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Milk intake during pregnancy is inversely associated with the risk of postpartum depressive symptoms in Japan: the Kyushu Okinawa Maternal and Child Health Study

Yoshihiro Miyake[a,b,*], *Keiko Tanaka*[a,b], *Hitomi Okubo*[c], *Satoshi Sasaki*[d], *Shinya Furukawa*[a,b], *Masashi Arakawa*[e]

[a] *Department of Epidemiology and Preventive Medicine, Ehime University Graduate School of Medicine, Ehime, Japan*
[b] *Epidemiology and Medical Statistics Unit, Translational Research Center, Ehime University Hospital, Ehime, Japan*
[c] *Department of Health Promotion, National Institute of Public Health, Saitama, Japan*
[d] *Department of Social and Preventive Epidemiology, Graduate School of Medicine, The University of Tokyo, Tokyo, Japan*
[e] *Health Tourism Research Fields, Graduate School of Tourism Sciences, University of the Ryukyus, Okinawa, Japan*

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ABSTRACT

Only one epidemiologic study has investigated the association between dairy product intake during pregnancy and postpartum depressive symptoms. Epidemiologic evidence on the relationships between calcium and vitamin D intake during pregnancy and postpartum depressive symptoms is also lacking. The present prospective study examined these issues in Japan. Study subjects were 1319 women. During pregnancy, dietary intake during the preceding month was assessed using a self-administered diet history questionnaire in the baseline survey. Postpartum depressive symptoms were defined as present when subjects had an Edinburgh Postnatal Depression Scale score of 9 or higher between 3 and 4 months postpartum. Adjustment was made for age, gestation at baseline, region of residence, number of children, family structure, history of depression, family history of depression, job type, education, body mass index, having smoked during pregnancy, cesarean delivery, baby's sex, baby's birth weight, and total energy intake. After adjustment for the confounding factors, compared with milk intake in the lowest quartile, intake levels in the second and fourth quartiles were independently associated with a reduced risk of postpartum depressive symptoms, although the inverse exposure-response relationship was not significant: the adjusted odds ratio between extreme quartiles was 0.51 (95% confidence interval, 0.28-0.93; *P* for trend = .12). No material relationships were observed between intake of total dairy products, yogurt, cheese, calcium, or vitamin D and the risk of postpartum depressive symptoms. The present prospective cohort study in Japan suggests that higher milk intake during pregnancy is associated with a reduced risk of postpartum depressive symptoms.

Abbreviations: CES-D, Center for Epidemiologic Studies Depression Scale; CI, confidence interval; DHQ, diet history questionnaire; EPDS, Edinburgh Postnatal Depression Scale; KOMCHS, Kyushu Okinawa Maternal and Child Health Study; OR, odds ratio.

* *Corresponding author at:* Department of Epidemiology and Preventive Medicine, Ehime University Graduate School of Medicine, Ehime 791-0295, Japan. Tel.: +81 89 960 5281; fax: +81 89 960 5284.
E-mail address: miyake.yoshihiro.ls@ehime-u.ac.jp (Y. Miyake).

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1. Introduction

Epidemiologic investigations on the relationship between dietary factors and depressive symptoms have been a focus of constant attention in recent years [1]. Nevertheless, only one epidemiologic study has previously investigated the association between dairy product intake during pregnancy and postpartum depressive symptoms, showing no significant association in a prebirth cohort study in Japan [2]. To our knowledge, there have been no epidemiologic studies regarding the relationship between intake of calcium or vitamin D and postpartum depressive symptoms. In our previous studies [3,4], higher intake levels of yogurt, calcium, and vitamin D, but not total dairy products, milk, or cheese, were significantly associated with a lower prevalence of depressive symptoms during pregnancy, defined as a score of 16 or higher on the Center for Epidemiologic Studies Depression Scale (CES-D), in this population. The objective of the present prospective cohort study was to examine the relationships between dietary intake of dairy products, calcium, and vitamin D during pregnancy and the risk of postpartum depressive symptoms using data from the Kyushu Okinawa Maternal and Child Health Study (KOMCHS). We hypothesized that higher intake of dairy products, calcium, and vitamin D during pregnancy would be related to a reduced risk of postpartum depressive symptoms.

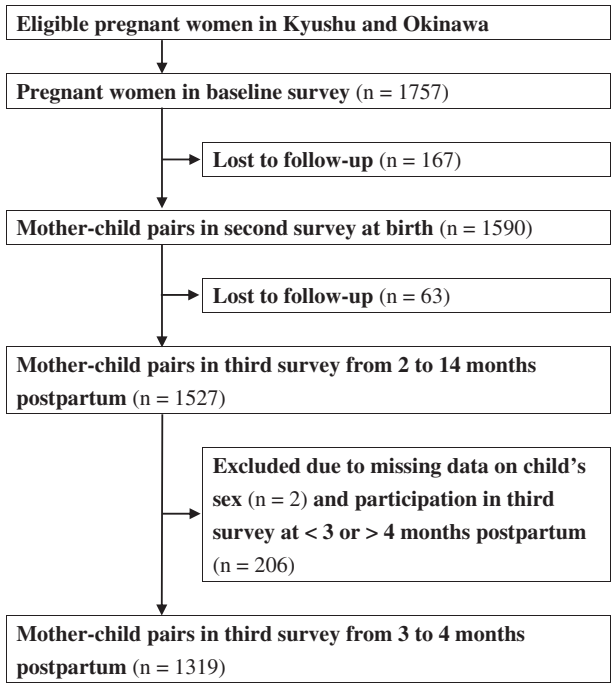

Figure – Eligibility for and participation in the KOMCHS.

2. Methods and materials

2.1. *Study population*

The KOMCHS is an ongoing prospective prebirth cohort study performed to identify risk and preventive factors for maternal and child health problems. Details of the baseline survey of the KOMCHS have been described elsewhere [5]. Eligible pregnant women were those who lived in 1 of 7 prefectures on Kyushu Island in southern Japan, with a total population of approximately 13.26 million, or in Okinawa Prefecture, an island chain in the southwest of Japan, with a total population of nearly 1.37 million. Between April 2007 and March 2008, we requested that 423 obstetric hospitals in the abovementioned 8 prefectures provide as many pregnant women as possible with a set of leaflets explaining the KOMCHS, an application form to participate in the KOMCHS, and a self-addressed and stamped return envelope. Pregnant women who were willing to participate in the KOMCHS returned the application form containing a written description of their personal information to the data management center. Based on this personal information, research technicians gave each participant a detailed explanation of the KOMCHS by telephone and sent them a self-administered questionnaire after obtaining their agreement. In total, 1757 pregnant women between the 5th and 39th weeks of pregnancy gave their written informed consent to participate in the KOMCHS and completed the baseline survey. Of the 1757 women, 1590 (90.5%) and 1527 (86.9%) mother-child pairs participated in the second (after delivery) and third (around 4 months postpartum) surveys, respectively (Figure). After excluding 2 pairs with missing data on the child's sex and 206 pairs who participated in the third survey at <3 or >4 months postpartum, the final analysis sample consisted of 1319 women who took part in the third survey between 3 and 4 months postpartum. The KOMCHS was approved by the ethics committees of the Faculty of Medicine, Fukuoka University, and Ehime University Graduate School of Medicine.

2.2. *Measurements*

Each survey consisted of a self-administered questionnaire. Participants filled out the questionnaires and then mailed them to the data management center at the time of each survey. Research technicians completed missing or illogical data by telephone interview.

In the first part of the questionnaire at baseline during pregnancy, we obtained information on maternal age, gestation, region of residence, number of children, family structure, personal history of doctor-diagnosed depression, family history of depression, employment status, and educational level. A family history of depression was considered to be present if one or more parents or siblings of the study subjects had been diagnosed as having depression by a physician. Women were classified as being unemployed if they were unemployed both in the year the baseline survey was performed and in the preceding year.

The second part of the questionnaire at baseline was a semiquantitative, comprehensive diet history questionnaire (DHQ) that assessed dietary habits during the preceding month [6–12]. Estimates of daily intake for 150 food and beverage items as well as for energy, nutrients, and alcohol were calculated using an ad hoc computer algorithm for the DHQ, which was based on the Standard Tables of Food and Composition in Japan [13]. *Total dairy product intake* was defined as the sum of full-fat milk, low-fat milk, yogurt, cheese, and cottage cheese intake.

Milk intake was defined as the sum of full-fat milk and low-fat milk. *Cheese intake* was defined as the sum of cheese and cottage cheese intake. For each of the 5 food items, the subjects were asked to report their average consumption frequency from among 8 categories ranging from "two or more times per day" to "less than once a month" and their relative portion size consumed in comparison with a standard portion size from among 5 categories: "50% smaller or less," "20%-30% smaller," "same," "20%-30% larger," and "50% larger or more" [6]. Because only a small number of subjects (5.9%) used supplemental calcium on a weekly or more frequent basis, information on the supplement was not incorporated into the analysis. In a validation study of 92 Japanese women, Pearson correlation coefficients between the DHQ and 16-day weighed dietary records were 0.56 for calcium and 0.54 for vitamin D [9]. Body weight and height were self-reported as part of the DHQ. Body mass index was calculated as weight (in kilograms) divided by the square of height (in meters).

A questionnaire in the second survey elicited information on the baby's sex, birth weight, and date of birth, and maternal smoking during pregnancy. A questionnaire in the third survey included the Japanese version of the Edinburgh Postnatal Depression Scale (EPDS). The EPDS is a 10-item self-reported scale, specially designed to screen for postpartum depressive symptoms in community samples [14]. Each item includes 4 response options (scaled 0-3), and the total score ranges from 0 to 30, with higher scores indicating higher levels of depressive symptoms. The scale rates the intensity of depressive symptoms present within the previous 7 days. Although Cox et al [14] proposed a cutoff level of 10 when the test is used for screening purposes in the postpartum period, a cutoff score with a threshold of 8/9 has been shown to have a specificity of 93% and a sensitivity of 75% for depression among Japanese women [15]. Thus, in the current study, we defined postpartum depressive symptoms as present when a subject had an EPDS score of 9 or higher.

2.3. *Statistical analyses*

Study subjects were divided into quartiles according to their dietary intake levels under study. Age, gestation at baseline, region of residence, number of children, family structure, history of depression, family history of depression, job type, education, body mass index, having smoked during pregnancy, cesarean delivery, baby's sex, baby's birth weight, and total energy intake were selected a priori as potential confounding factors. Age, gestation, body mass index, baby's birth weight, and total energy intake were used as continuous variables.

Crude odds ratios (ORs) and 95% confidence intervals (CIs) for postpartum depressive symptoms for each quartile of each of the dietary factors under study were calculated using logistic regression analysis, and the lowest quartile was used as the reference. Multiple logistic regression analysis was used to adjust for potential confounding factors. Tests for a linear trend were performed by means of a logistic regression model assigning consecutive integers (1-4) to the quartiles of the dietary factors. All statistical analyses were performed using the SAS software package version 9.4 (SAS Institute, Inc, Cary, NC, USA).

3. Results

Among the 1319 women who participated in the third survey at 3 to 4 months postpartum, the risk of postpartum depressive symptoms was 8.2%. The median age of the 1319 women at baseline was 32.0 years (interquartile range [IQR], 28.0-34.0 years; Table 1). A personal history of depression and a family history of depression were reported by 4.5% and 10.1% of the subjects, respectively. Median daily consumption of total energy, total dairy products, and milk during pregnancy was 7137.9 kJ (IQR, 6083.5-8493.5 kJ), 118.0 g (IQR, 45.0-198.9 g), and 67.0 g (IQR, 12.5-150.0 g), respectively. Intake levels of total dairy products and milk were positively associated with gestation at baseline and intake of total energy, dairy products under study, calcium, and vitamin D, and inversely associated with baby's birth weight. Total dairy product intake was positively associated with age and inversely associated with number of children and having smoked during pregnancy. Milk intake was positively associated with body mass index.

Table 2 presents crude and adjusted ORs and 95% CIs for postpartum depressive symptoms by quartiles of intake of dairy products, calcium, and vitamin D during pregnancy. Compared with milk intake in the lowest quartile, intake in the second quartile was significantly associated with a reduced risk of postpartum depressive symptoms. After adjustment for confounding factors under study, the inverse association was slightly strengthened; intake levels in both the second and fourth quartiles were independently related to a reduced risk of postpartum depressive symptoms, although the inverse linear trend was not significant: the adjusted OR between extreme quartiles was 0.51 (95% CI, 0.28-0.93; P for trend = .12). No material relationships were observed between intake of total dairy products, yogurt, cheese, calcium, or vitamin D and the risk of postpartum depressive symptoms.

4. Discussion

The current study showed that higher milk intake during pregnancy was independently associated with a decreased risk of postpartum depressive symptoms. No evident relationships were found between intake of total dairy products, yogurt, cheese, calcium, or vitamin D and the risk of postpartum depressive symptoms. Thus, our hypothesis was partly supported by the present study.

In a previous prebirth cohort study conducted in Osaka, Japan, no significant association was shown between total dairy product intake during pregnancy and the risk of postpartum depressive symptoms as defined the same way as in the present study; however, associations with intake levels of individual dairy foods such as milk were not examined in that study [2]. The current results are in partial agreement with this finding. In a US study of 97 postpartum women attending 7 monthly visits, adjusted mean EPDS sum scores for 7 visits were significantly lower for women with serum 25-hydroxyvitamin D (25[OH]D) levels higher than 32 ng/mL compared with those at or lower than 32 ng/mL [16]. The current results are at variance with this finding. Our results are in partial agreement with those of our above-mentioned studies showing that intake levels of yogurt,

Table 1 – Characteristics of the 1319 women, according to quartile (Q) of intake of total dairy products and milk during pregnancy [a]

Variable	Total (n = 1319)	Total dairy products			Milk		
		Q1 (n = 328)	Q4 (n = 332)	*P* for trend [b]	Q1 (n = 251)	Q4 (n = 404)	*P* for trend [b]
Baseline characteristics							
Age (y)	32.0 (28.0-34.0)	31.0 (28.0-34.0)	32.0 (29.0-34.0)	.004	31.0 (28.0-34.0)	32.0 (29.0-34.0)	.11
Gestation (wk)	17.0 (14.0-21.0)	16.0 (14.0-20.0)	18.0 (15.0-23.0)	<.0001	16.0 (14.0-19.0)	18.0 (15.0-22.5)	<.0001
Region of residence (%)							
Fukuoka Prefecture	56.9	57.6	56.3	.79	57.4	55.2	.33
Other than Fukuoka Prefecture in Kyushu	34.2	31.7	35.2		31.1	35.9	
Okinawa Prefecture	8.9	10.7	8.4		11.6	8.9	
No. of children (%)							
0	40.6	34.5	44.3	.009	36.3	41.3	.17
1	40.0	44.8	39.2		45.8	40.4	
≥2	19.3	20.7	16.6		17.9	18.3	
Nuclear family structure (%)	85.1	85.4	86.8	.48	85.3	87.4	.26
History of depression (%)	4.5	4.9	4.5	.84	5.6	3.5	.39
Family history of depression (%)	10.1	8.8	10.8	.29	9.6	11.1	.35
Job type (%) [c]							
Unemployed	38.5	42.7	35.5	.31	42.2	37.6	.15
Professional or technical	26.5	25.9	28.0		25.5	26.2	
Clerical or related occupation	19.0	15.2	22.0		17.5	20.3	
Sales	4.8	5.2	4.5		6.8	4.2	
Service	6.9	7.3	5.7		6.0	7.7	
Production	2.7	2.4	2.4		0.8	2.7	
Other [d]	1.6	1.2	1.8		1.2	1.2	
Education (%)							
<13 y	22.3	26.8	21.4	.20	26.7	21.3	.43
13-14 y	33.5	32.0	34.6		33.5	34.9	
≥15 y	44.2	41.2	44.0		39.8	43.8	
Body mass index (kg/m^2)	20.9 (19.5-22.7)	20.7 (19.4-22.8)	21.2 (19.7-23.0)	.15	20.7 (19.4-22.7)	21.1 (19.6-23.0)	.02
Daily intake							
Total energy (kJ)	7137.9 (6083.5-8493.5)	6355.5 (5376.4-7690.2)	8024.9 (6861.8-9154.6)	<.0001	6594.0 (5460.1-7828.3)	7631.6 (6606.5-8991.4)	<.0001
Total dairy products (g)	118.0 (45.0-198.9)	18.5 (8.3-30.1)	258.6 (225.7-370.2)	<.0001	14.3 (6.8-38.2)	236.9 (196.4-322.7)	<.0001
Milk (g)	67.0 (12.5-150.0)	5.0 (0.0-12.5)	187.5 (150.0-300.0)	<.0001	0.0 (0.0-5.0)	187.5 (150.0-240.0)	<.0001
Yogurt (g)	17.9 (8.3-44.6)	8.3 (3.3-14.3)	53.6 (22.9-100.0)	<.0001	8.3 (3.3-35.7)	35.7 (14.3-71.4)	<.0001
Cheese (g)	2.5 (1.0-5.0)	2.5 (1.0-2.5)	4.3 (1.4-10.7)	<.0001	2.5 (1.0-3.5)	2.5 (1.0-10.0)	<.0001
Calcium (mg)	472.7 (349.3-609.6)	299.8 (239.9-395.7)	684.4 (571.1-865.0)	<.0001	320.2 (246.7-433.4)	629.2 (525.3-813.4)	<.0001
Vitamin D (μg)	5.1 (3.7-7.0)	4.2 (2.6-6.1)	5.8 (4.2-8.1)	<.0001	4.3 (2.8-5.9)	5.5 (4.1-7.6)	<.0001
Characteristics at the postnatal assessment							
Having smoked during pregnancy (%)	8.1	14.0	6.0	.0006	11.2	7.4	.11
Cesarean section (%)	17.0	16.8	17.8	.54	14.3	17.8	.32
Baby's male sex (%)	48.8	47.6	49.4	.89	50.2	51.0	.85
Baby's birth weight (g)	3006 (2765-3244)	3022 (2778-3275)	2951 (2697-3195)	.004	3030 (2780-3266)	2966 (2709-3210)	.003

[a] Values are medians and IQRs for continuous variables and percentages of subjects for categorical variables.
[b] For continuous variables, a linear trend test was used; for categorical variables, a Mantel-Haenszel χ^2 test was used.
[c] Employment status in the year when the first questionnaire was conducted or in the previous year.
[d] Management; protection services; farming, fishing, or forestry; transportation or communications; or construction.

calcium, and vitamin D were significantly inversely associated with the prevalence of depressive symptoms during pregnancy (CES-D score ≥16), whereas no material associations were found between intake levels of total dairy products, milk, or cheese and depressive symptoms during pregnancy [3,4]. A cross-sectional study of 114 pregnant Korean women reported that mean calcium intake was higher in the low-depression score group (<10 points) than in the high-depression score group (≥10 points), based on the Beck Depression Inventory [17]. In a cross-sectional study of 4101 women in the Netherlands, compared with normal vitamin D levels (25[OH]D ≥ 80 nmol/L), vitamin D deficiency (≤29.9 nmol/L) and insufficiency (30-49.9 nmol/L) were significantly positively associated with the prevalence of depressive symptoms during pregnancy (CES-D score ≥16) [18]. A significant inverse association was found between log 25[OH]D and the prevalence of depressive symptoms during pregnancy (CES-D score ≥16) in a cross-sectional study of 178 African American women [19]. The present results are inconsistent with these

Table 2 – Association of intake of dairy products, calcium, and vitamin D during pregnancy with postpartum depressive symptoms in 1319 women

Variable	Quartile				
	1 (Lowest)	2	3	4 (Highest)	*P* for trend
Total dairy products					
Intake (g/d) [a]	18.5	80.2	158.3	258.6	
Risk (%) [b]	32/328 (9.8)	24/331 (7.3)	23/328 (7.0)	29/332 (8.7)	
Crude OR (95% CI)	1.00	0.72 (0.41-1.25)	0.70 (0.40-1.22)	0.89 (0.52-1.50)	.63
Adjusted OR (95% CI) [c]	1.00	0.73 (0.40-1.31)	0.67 (0.37-1.22)	0.75 (0.41-1.37)	.34
Milk					
Intake (g/d) [a]	0.0	33.9	107.1	187.5	
Risk (%) [b]	28/251 (11.2)	24/390 (6.2)	27/274 (9.9)	29/404 (7.2)	
Crude OR (95% CI)	1.00	0.52 (0.29-0.92)	0.87 (0.50-1.53)	0.62 (0.36-1.07)	.32
Adjusted OR (95% CI) [c]	1.00	0.48 (0.26-0.89)	0.73 (0.39-1.34)	0.51 (0.28-0.93)	.12
Yogurt					
Intake (g/d) [a]	0.0	8.3	35.7	75.0	
Risk (%) [b]	21/240 (8.8)	33/416 (7.9)	14/300 (4.7)	40/363 (11.0)	
Crude OR (95% CI)	1.00	0.90 (0.51-1.61)	0.51 (0.25-1.02)	1.29 (0.75-2.29)	.42
Adjusted OR (95% CI) [c]	1.00	0.92 (0.51-1.71)	0.62 (0.29-1.29)	1.45 (0.79-2.72)	.23
Cheese					
Intake (g/d) [a]	0.0	1.0	2.5	10.7	
Risk (%) [b]	20/229 (8.7)	27/237 (11.4)	38/520 (7.3)	23/333 (6.9)	
Crude OR (95% CI)	1.00	1.34 (0.73-2.50)	0.82 (0.47-1.48)	0.78 (0.42-1.46)	.16
Adjusted OR (95% CI) [c]	1.00	1.36 (0.72-2.61)	0.88 (0.49-1.61)	0.74 (0.38-1.46)	.18
Calcium					
Intake (mg/d)	275.0	418.9	531.7	757.8	
Risk (%) [b]	29/329 (8.8)	26/330 (7.9)	22/330 (6.7)	31/330 (9.4)	
Crude OR (95% CI)	1.00	0.89 (0.51-1.54)	0.74 (0.41-1.31)	1.07 (0.63-1.83)	.94
Adjusted OR (95% CI) [c]	1.00	0.78 (0.42-1.42)	0.62 (0.32-1.19)	0.80 (0.39-1.66)	.44
Vitamin D					
Intake (μg/d) [a]	2.7	4.4	5.9	9.1	
Risk (%) [b]	28/329 (8.5)	27/329 (8.2)	24/331 (7.3)	29/330 (8.8)	
Crude OR (95% CI)	1.00	0.96 (0.55-1.67)	0.84 (0.47-1.48)	1.04 (0.60-1.79)	.99
Adjusted OR (95% CI) [c]	1.00	0.93 (0.51-1.67)	0.75 (0.40-1.39)	0.89 (0.47-1.69)	.59

[a] Values for intake are medians.
[b] Risk of postpartum depressive symptoms based on the EPDS for each quartile.
[c] Adjustment for age, gestation, region of residence, number of children, family structure, history of depression, family history of depression, job type, education, body mass index, having smoked during pregnancy, cesarean delivery, baby's sex, baby's birth weight, and total energy intake.

findings. Regarding nonperinatal depressive symptoms, our results are in partial agreement with those of a cohort study of 1609 Taiwanese men and women 65 years or older that showed no associations between dairy intake and the risk of new depressive symptoms (10-item CES-D score ≥10) within 4 years [20] and those of a cross-sectional study of 887 Japanese 65 years or older showing a significant inverse relationship between daily milk product consumption and depressive symptoms, based on the 5-item Geriatric Depression Scale [21]. On the other hand, a significant positive association was observed between intake of milk products and depression in a cross-sectional study of 10 986 Australians aged 18 to 79 years [22]. In a cross-sectional study of 105 women aged 41 to 57 years in Korea, calcium intake was significantly inversely associated with self-rated depression [23]. A cross-sectional study of 2006 Japanese men and women aged 19 to 69 years showed a significant inverse relationship between calcium intake and depressive symptoms (CES-D score ≥16) [24]. The current results are at variance with these findings. Our results are in partial agreement with those of a cross-sectional study of 4734 US adolescents that found no material associations between intake levels of calcium or vitamin D and depressive symptoms, based on a 6-item score developed by Kandel and Davies [25]. In a cohort study of 56 366 US women aged 50 to 79 years, vitamin D intake from food sources was significantly inversely associated with the risk of depressive symptoms after 3 years of follow-up as defined as a Burnam score of 0.06 of higher [26]. The present results are not consistent with this finding. A randomized, double-blinded US trial among 36 282 postmenopausal women failed to find that 2 years of supplementation with 400 IU/d of vitamin D_3, combined with 1000 mg/d of element calcium, influenced the risk of depressive symptoms [27]. Two other trials also failed to demonstrate that vitamin D supplementation has a beneficial effect on depressive symptoms [28,29].

The mechanisms underlying the protective association between milk intake and postpartum depressive symptoms are unclear. Milk is a source of many biologically active substances that may confer many health benefits, such as proteins, lipids, carbohydrates, lactose, vitamins, minerals, enzymes, hormones, immunoglobulins, and growth factors [30]. The protective association between milk intake and postpartum depressive symptoms may be ascribed to unknown ingredients in milk

other than calcium. Alternatively, some unrecognized dietary or nondietary factors in relation to milk intake might have confounded the observed inverse association.

In a sensitivity analysis using energy-adjusted intake by the residual method, adjusted ORs (95% CIs) for postpartum depressive symptoms in the first, second, third, and fourth quartiles of energy-adjusted milk intake were 1 (reference), 0.61 (0.34-1.08), 0.73 (0.42-1.27), and 0.52 (0.28-0.93), respectively (*P* for trend = .051); these results were less clear than those shown in Table 2. Median (IQR) daily crude milk intake values in the lowest and highest quartiles of total energy intake were 28.6 g (5.0-107.1 g) and 112.5 g (42.9-187.5 g), respectively. When the residual method is used, the difference in milk intake between the lowest and highest energy intake quantiles might make the results less intelligible.

There are methodological limitations to be considered. The DHQ could only approximate consumption and was designed to assess dietary intake for 1 month prior to completing the questionnaire. Although the validity of the DHQ regarding intake of calcium and vitamin D seems reasonable, as described above, any nondifferential exposure misclassification would give rise to an underestimation of the strength of the association between exposure and outcome. Substantial changes in diet in the previous month were experienced by 388 pregnant women because of nausea gravidarum (366 women), maternal and fetal health (20 women), and other reasons (2 women). The results of a sensitivity analysis excluding these 388 women were similar to those in the overall analysis: the adjusted OR in the highest quartile was 0.40 (95% CI, 0.18-0.86; *P* for trend = .10) for milk.

Postpartum depressive symptoms were assessed using the EPDS, a self-reported rating scale, rather than through structured diagnostic interviews. The EPDS was originally designed as a screening test for depressive symptoms within the previous 7 days. The present study subjects answered the EPDS between 3 and 4 months postpartum. Because the period assessed by the EPDS is so much shorter than our subjects' postnatal periods, it is difficult to ascertain the precise incidence and prevalence of postpartum depressive symptoms using the EPDS. Because this type of outcome misclassification would be nondifferential, the consequence would have led to an underestimation of values in our results.

Of the 1757 participants at baseline, 438 women were not included in the present study. There were no material differences between the 438 nonincluded women and the 1319 study subjects with regard to distribution of region of residence, number of children, family structure, history of depression, family history of depression, job type, and intake of dietary factors under study. Compared with the nonincluded women, the study subjects were more likely to be older, to have participated in the baseline survey earlier in their gestation, and to report high educational levels and low body mass index. Moreover, at baseline, we could not estimate the participation rate because we do not have exact figures for the number of pregnant women who were provided with a set of leaflets explaining the KOMCHS, an application form, and a self-addressed and stamped return envelope by the 423 collaborating obstetric hospitals. The mothers in the present study were likely not representative of Japanese mothers in the general population. For example, a population census conducted in 2000 in Fukuoka Prefecture found that the percentages of women aged 30 to 34 years with <13, 13-14, and ≥15 years and an unknown number of years of education were 52.0%, 31.5%, 11.8%, and 4.8%, respectively [31]. The corresponding figures for the current study were 22.3%, 33.5%, 44.2%, and 0.0%, respectively. Thus, our study subjects were more educated and probably more aware of health topics than are women in the general population.

Although adjustment was made for several potential confounding factors, residual confounding effects could not be ruled out.

To the best of our knowledge, the present prospective study is the first to show a significant inverse relationship between milk intake during pregnancy and the risk of postpartum depressive symptoms. Further epidemiologic investigations are required to ascertain whether the inverse relationship is replicated in other populations.

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