



Association Between Dietary Quality and Postpartum Depression in Lactating Women: A Cross-Sectional Survey in Urban China

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Background: Evidence on the effects of dietary quality on the risk of postpartum depression in the Chinese population is limited. This study aimed to examine the association between dietary quality and postpartum depression in Chinese lactating women.

Methods: A total of 939 participants from 10 cities were included in this analysis. A one-time 24-h dietary recall was used to obtain the data on food consumption and dietary quality was assessed based on Diet Balance Index. The Edinburgh postnatal depression scale was considered at a cutoff point of 10 to detect postpartum depression. Poisson regression models were used to explore the association of dietary quality with postpartum depression.

Results: Depressed women tended to have a more inadequate intake of vegetables and have more insufficient food variety. The median (25th, 75th) of the overall high bound score (HBS), low bound score (LBS), and diet quality distance (DQD) was 9 (5, 14), 30 (25, 37), and 40 (34, 47), respectively. Compared with subjects with the lowest quartile of LBS, those with the highest quartile of LBS had a higher risk of postpartum depression [adjusted prevalence ratio (aPR), 1.08; 95% confidence interval (95% CI), 1.01, 1.15; P for trend, 0.043]. We also observed a significant association between DQD and postpartum depression (Q4 vs. Q1: aPR, 1.07; 95% CI: 1.00, 1.14; P for trend, 0.036).

Conclusion: Poor dietary quality was associated with postpartum depression in Chinese lactating women.

Keywords: diet quality, postpartum depression, diet balance index, lactating women, Chinese dietary guidelines

INTRODUCTION

Postpartum depression is a widely recognized public health concern that has important implications for the health and well-being of many new mothers, their infants, and their families (1, 2). Depressive symptoms may include extreme sadness, fatigue, anxiety, crying, irritability, and changes in lifestyle habits (3). A meta-analysis has reported that pooled prevalence of postpartum depression was 14.8% and showed a significant increasing trend in the last decade

in Mainland China (4). There may be numerous mechanisms mediating the development of a typical pathophysiological signature associated with postpartum depression (5). Still, the etiology of postpartum depression has not been fully cleared. Even worse, some women may be unwilling to take pharmacological treatments, because they concern about the transmission of antidepressant medication to their infants if they are breastfeeding (6). Therefore, the efforts toward the identification of risk factors are crucial for both maternal and children's health and well-being.

Dietary quality may be a modifiable risk factor for depression because some nutritional factors may modulate the potential biological pathways related to mental disorders, such as inflammation, oxidative stress, the gut microbiome, epigenetic modifications, and neuroplasticity (7). A healthy dietary pattern, which was characterized by fruits, vegetables, whole grains, and fish, may decrease the risk of depression (8, 9). However, the associations of dietary quality with postpartum depression have primarily been explored in western countries (10–13), and results were inconsistent. Researches among Chinese lactating women are less. Despite the knowledge that lactating women require varied diets and increased nutrient intake, Chinese lactating women tend to be more prone to poor dietary quality, especially for the women in the puerperium. Chinese traditional beliefs about the importance of “*Yin-Yang* balance” affect the daily food practices of lactating women. Childbirth is believed to disturb the “*Yin-Yang* balance,” and different food characteristics (such as “hot” and “cold”) can alter the “*Yin-Yang* balance” in the body (14–16). Usually, the “cold” foods were related “*Yin*.” Therefore, lactating women should avoid “cold” foods to maintain body warmth and restore maternal “*Yin-Yang* balance.” For example, fresh fruits or vegetables, even seafood, are not highly recommended because most of these foods are considered to have “cold” properties. In addition, lactating women are encouraged to consume more certain foods, such as animal products, red sugar, even rice wine, because these foods have been traditionally regarded as beneficial to maternal health and breast milk quantity and quality. However, these dietary restrictions are not aligned with nutritional needs and may cause some common postpartum symptoms. For example, a decreased intake of fruit and vegetables and excessive sugar intake are associated with a high incidence of constipation, hemorrhoids, and oral problems (17).

The objective of the current study was to explore the potential associations between dietary quality and postpartum depression.

METHODS

Participants

The data were collected as part of the Young Investigation (YI Study), which was a cross-sectional survey on health and nutrition status of pregnant women, lactating women, young children aged 0–3 years from 2019 to 2020. Two first-tier cities (Beijing and Guangzhou), three new first-tier cities (Suzhou, Chengdu, and Shenyang), three second-tier cities (Ningbo, Lanzhou, and Nanchang), one third-tier city (Hohhot), and one fourth-tier city (Xuchang) were selected. One hospital or

one maternal and child health care center was selected in each city. The target was to recruit at least 90 lactating women in each city, and lactating women were conveniently recruited according to their visiting time until the number of participants satisfied the sample size. For lactating women, the inclusion criteria were healthy women in the first year postpartum, aged between 20 and 45 years, with singleton delivery, no smoking or alcohol abuse, without mastitis or any infectious diseases, and without cardiovascular or metabolic diseases. We excluded those participants with missing data or extreme outliers for key variables under the purpose of this report. Finally, 939 participants were enrolled in the current study.

Data Collection and Measures

The investigation was conducted using face-to-face interviews. All interviewers were subject to unified training before starting the investigation.

Postpartum depression was assessed by the Edinburgh Postnatal Depression Scale (EPDS). The EPDS included 10 items using 4-point response options ranging from 0 to 3 to capture symptoms in the previous seven days. The total score ranged from 0 to 30, with higher scores indicating greater severity of depression. The cutoff scores of ≥ 10 were used to classify non-depressed and depressed mothers, respectively, and the cutoff scores of ≥ 13 were used to further classify mildly depressed and moderate or severe depressed mothers, respectively, among the depressed mothers (18, 19).

A one-time 24-h dietary recall (24HDR) was used to obtain the data on food consumption over the previous 24 h to the investigation. With the help of trained interviewers, participants were asked to recall all food, beverages, and condiments consumed individually over the previous 24 h to the investigation. Standard-sized bowls, standard-sized teaspoons, and illustrated photos of food items were shown to help participants to assess quantities (20). Total energy intake was calculated based on the Chinese Food Composition Table coupled with the nutrition information packaging (21). In China, Diet Balance Index (DBI) was recommended to assess human diet quality. It can measure the dietary quality as a whole, and reflect not only insufficient dietary intake but also excessive dietary intake (22, 23). DBI was established based on the Chinese dietary guidelines. It was firstly released in 2005 and has been updated twice, with DBI_16 being the current measure (24–26). DBI_16 was based on current Chinese dietary guidelines and Food Guide Pagoda (2016), and has more specific energy assignment levels that comprehensively reflect the dietary quality of the population. DBI_16 could be minor adjusted to meet the needs of different populations based on specific dietary guidelines, and a previous study has proved that adjusted DBI was a reliable tool to measure the diet quality among lactating women (27). In this study, DBI comprised eight components, namely (range of values) (1) cereals (–12~12); (2) vegetables (–6~0), fruits (–6~0); (3) dairy (–6~0), soybean (–6~0); (4) animal foods (–4~4 for meat and poultry, –4~0 for fish and shrimp, –4~4 for eggs); (5) empty energy food (0~6 for cooking oil, 0~6 for alcohol); (6) salt (0~6); (7) food variety (–12~0); and (8) water (–12~0). A score of 0 for each component indicated that the recommended

intake had been met. The positive or negative scores indicated that recommended level was exceeded or not met, respectively. The specific calculating methods of each component are given in **Supplementary Table 1**. After calculating the scores of each component, high bound score (HBS), low bound score (LBS), and diet quality distance (DQD) were calculated. The HBS referred to the sum of all positive scores, indicating excessive food intake (range: 0~38). The LBS referred to the sum of the absolute values of all negative scores, indicating insufficient food intake (range: 0~72). DQD referred to the sum of the absolute values of both positive and negative scores, indicating imbalanced food intake (range: 0~90). The larger values for HBS, LBS, and DQD indicate more inferior diet quality. HBS, LBS, and DQD were further divided into four levels (excellent or good, mild poor, moderately poor, and severe poor) according to 0~40%, 40~60%, 60~80%, and 80~100% of total scores, respectively.

Essential characteristics of the lactating women were collected, including age, education, family monthly per capita income

(Chinese yuan), puerperium (within 6 weeks after delivery) or not, and primiparas or not. Weight and height were measured on the day of investigation, and body mass index (BMI) was coded into three categories: underweight or normal ($BMI < 24 \text{ kg/m}^2$), overweight ($24 \leq BMI < 28 \text{ kg/m}^2$), and obese ($BMI \geq 28 \text{ kg/m}^2$) (28). Based on the short version of the International Physical Activity Questionnaire (IPAQ), metabolic equivalent of energy (MET) hours per week were calculated, and the physical activity of participants was equally divided into three groups: Low, medium, and High (29). The status of husband or partner, and parent support were self-reported by lactating women (rarely, sometimes, or always).

Statistical Analyses

The statistical analysis was performed by and SPSS 26.0. All non-normally distributed continuous variables are presented as median (25th, 75th). All categorical variables are presented as percentages. First, chi-square tests were performed to compare

TABLE 1 | Characteristics of lactating women by depression status.

Variables		Total	Non-depression	Mild depression	Moderate or severe depression	P ^a
N	–	939	621	166	152	–
Age (years)	≤30	472 (50.3)	290 (46.7)	87 (52.4)	95 (62.5)	0.002
	>30	467 (49.7)	331 (53.3)	79 (47.6)	57 (37.5)	–
College or university	No	235 (25.0)	153 (24.6)	33 (19.9)	49 (32.2)	0.037
	Yes	704 (75.0)	468 (75.4)	133 (80.1)	103 (67.8)	–
Family monthly per capita income (Chinese yuan)	<5,000	424 (45.2)	277 (44.6)	73 (44.0)	74 (48.7)	0.680
	5,000–9,999	349 (37.2)	239 (38.5)	60 (36.1)	50 (32.9)	–
	≥10,000	166 (17.7)	105 (16.9)	33 (19.9)	28 (18.4)	–
Puerperium	Yes	202 (21.5)	143 (23.0)	33 (19.9)	26 (17.1)	0.240
	No	737 (78.5)	478 (77.0)	133 (80.1)	126 (82.9)	–
Primiparas	Yes	620 (66.0)	391 (63.0)	113 (68.1)	116 (76.3)	0.006
	No	319 (34.0)	230 (37.0)	53 (31.9)	36 (23.7)	–
BMI	Underweight or normal weight	593 (63.2)	390 (62.8)	108 (65.1)	95 (62.5)	0.946
	Overweight	264 (28.1)	174 (28.0)	46 (27.7)	44 (28.9)	–
	Obese	82 (8.7)	57 (9.2)	12 (7.2)	13 (8.6)	–
Physical activity	Low	343 (36.5)	226 (36.4)	60 (36.1)	57 (37.5)	0.978
	Medium	298 (31.7)	201 (32.4)	51 (30.7)	46 (30.3)	–
	High	298 (31.7)	194 (31.2)	55 (33.1)	49 (32.2)	–
Husband or partner support	Rarely	53 (5.6)	33 (5.3)	12 (7.2)	8 (5.3)	0.003
	Sometimes	211 (22.5)	119 (19.2)	54 (32.5)	38 (25.0)	–
	Always	675 (71.9)	469 (75.5)	100 (60.2)	106 (69.7)	–
Parent support	Rarely	61 (6.5)	35 (5.6)	16 (9.6)	10 (6.6)	0.066
	Sometimes	189 (20.1)	114 (18.4)	42 (25.3)	33 (21.7)	–
	Always	689 (73.4)	472 (76.0)	108 (65.1)	109 (71.7)	–
Cities	First-tier	187 (19.9)	122 (19.6)	36 (21.7)	29 (19.1)	0.697
	New first-tier	277 (29.5)	194 (31.2)	44 (26.5)	39 (25.7)	–
	Second-tier	283 (30.1)	184 (29.6)	48 (28.9)	51 (33.6)	–
	Third or fourth-tier	192 (20.4)	121 (19.5)	38 (22.9)	33 (21.7)	–
Regions	South	467 (49.7)	300 (48.3)	88 (53.0)	79 (52.0)	0.467
	North	472 (50.3)	321 (51.7)	78 (47.0)	73 (48.0)	–

^aChi-square test.

the characteristics of lactating women by depression status. Second, Mann-Whitney U or Kruskal-Wallis H tests were performed to compare the HBS, LBS, and DQD by different characteristics of lactating women. Third, Spearman correlation analyses were performed to explore the associations of total scores of EPDS with HBS, LBS, and DQD. Mann-Whitney U tests were performed to compare each food component, HBS, LBS and DQD of lactating women by depression status. Fourth, poisson regression models were performed to explore the associations of HBS, LBS, and DQD with postpartum depression, and prevalence ratios (PRs) and their respective 95% confidence intervals (95% CIs) were estimated.

RESULTS

As shown in **Table 1**, the overall proportion of postpartum depression was 33.9%, which was comprised of mild depression (17.7%) and moderate or severe depression (16.2%). Depressed women tended to be younger, less educated, primiparas, and with less husband or partner support.

Overall the proportion of participants meeting the recommended dietary intakes (score = 0) was ranged from 0.0 to 98.9%, with 0.0% for food variety, 7.8% for meat and poultry, 7.9% for dairy, 9.8% for eggs, 10.6% for vegetables, 11.0% for cereals, 18.6% for fish and shrimp, 26.0% for fruits, 28.4% for soybean, 31.1% for salt, 51.2% for water, 59.1% for cooking oil, and 98.9% for alcohol. As shown in **Figure 1**, the insufficient food intake of vegetables, fruits, dairy, soybean, and fish and shrimp were common. The median score of food variety was only -5.

The median (25th, 75th) of overall HBS, LBS, and DQD was 9 (5, 14), 30 (25, 37), and 40 (34, 47), respectively. The sum of the proportions of HBS, LBS, and DQD in the poor level was as high as 53.7, 97.3, and 99.7%, respectively (**Figure 2**). As shown in **Table 2**, lactating women aged ≤ 30 , with lower education level and family income tended to have higher LBS, and lactating women with lower education level and family income tended to have higher DQD.

As shown in **Figure 3**, depressed women tended to have a more inadequate intake of vegetables and have more insufficient

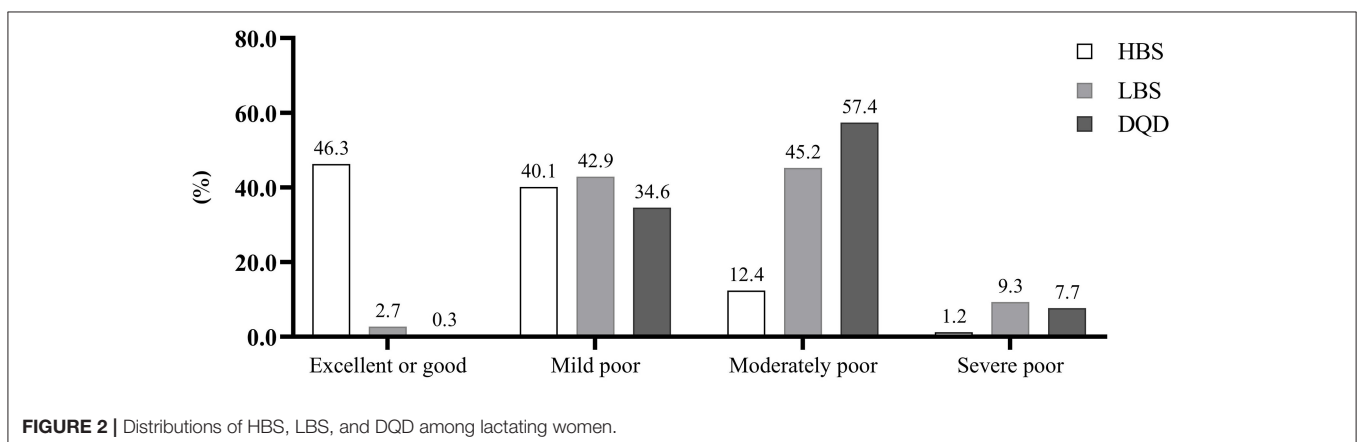
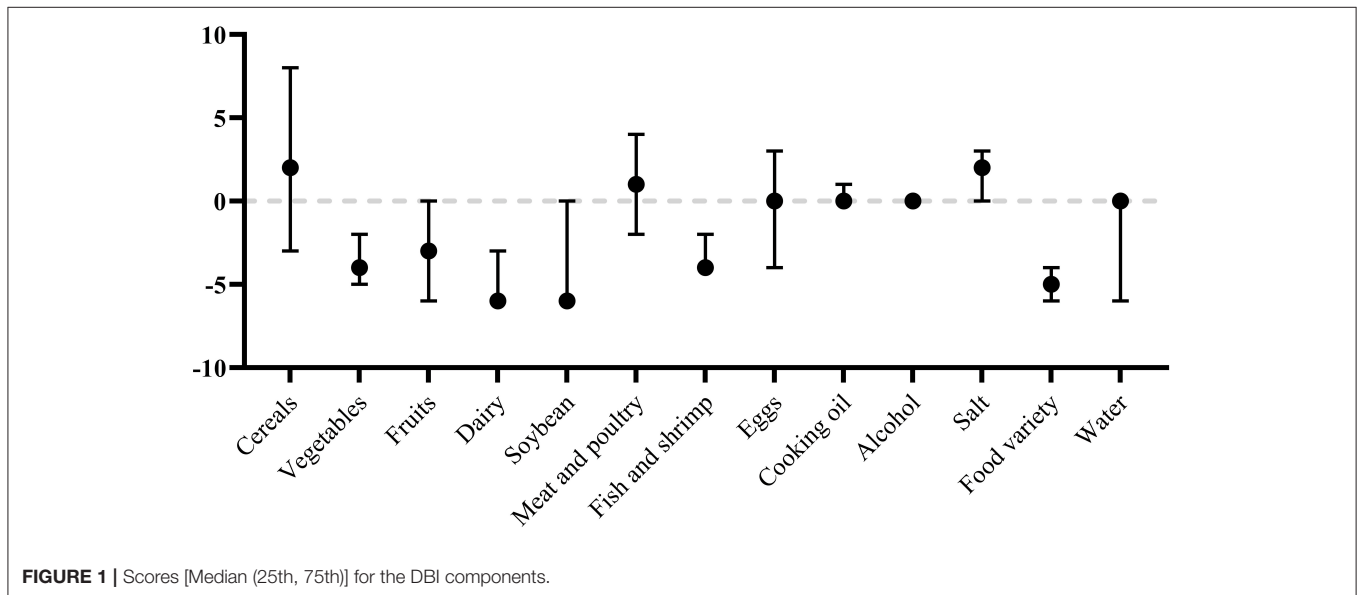


TABLE 2 | Comparison of HBS, LBS, and DQD [Median (25th, 75th)] by different characteristics of lactating women.

Variables		HBS	<i>P</i> ^a	LBS	<i>P</i> ^a	DQD	<i>P</i> ^a
		Median (25th, 75th)		Median (25th, 75th)		Median (25th, 75th)	
Age (years)	≤30	9 (5, 14)	0.124	32 (25, 38)	0.023	41 (34, 48)	0.288
	>30	9 (6, 14)	–	30 (24, 35)	–	40 (34, 47)	–
College or university	No	9 (6, 14)	0.961	32 (27, 38)	0.001	43 (37, 49)	< 0.001
	Yes	9 (5, 14)	–	30 (24, 36)	–	40 (34, 47)	–
Family monthly per capita income (Chinese yuan)	<5,000	9 (5, 14)	0.819	32 (25, 38)	0.007	42 (35, 49)	0.005
	5,000–9,999	9 (6, 14)	–	30 (24, 35)	–	40 (34, 46)	–
	≥10,000	9 (5, 15)	–	30 (23, 37)	–	40 (33, 46)	–
Puerperium	Yes	9 (5, 14)	0.456	31 (24, 36)	0.861	40 (34, 47)	0.713
	No	9 (5, 14)	–	30 (25, 37)	–	41 (34, 47)	–
Primiparas	Yes	9 (5, 14)	0.947	31 (24, 37)	0.349	41 (34, 48)	0.320
	No	9 (6, 14)	–	30 (25, 36)	–	40 (34, 46)	–
BMI	Underweight or normal weight	9 (6, 14)	0.612	30 (24, 37)	0.892	41 (34, 48)	0.986
	Overweight	9 (5, 13)	–	31 (25, 36)	–	40 (35, 47)	–
	Obese	9 (6, 13)	–	31 (23, 37)	–	40 (34, 47)	–
Physical activity	Low	9 (6, 15)	0.036	31 (25, 37)	0.813	42 (35, 48)	0.069
	Medium	9 (5, 12)	–	30 (24, 37)	–	40 (33, 46)	–
	High	9 (6, 14)	–	31 (24, 37)	–	40 (34, 48)	–
Husband or partner support	Rarely	9 (5, 14)	0.734	32 (26, 35)	0.299	41 (34, 47)	0.741
	Sometimes	9 (6, 14)	–	31 (26, 38)	–	41 (35, 47)	–
	Always	9 (5, 14)	–	30 (24, 37)	–	40 (34, 48)	–
Parent support	Rarely	9 (5, 14)	0.444	32 (26, 38)	0.353	41 (35, 48)	0.359
	Sometimes	9 (6, 14)	–	31 (25, 37)	–	42 (35, 48)	–
	Always	9 (5, 14)	–	30 (24, 36)	–	40 (34, 47)	–
Cities	First-tier	8 (5, 12)	< 0.001	30 (24, 37)	0.065	39 (33, 46)	0.142
	New first-tier	9 (5, 14)	–	32 (25, 38)	–	42 (34, 48)	–
	Second-tier	10 (7, 15)	–	30 (24, 35)	–	40 (34, 47)	–
	Third or fourth-tier	9 (6, 13)	–	30 (24, 37)	–	40 (34, 46)	–
Regions	South	9 (5, 15)	0.089	30 (25, 36)	0.329	41 (34, 47)	0.730
	North	9 (5, 13)	–	31 (25, 37)	–	40 (34, 48)	–

^aMann-Whitney *U* or Kruskal-Wallis *H*-test.

food variety. However, depressed mothers tended to have a slightly more moderate intake of eggs. The correlations of total scores of EPDS with HBS, LBS, and DQD were -0.007 ($P = 0.939$), 0.064 ($P = 0.048$), and 0.065 ($P = 0.047$), respectively. As shown in **Table 3**, depressed women tended to have higher LBS and DQD.

As shown in **Table 4**, a significant association was observed between LBS and postpartum depression; in addition, a significant association was observed between DQD and postpartum depression.

DISCUSSION

To our knowledge, it is the first study to assess the association of dietary quality and postpartum depression of Chinese lactating women in the first year postpartum based on the DBI. We

found that nearly one-third of Chinese lactating women in the first year postpartum suffered from depressive symptoms. Those with younger age, lower education, being primiparous, and with less support from husband or partner were more vulnerable. The dietary quality of lactating women was poor, the intake of vegetables, fruits, dairy, soybean, and fish and shrimp was insufficient, and the food variety was very limited. Depressed women had less vegetable intake and had more insufficient food variety. An imbalanced diet was associated with an increased risk of postpartum depression.

Postpartum depression is a mood disorder associated with childbirth, usually develops between a week and a month after delivery. Puerperium is considered as a period of the high prevalence of mental disorder illnesses in women (30), but in this study, no significant difference was observed between women in puerperium and after puerperium. Postpartum

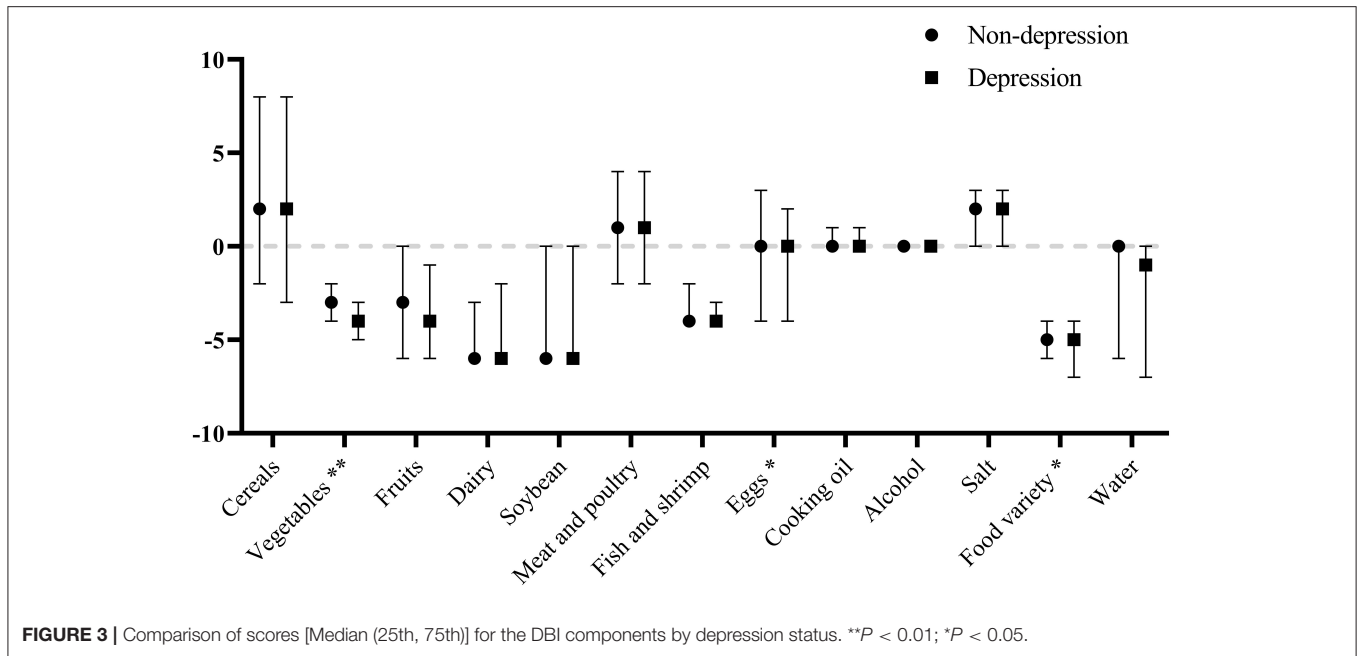


FIGURE 3 | Comparison of scores [Median (25th, 75th)] for the DBI components by depression status. ** $P < 0.01$; * $P < 0.05$.

TABLE 3 | Comparison of HBS, LBS, and DQD [Median (25th, 75th)] by depression status.

	Non-depression	Depression	P^a
HBS	9 (5, 14)	9 (5, 14)	0.323
LBS	30 (24, 36)	31 (26, 39)	0.010
DQD	40 (34, 47)	42 (35, 49)	0.025

^aMann-Whitney U-test.

depression can be spontaneously alleviated within 3–6 months, but some depressed mothers still have symptoms at 1 year, with increased negative effects on both maternal and children’s health and well-being (31). Some researchers suggest the assessment period of postpartum depression should be extended to 12 months postpartum (32). Further, although the National Health Commission (NHC) of China has planned that introducing screening for depression during pregnancy and childbirth to routine antenatal care and postpartum visits, one study has found that the majority of symptom-positive women during the perinatal period do not accept a subsequent referral to mental health services (33). Depressed lactating women who are recommended to take an antidepressant may concern that the drugs have a possible effect on their infants via breast milk (34). Therefore, understanding the associations between dietary quality and postpartum depression may have some certain meanings.

We found younger mothers tended to have a higher risk of postpartum depression, which was in line with previous researches (35, 36). One possible reason was that younger mothers might not be fully prepared for the new maternal role. However, the associations of maternal age and risk of

TABLE 4 | Poisson regression analysis of associations of diet quality and postpartum depression.

	PR (95%CI) ^a	P	P for trend
HBS			
Q1	1.00 (Ref.)	–	0.666
Q2	0.99 (0.93, 1.05)	0.666	–
Q3	0.99 (0.93, 1.06)	0.824	–
Q4	0.98 (0.92, 1.05)	0.604	–
LBS			
Q1	1.00 (Ref.)	–	0.043
Q2	1.05 (0.98, 1.12)	0.154	–
Q3	1.02 (0.96, 1.08)	0.631	–
Q4	1.08 (1.01, 1.15)	0.016	–
DQD			
Q1	1.00 (Ref.)	–	0.036
Q2	0.99 (0.93, 1.06)	0.805	–
Q3	1.00 (0.94, 1.07)	0.956	–
Q4	1.07 (1.00, 1.14)	0.040	–

^aAdjusted for maternal age, education, primiparas, and husband or partner support.

depression were still inconclusive. A study has reported that women of advanced maternal age have significantly higher rates of depression than younger women (37). Another study has reported that women’s risk for depression increases with age, and age 30 is a critical point (38). Considering the inconsistencies in the existing studies, there is a need for further longitudinal and qualitative studies to understand the associations between maternal age and postpartum depression. We also found less educated women had a higher proportion of postpartum depression, consistent with many studies (39,

40). Further, primiparas had a higher proportion of postpartum depression. Being a first-time mother was a huge challenge, and it is difficult for primiparas to adapt to their new role (41, 42). Lack of husband or partner support was a strong risk factor on postpartum depression (43, 44), and we also observed similar results.

We did not observe the associations between family monthly per capita income and postpartum depression, inconsistent with previous studies (45, 46). One of the possible explanations is that the data were based on an investigation in urban areas, and the surveyed women have a relatively higher economic level. Future studies could include women from different socioeconomic backgrounds to better understand the associations between family income and postpartum depression among Chinese lactating women. We also did not observe the associations between BMI and postpartum depression. Several biological mechanisms have been hypothesized underlying the association between weight and mental health, such as inflammation, the dysregulation of the hypothalamus-pituitary-adrenal axis, and metabolic changes (47), but the association between BMI and postpartum depression are mixed in previous studies (48, 49). Since the lactation period is one of substantial weight change and retention for women, the weight information provided by single-point measurement would be limited to some extent, especially for women who had just given birth. Future studies could include information about dynamic changes in body weight during postpartum to understand the associations between BMI and postpartum depression. Although we did not observe the associations between physical activity and postpartum depression, the benefits of physical activity during the postpartum period to postpartum depression have been proved in many types of research, consistent with those for depression among the general population (50, 51). Mental and physical health are interdependent, and activities which are started after prior consultation with a specialist and proper instruction are recommended (51).

We found depressed women had less vegetable consumption. Higher vegetable consumption, particularly yellow/orange/red and leafy green vegetables, may help to lower depressive symptoms (52, 53), and the possible explanation is certain nutrients found in vegetables, such as vitamins, phytochemicals, minerals, fiber, and amino acids (52). We also found depressed women had more insufficient food variety. Based on our data, a decreased food variety was associated with lower consumption of vegetables, fruit, dairy, and fish and shrimp. All these foods provide our bodies with essential nutrients, such as vitamins, phytochemicals, polyunsaturated fatty acids, and proteins. One study has reported that with an increase in food diversity, the dietary pattern of the individuals could become more similar to the Mediterranean dietary pattern (54), which is inversely associated with many mental health problems, including depression, anxiety, and psychological distress (55). Further, higher LBS and DQD were associated with an increased risk of postpartum depression. Based on DBI calculating method, a score of 0 is in full compliance with the dietary guidelines, and the farther the score is from 0, the lower the quality of

the diet. Higher LBS and DQD indicated more insufficient intake and a more imbalanced diet. The negative association between adherence to dietary guidelines and mental disorders has been reported among Western countries (56, 57). This study added related evidence in China, where lifestyle components of lactating women are significantly different from those in Western countries. This favorable association of poor diet quality with postpartum depression may have been attributed to some components of DBI, including vegetables, fruit, dairy, and fish and shrimp, and the cumulatively diverse neuropsychological effects of all diets. One study has reported the inverse association of Alternative Healthy Eating Index (AHEI) with depression and suggested this inverse association has been generated by the cumulative effects of all components of AHEI rather than an individual nutrient or food group (58). The anti-depression effect of nutrients is cumulative, and a balanced diet includes multiple components and complex interactions between dietary components and nutrients and their synergistic effects (56, 59). Our results highlighted the importance of maintaining the proper dietary balance on the decreased risk of postpartum depression.

Although the current study improves a broader understanding of dietary quality and postpartum depression, several limitations should be considered. First, because the analyses were carried out using cross-sectional data, no causal interpretations can be made. Notably, there may be a bidirectional association in that depressive symptoms and diet quality could be dependent upon one another. More prospective and longitudinal studies are needed. Second, a note of caution was due regarding the extrapolation of our results, in that it was a convenience sample in urban areas of China. Future studies with more representative samples are needed to confirm our results. Third, the DBI score was calculated using a single 24-h recall, which may not reflect usual dietary intake (60). In addition, recall bias cannot be excluded. In our fieldwork, we used a simple semi-quantitative food frequency questionnaire (SFFQ) to obtain participants' average daily food consumption in the past month at the same time. We calculated Spearman's correlation coefficient between 24HDR-derived and SFFQ-derived food groups, and all *P*-values were <0.01. The correlation coefficient between 24HDR-derived and SFFQ-derived data may help demonstrate the interrelations between various food groups assessed by different dietary assessment tools. Future studies should further explore and optimize the dietary assessments to obtain more adequate habitual food consumption data (61, 62). Fourth, information on some variables, such as marital satisfaction, domestic violence, depression history, and other mental disorders, were not available for our study. Although we have adjusted for a series of potentially confounding covariates, we cannot rule out the possibility of residual confounding.

CONCLUSION

In our studied population, nearly one-third of lactating women in the first year postpartum suffered from depressive symptoms.

Depressed women had less vegetable intake and had more insufficient food variety. An imbalanced diet was associated with an increased risk of postpartum depression.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Medical Ethics Research Board of Peking University (NO. IRB00001052-19045). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AZ, IS, PW, and YZ: conceptualization. CY, ZR, and JZ: formal analysis. CY, AZ, HL, ZR, and JZ: investigation and methodology.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fnut.2021.705353/full#supplementary-material>

Supplementary Table 1 | The DBI calculating methods in this study.

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The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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