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Original Article

Association Between Caffeine Consumption During Pregnancy and Postpartum Depression: A Population-Based Study

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Background: This study aimed to examine the association between caffeine intake and postpartum depression in a group of Iranian women.
Methods: This population-based cross-sectional study was performed on a representative sample of 360 women attending healthcare centers in Ardabil, Iran. Dietary intakes were assessed using a validated 106-item dish-based semiquantitative food frequency questionnaire. Caffeine intake was calculated through considering caffeine from all foods and beverages. The Edinburgh Postnatal Depression Scale was used to examine postpartum depression. Women with a score of 13 or more were considered as depressed.
Results: Point prevalence of postpartum depression was 34.8 per 100 subjects. After controlling for potential confounders, we observed a significant association between caffeine intake and postpartum depression, controlling for some possible confounding variables (odds ratios [ORs] and corresponding 95% confidence interval [CI] for quartiles 1, 3, and 4 of caffeine intake were 1.8 [.9–3.6], 1.2 [.63–2.4], and 2.1 [1.1–4.1]), respectively. Furthermore, tea consumption was not related to the odds of postpartum depression (ORs and corresponding 95% CI for quartiles 1, 3, and 4 of tea intake were 1.1 [.59–2.2], 1.1 [.6–2.1], and 1.2 [.63–2.3]), respectively. The second quartile was considered as the reference group.
Conclusion: No significant association was observed between caffeine or tea intake and odds of postpartum depression except for last quartile of caffeine in an adjusted model. Further investigations are needed to determine whether usual caffeine consumption can contribute to the risk of postpartum depression.

Keywords: caffeine, tea, pregnancy, postpartum depression

Introduction

Postpartum depression is one of the important public health problems. This condition is associated with reduced quality of life, anxiety and irritability, tearfulness, disappointment, fatigue, and disinclination to breast feed.[1] Prevalence of postpartum depression is ~20–40% in mothers and slightly lower in fathers.[2] In Iran, it has been estimated that 15.5–37.7% of women are affected.[3,4] Considering the effect of this condition on the life of women and their children's growth,[5,6] finding the contributing factors to this condition is of great importance.

Diet, as a modifiable risk factor, plays a key role in postpartum depression.[7,8] Earlier studies have examined the relationship between nutrients such as selenium, magnesium, zinc, omega-3, iron and postpartum depression.[6,9,10]

Caffeine intake might attenuate the symptoms of depression by decreasing the serotonin level in the brain.[11]

Studies that assess the relationship between caffeine intake and postpartum depression are rare and there are inconsistent findings. One longitudinal study showed an inverse association between consumption of caffeinated coffee and risk of depression[12] and another one indicated no significant association or has found an inverse association only in women.[13]

It must be kept in mind that almost all previous publications on the association between caffeine intake and depression came from western nations and no information

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is available in this regard from developing countries, in particular from Middle East countries. Dietary intakes, as well as caffeine intake, in these countries are totally different from those in western societies. Furthermore, besides diet, contributing factors to depression and in particular to postpartum depression are different in the Middle-Eastern population than for western countries. Given the high prevalence of postpartum depression in Iranian women, this study aimed to examine the association between caffeine intake and postpartum depression in a representative sample of Iranian women residing in Ardabil, Iran.

Subjects and Methods

Study participants

This population-based cross-sectional study was performed on a representative sample of 360 women attending healthcare centers of Ardabil, Iran. Participants were selected based on a systematic random sampling method.

There are 30 healthcare centers in Ardabil County, and we used all of them for sampling. In each center, after sorting a list of eligible women based on delivery date, 25% of them were selected using systematic random sampling. Participants were included in the study if they had a live birth and had delivered in the last 3 months. Individuals with a history of self-reported depression and other psychiatric disorders were excluded from the study. All subjects signed an informed consent. This study was approved by the Ethics Committee of Isfahan University of Medical Sciences, Isfahan, Iran.

Assessment of dietary intake

To examine the usual dietary intakes of study participants throughout their pregnancy, we used a 106-item Willett-format dish-based semiquantitative food frequency questionnaire (DS-FFQ) that was specifically designed for Iranian adults.[14] The questionnaire contained five categories of foods and dishes, including mixed dishes (cooked or canned, 29 items); grains (different types of bread, cakes, biscuits, and potato, 10 items); dairy products (dairies, butter, and cream, 9 items); fruits and vegetables (22 items); and miscellaneous food items and beverages (including sweets, fast foods, nuts, desserts, and beverages, 36 items).

The frequency response categories for the food list varied from ''never or less than once a month'' to ''12 or more times per day.'' For instance, the frequency response for coffee consumption included nine categories as follows: never or less than 1 glass/month, 1–3 glasses/month, 1 glass/week, 2–4 glasses/week, 5–6 glasses/week, 1 glass/day, 2–3 glasses/day, 4–5 glasses/day, ≥6 glasses/day. The frequency response for tea consumption included nine categories as follows: never or less than 1 cup/month, 1–3 cups/month, 1–3 cups/week, 4–6 cups/week, 1 cup/day, 2–4 cups/day, 5–7 cups/day, 8–11 cups/day, ≥12 cups/day. Finally, we computed daily intake of all food items and then converted to grams per day using household measures. To examine nutrient intakes, we used Nutritionist IV software. Total caffeine intake was calculated based on caffeine from all foods and beverages.

Assessment of postpartum depression

The Edinburgh Postnatal Depression Scale (EPDS) was used for assessing postpartum depression. It is a 10-item self-report scale, with four response categories for each item, ranging from a score of 0 (no presence of the symptom) to 3 (marked presence or change). Total score of questionnaire is 0–30. Those with the score of 13 or more were considered as depressed. Sensitivity, specificity, and reliability of the questionnaire have earlier been reported.[15]

Assessment of other variables

Data on other variables, including age, education, occupation, type of delivery, the interval of the previous delivery, sex of the infant, birth order, physical activity, height and weight before pregnancy, were collected through the use of a pretested questionnaire. Body mass index was calculated by dividing the weight (kg) to the square of height (m).

Statistical analysis

We used SPSS version 18 (PASW Statistics for Windows, Chicago: SPSS, Inc.) for data analysis. Continuous variables are expressed as mean ± standard deviation. Student's *t*-test was used to determine statistical differences in continuous variables between the two groups and if distribution was not normal (skewed). The nonparametric Mann–Whitney *U*-test was used (except refined grain the others were not normally distributed).

Categorical variables were examined by the use of chi-square test. Participants were categorized based on quartiles of caffeine intake. We compared the demographic and other potential confounders in caffeine intake quartiles by one-way ANOVA test for variables with normal distribution (refined grain) and the Kruskal–Wallis test for variables with non-normal distribution (the other variables except refined grain). Also, categorical variables were compared by the use Chi-square test. To examine the association of caffeine intake with postpartum depression, we applied logistic regression in different models. First, we controlled for age (categorical), education (categorical), sex of the infant, dietary intake of meats (red meats and organ meats), whole grains, nuts, dairy, fish and poultry, hydrogenated fats, fruits, and vegetables. The amount of caffeine intake was adjusted with energy intake, using the regression residual method, and then divided into quartiles. All of the reported *p* values were two tailed, and *p* value of 0.05 was as a significance level.

Results

A total of 360 delivered women enrolled in the study. One subject did not complete the food frequency

questionnaire (FFQ) and one subject did not complete the Edinburgh Postnatal Depression Scale (EPDS). These two participants were excluded from the analysis. The EPDS score of 125 (34.8%) women were equal to 13 or more and considered as depressed subjects. Figure 1 illustrates the prevalence of postpartum depression in each quartile of caffeine intake. There were no statistically significant differences between demographic characteristics in the depressed and nondepressed subjects (p values were varied from 0.201 to 0.968). Data are presented in Table 1.

Demographic characteristics and dietary intakes of delivered depressed and non-depressed were illustrated in Table 1. Vegetable, fruit, nut, and red and organ meat consumption in depressed women was significantly lower than nondepressed women ($p<0.001$; $p<0.001$; $p=0.015$; $p=0.011$, respectively). Refined grain consumption in depressed women was significantly higher than nondepressed women ($p=0.037$). There were no significant differences in other dietary intake between depressed and nondepressed women.

Demographic characteristics and dietary intakes in caffeine intake quartiles were shown in Table 2. Based on the second quartile as a reference group, crude and adjusted odds ratios (ORs) and their 95% confidence intervals (95% CI) for age, education, sex of the infant, intake of meats (red meats and organ meats), whole grains, nuts, dairy, fish and poultry, hydrogenated fats, fruits, and vegetables are shown for postpartum depression across the categories of caffeine and tea intake in Table 3.

As shown in Table 3, in the crude model there was no significant association between caffeine intake and postpartum depression in any of the quartiles of caffeine intake ($p>0.05$). Also, there was no significant association between caffeine intake and postpartum depression in any of the quartiles of caffeine intake in model 1 (adjusted for age, education, sex of the infant). The result of fitting model 2 (adjusted for age, education, sex of the infant, intake of meats, grains, nuts, dairy, fish and poultry, hydrogenated fats, fruit, and vegetables) confirmed odds of postpartum depression in these who were exposed to

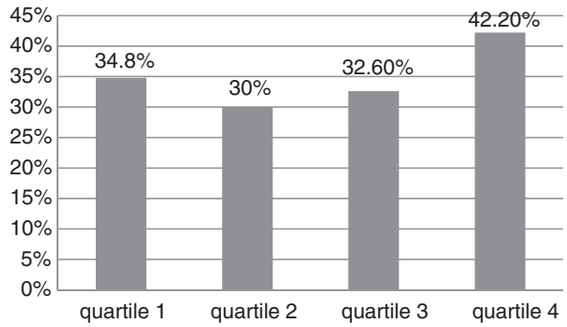

FIG. 1. Prevalence of postpartum depression in each quartile of caffeine intake.

Table 1. Demographic Characteristics and Dietary Intakes of Delivered Depressed and Nondepressed Women Based on EPDS

Variables	*Depressed,* N *(%)*	*Nondepressed,* N *(%)*	p
Age (year)			
≤19	11 (8.8)	15 (6.4)	0.715
20–24	38 (30.4)	61 (26.1)	
25–29	41 (32.8)	79 (33.8)	
30–34	22 (17.6)	48 (20.5)	
≥35	13 (10.4)	31 (13.2)	
Infant sex			
Girl	66 (52.8)	107 (45.7)	0.201
Boy	59 (47.2)	127 (54.3)	
Education			
To guidance school	33 (26.4)	77 (32.9)	0.335
High school	64 (51.2)	102 (34.6)	
Academic	28(22.4)	55 (23.5)	
Occupation			
Employee	10 (8)	19 (8.1)	0.968
Homemaker	115 (92)	215 (91.9)	
Type of delivery			
Vaginal	44 (35.2)	88 (37.6)	0.652
Cesarean	81 (64.8)	146 (62.4)	
Physical activity			
Never	11 (8.9)	20 (8.7)	0.860
Mild	40 (32.3)	72 (31.4)	
Moderate	63 (50.8)	112 (48.9)	
Severe	10 (8.1)	25 (10.9)	
Rating child			
First child	68 (54.4)	132 (56.4)	0.918
Second child	46 (36.8)	81 (34.6)	
More than two children	11 (8.8)	21 (9)	
BMI (kg/m^2)			
<25	50 (40)	99 (42.3)	0.889
25–30	49 (39.2)	86 (36.8)	
>30	26 (20.8)	49 (20.9)	
Interval between deliveries			
Mean ± SD	4.6 ± 3.1	4.2 ± 3.2	0.630
Energy (kcal/day)			
Mean ± SD	2828.3 ± 814	2993.8 ± 803.1	0.065
Red and organ meat (g)			
Mean ± SD	87.1 ± 53	108.1 ± 72.5	0.011
Fish and poultry (g)			
Mean ± SD	82.7 ± 65.2	94 ± 66.8	0.088
Dairy product (g)			
Mean ± SD	339.6 ± 271.5	405.6 ± 328.9	0.092
Vegetable (g)			
Mean ± SD	265.7 ± 85.6	298.9 ± 90.5	<0.001
Fruit (g)			
Mean ± SD	205 ± 179.7	305.8 ± 227.5	<0.001
Refined grain (g)			
Mean ± SD	673.5 ± 300.1	605.7 ± 289.1	0.037
Whole grain (g)			
Mean ± SD	1.3 ± 4.2	4.3 ± 15.9	0.074
Legume (g)			
Mean ± SD	65.9 ± 103.6	62.3 ± 45.5	0.313
Nut (g)			
Mean ± SD	6.4 ± 11.2	10.6 ± 21.0	0.015
Tea (g)			
Mean ± SD	332.9 ± 307.8	290.1 ± 261.5	0.333
Coffee (g)			
Mean ± SD	2.3 ± 6.5	4.6 ± 18.8	0.818
Soft drink (g)			
Mean ± SD	39.6 ± 73.2	34.2 ± 65.5	0.409
Caffeine (g)			
Mean ± SD	70.2 ± 62.5	62.3 ± 52.4	0.327

BMI, body mass index; EPDS, Edinburgh Postnatal Depression Scale; SD, standard deviation.

Table 2. Demographic Characteristics and Dietary Intakes in Caffeine Intake Quartiles (Comparing of Demographic and Dietary Intakes in Caffeine Intake Quartiles)

Variables	*Caffeine intake*				
	Quartile 1	*Quartile 2*	*Quartile 3*	*Quartile 4*	p
Age (year)					
≤19	8 (9.0)	5 (5.6)	4 (4.4)	9 (10.0)	
20–24	26 (29.2)	31 (34.4)	24 (26.7)	18 (20.0)	
25–29	33 (37.1)	24 (26.7)	32 (35.6)	31 (34.4)	0.084
30–34	9 (10.1)	20 (22.2)	15 (16.7)	25 (27.8)	
≥35	13 (14.6)	10 (11.1)	15 (16.7)	7 (7.8)	
Infant sex					
Girl	42 (47.2)	42 (46.7)	41 (45.6)	47 (52.2)	0.815
Boy	47 (52.8)	48 (53.3)	49 (54.4)	43 (47.8)	
Education					
Primary and secondary school	23 (25.8)	28 (31.1)	23 (25.6)	36 (40.0)	
High school	40 (44.9)	36 (40.0)	47 (52.2)	43 (47.8)	0.044
University	26 (29.2)	26 (28.9)	20 (22.2)	11 (12.2)	
Occupation					
Employee	9 (10.1)	10 (11.1)	7 (7.8)	3 (3.3)	0.226
Homemaker	80 (89.9)	80 (88.9)	83 (92.2)	87 (96.7)	
Type of delivery					
Vaginal	32 (36.0)	36 (40.0)	33 (36.7)	31 (34.4)	0.887
Cesarean	57 (64.0)	54 (60.0)	57 (63.3)	59 (65.6)	
Physical activity					
Never	7 (8.1)	11 (12.4)	6 (6.7)	8 (9.1)	
Mild	27 (31.4)	29 (32.6)	29 (32.2)	27 (30.7)	0.800
Moderate	41 (47.7)	41 (46.1)	44 (48.9)	48 (54.5)	
Severe	11 (12.8)	8 (9.0)	11 (12.2)	5 (5.7)	
Rating child					
First child	52 (58.4)	54 (60.0)	47 (52.2)	47 (52.2)	
Second child	30 (33.7)	28 (31.1)	36 (40.0)	32 (35.6)	0.788
More than two children	7 (7.9)	8 (8.9)	7 (7.8)	11 (12.2)	
BMI (kg/m^2)					
<25	41 (46.1)	36 (40.0)	40 (44.4)	31 (34.4)	
25–30	29 (32.6)	40 (44.4)	30 (33.3)	37 (41.1)	0.418
>30	19 (21.3)	14 (15.6)	20 (22.2)	22 (24.4)	
Interval between deliveries					
Mean ± SD	3.0 ± 4.4	2. 8 ± 3.8	3.6 ± 4.3	3.4 ± 4.2	
Energy (kcal/day)					
Mean ± SD	2802.7 ± 852.1	3207.7 ± 716.1	2854.6 ± 856.2	2873 ± 759.5	0.004
Red and organ meat (g)					
Mean ± SD	116.2 ± 65.9	105.0 ± 79. 8	90.3 ± 55.3	91.8 ± 62.9	0.017
Fish and Poultry (g)					
Mean ± SD	93.1 ± 58.8	97.3 ± 76. 6	80.9 ± 66.6	89.4 ± 62.1	0.257
Dairy product (g)					
Mean ± SD	414.7 ± 328.6	400.2 ± 285.1	357.5 ± 295.4	355.8 ± 336.2	0.169
Vegetable (g)					
Mean ± SD	290.6 ± 83.7	287.6 ± 90.6	284.8 ± 96.3	287 ± 90.4	0.850
Fruit (g)					
Mean ± SD	285.9 ± 210.3	269.6 ± 221.5	285.5 ± 221. 7	243.9 ± 215.5	0.230
Refined grain (g)					
Mean ± SD	507.8 ± 258.2	717.1 ± 282.1	657.5 ± 285.2	632.5 ± 314.9	<0.001
Whole grain (g)					
Mean ± SD	2.4 ± 5.3	5.9 ± 22.6	1.9 ± 6.2	2. 7 ± 10.6	0.370
Legume (g)					
Mean ± SD	64.5 ± 46.1	76.4 ± 117.7	55. ± 40.5	58.2 ± 50.5	0.128
Nut (g)					
Mean ± SD	12.1 ± 20.8	7.7 ± 12.0	7.6 ± 12. 8	9.6 ± 24.6	0.140
Tea (g)					
Mean ± SD	44.7 ± 105.1	178.7 ± 118.3	338.9 ± 40.5	654.7 ± 278.5	<0.001
Coffee (g)					
Mean ± SD	1.1 ± 4.4	4.3 ± 17.2	1.5 ± 4. 9	8.4 ± 24.9	0.005
Soft drink (g)					
Mean ± SD	12.9 ± 27.9	34.1 ± 65.3	27.1 ± 61.5	69.2 ± 90.2	<0.001

Table 3. Odds Ratio (95% CIs) of Clinical Postpartum Depression According to Caffeine Intake

	Quartile 1	*Quartile 2*	*Quartile 3*	*Quartile 4*
Caffeine				
Crude	1.2 (0.67–2.3)	1	1.1 (0.60–2.1)	1.7 (0.92–3.1)
Model 1	1.2 (0.65–2.3)	1	1.1 (0.61–2.2)	1.7 (0.95–3.3)
Model 2	1.8 (0.9–3.6)	1	1.2 (0.63–2.4)	***2.1 (1.1–4.1)***
Tea				
Crude	0.95 (0.51–1.8)	1	1.1 (0.58–2)	1.2 (0.65–2.2)
Model 1	0.92 (0.49–1.7)	1	1.1 (0.59–2)	1.3 (0.69–2.4)
Model 2	1.1 (0.59–2.2)	1	1.1 (0.6–2.1)	1.2 (0.63–2.3)

Model 1: adjusted with age, education, and sex of the infant.
Model 2: age, education, sex of the infant, intake of meat (red and organ meat), grains, nuts, dairy, fish and poultry, hydrogenated fats, fruits, and vegetables.
Significant p-values = 0.035 is shown in bold.
CI, confidence interval.

caffeine in quartile 4 was more than twofold than the reference category (OR = 2.1; 95% CI: 1.1–4.1; $p = 0.035$).

In the crude model, there was no significant association between tea intake and postpartum depression in any of the quartiles of tea intake ($p > 0.05$). There was no significant association between tea intake and postpartum depression in any of the quartiles of tea intake in model 1 and 2 ($p > 0.05$) (Table 3).

Discussion

Prevalence of postpartum depression was 34.8% in the present study. To our knowledge, this is the first study that investigated the associations between the intake of caffeine/tea and postpartum depression. Previous studies investigated the association between caffeine, coffee, or tea consumption and depressive symptoms in the general population.

Previous studies reported inconsistent findings on caffeine, coffee, or tea intake and depressive symptoms.[12,16–18] Two US cohort studies showed a lower risk of suicide due to depression with higher coffee consumption.[18,19] A longitudinal study on middle-aged men in Eastern Finland showed that only coffee consumption may decrease the risk of depression and no association was found between tea or caffeine intake and depression.[13] According to one large cohort study on 50,739 US women, depression risk decreased with increasing caffeinated coffee consumption.[12] Study on 3223 nonworking participants (mean age of 49.6 ± 21.9 years) showed that consumption of caffeine was associated with reduced risk of depression.[17] However, our results did not confirm the inverse association between caffeine/tea and postpartum depression. We founded no statistically significant relationship between tea consumption and postpartum depression. It might be an interesting point that based on our finding, there was a nonlinear association between caffeine intake and postpartum depression.

The possible protective effect of caffeine has been described with some mechanisms such as antagonist action of caffeine on the adenosine A2A receptor, role in the enhancing of dopaminergic transmission and modulation of nondopaminergic mechanisms, including the release of acetylcholine and serotonin. Reduced activity of dopaminergic system plays a central role in depression, and antidepressant drugs increase the dopaminergic activity.[20,21]

The present study has some limitations. The main limitation of our study is the cross-sectional design. Cross-sectional studies give less reliable information on the causal relationship than cohort design. Another possible limitation is probably the recall bias that could affect the result of study. We controlled several potential confounders; however, there may be other variables that could take a role as a confounder and we did not control them such as socioeconomic statues. In addition, the postpartum depressive status of participants was used based on their recorded medical files. The postpartum depression screener might to be another limitation of the study.

One of the strengths of this study was that dietary intake assessment was related to the time before delivery and incidence of postpartum depression, and intake of caffeine cannot be affected by postpartum depression. Another strength of this study was that the average consumption of foods was asked during the whole period of pregnancy and not related to a specific period, and thus the amount of caffeine intake and other foods less affected by fluctuations in appetite during pregnancy. In this study, many potential confounders (especially food items) were controlled.

Conclusion

In the present study, there was no significant association between tea or caffeine intake and postpartum depression in any of the quartiles of caffeine intake in the crude and adjusted models except for last quartile of caffeine in model 2. Further investigations are needed to determine whether caffeine consumption can contribute to postpartum depression.

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Authors' Contributions

All authors carried out the design. S.I. coordinated to complete the questionnaire and collected data. All authors participated in the preparation of the manuscript. S.I., M.H., and M.R.M. statistically analyzed the data. S.I. and M.R.M. participated in the writing of the manuscript. All authors have read and approved the content of the manuscript.

Author Disclosure Statement

No competing financial interests exist.

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