias. Also, the study was conducted in whole rural areas of the Hormozgan province and was not limited to some special areas; since, depression and especially nutrition are associated with various factors such as socioeconomic status, education level, and culture that all of them could be influenced by the place of residence (rural or urban). Conducting the study in whole rural areas of the province prevented selection bias and yield a more precise assessment of association of nutrition, PPD and hypochondriasis. Moreover, in this study, potential confounding factors

were controlled. For example, nutrition questionnaire was completed in each trimester (not after birth); so, the findings could not be influenced by appetite in various periods of pregnancy. Another strong point was using validated FFQ to assess nutritional status; since, it is a standard tool for assessing long-term nutritional status in cohort and cross-sectional studies. The limitation of present study was applying self-reported questionnaires for post-partum depression (Edinburg) and hypochondriasis. However, both questionnaires are used for screening as valid tools [66, 67].

Conclusions

The findings of present study showed that low intake of some micronutrients such as iron, selenium, iodine, folate, vitamin C, B12, EPA (in all trimesters) and vitamin c (in second trimester) are associated with PPD. Also, low intake of some micronutrients including iron, iodine, folate, selenium, EPA (in all trimesters) is associated with hypochondriasis. Nutrition is a controllable effective factor for hypochondriasis and PPD as high prevalence disorders with adverse outcomes. So, it is suggested that prenatal care providers put emphasize on consumption of micronutrients during pregnancy.

Declarations

Data Availability Statement

The primary data for this study is available from the authors (Fatemeh Bazarganipour) on direct request.

Disclosure statement

The authors report no conflicts of interest.

Authors' contributions

FB contributed in conception, design, statistical analysis and drafting of the manuscript. SA, ZA, MA and TD contributed in data collection and manuscript drafting. All authors approved the final version for submission. FB supervised the study.

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Conflict of interest

The authors declare that they have no conflict of interest.

Informed consent

Informed consent was obtained from all individual participants included in the study.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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