

Inverse Association Between Mothers' Cognitive Social Capital During Pregnancy and Postpartum Depression: The Japan Environment and Children's Study

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Purpose: Several studies have reported an apparent inverse association between cognitive social capital and depression in various groups, but insights into this association in perinatal mothers are fairly limited. Therefore, we explored the possible associations between expectant mothers' cognitive social capital (ie, neighborhood trust and reciprocity and generalized trust and reciprocity) and postpartum depression at 1 and 6 months after delivery.

Patients and Methods: As part of an ongoing cohort study, the Japan Environment and Children's Study, cognitive social capital was evaluated using a questionnaire survey during mid-late pregnancy and postpartum depression was assessed using the Japanese version of the Edinburgh Postnatal Depression Scale. This study analyzed data from 81,670 mothers. Logistic regression analysis was performed to calculate the odds ratios (ORs) for postpartum depression by the degree of neighborhood and generalized trust and reciprocity (high, relatively high, neutral, relatively low, and low) using the high category as a reference.

Results: Regardless of the measurement time point, prevalence gradually increased as the degree of neighborhood trust decreased (all $p < 0.001$), suggesting a higher likelihood of postpartum depression with less neighborhood trust. A comparable tendency was also observed for the other three variables of cognitive social capital (all $p < 0.001$). Moreover, the inverse association of postpartum depression with generalized trust and reciprocity was markedly stronger (ORs for low category ≥ 2.70) than that with neighborhood trust and reciprocity (ORs for low category ≤ 1.96).

Conclusion: Our findings highlight a statistically significant inverse association between cognitive social capital during pregnancy and postpartum depression at both time points.

Keywords: perinatal depression, trust, reciprocity, cohort study, Japan

Introduction

Postpartum depression is an episode of a severe depressive disorder that occurs in a period after childbirth.¹ It often starts in the first 2 weeks after delivery and persists for a few weeks to months, in some cases continuing through to a second period of postpartum depression.^{1,2} Postpartum depression exposes mothers to higher risks of mental and behavioral disorders such as anxiety and even maternal suicide in severe cases. It may lead to rejection, abuse, or negligent caregiving or impaired mother-infant bonding if the child has cognitive, emotional, behavioral, or physical developmental difficulties.^{3–8} A meta-analysis suggests that the global prevalence of postpartum depression among mothers is 14% at 0–3 months after delivery and 16% at 4–6 months.⁶ In Japan, the prevalence of postpartum depression appears to be highest at 1 month after delivery (16.9%⁹ and 17.6%⁸), and symptoms can become fixed and intractable at around 6 months postpartum.¹⁰ Given recent reports that such chronic postpartum depression has a greater negative impact on

child development than depression that resolves spontaneously,^{11–13} it would be beneficial to evaluate such impact beyond the standard 1 month postpartum at this 6-month time point also.

Social capital refers to the resources, embedded in social networks, through which individuals or a group can access, for instance, social networks, the norms of reciprocity and trustworthiness.^{14,15} Social capital varies in form and use, and there is thus a high degree of heterogeneity in its definition and measurement.^{15,16} A meta-analysis revealed that in the social capital and health literature, social capital is most commonly categorized into cognitive and structural dimensions.¹⁷ Cognitive social capital refers to norms and values, as well as individuals' perceptions of their social connections and relations in a given community.^{18,19} In the mental health literature, the major components of cognitive social capital are trust and reciprocity, and these are often measured at neighborhood or generalized levels.^{16,20–25} As the terms suggest, neighborhood trust refers to the trust of people in one's own neighborhood, while generalized trust is regarded as the trust of other people more generally, including strangers.^{14,21,26} Neighborhood reciprocity can be seen as a reciprocal interaction, such as people helping each other in their neighborhood, while generalized reciprocity can refer to a reciprocal interaction made between a provider of resources and someone else.^{15,16,23} Given that cognitive social capital can be understood as "the quality of perceived social connections",¹⁶ measures of cognitive social capital aim to assess the level of trust and reciprocity based on an individual's subjective evaluation.^{14,18,22,23} Structural social capital refers to the presence of community activities or social interactions, such as participation and social networks.^{18,19,27} This dimension can represent "the quantity of social interaction"²⁸ and can be characterized by behavioral expression. Its measures tend to gauge, for instance, the number of social participations, civil activities, volunteering activities, and members in an organization.^{23,25}

An inverse association has been reported between social capital, especially cognitive capital, and common mental disorders such as anxiety and depression in the mental health literature.^{16,23,27,29,30} In fact, a recent meta-analysis also supports this view.¹⁷ Nevertheless, insights into a link between the cognitive social capital of expectant mothers and postpartum depression are still fairly limited. Among the few studies that have investigated this association are a cohort study in Crete, Greece,³¹ a study in Zhejiang Province, China covering three time points,³² and a Japanese online survey conducted during COVID-19.³³ Given that perinatal women have an increased risk of developing psychiatric disorders,³⁴ this lack of knowledge and the paucity of accumulated evidence is somewhat surprising. Therefore, the present study analyzed a large data ($n > 80,000$) derived from the Japan Environment and Children's Study (JECS), a nationwide birth cohort, to ascertain what associations can be observed between the cognitive social capital of expectant mothers and postpartum depression at 1 and 6 months after delivery.

Methods

Study Design

The JECS is an ongoing, nationwide, government-funded birth cohort study focusing on the relationship of various environmental factors with child health and development. Details of the study design and baseline characteristics have been published elsewhere.^{35,36} Briefly, expectant mothers were recruited face-to-face between January 2011 and March 2014 at 15 regional centers, including both rural and urban locations throughout Japan. Eligibility criteria for participants (expectant mothers) were as follows: (1) residence in the study areas at the time of recruitment and expected to reside continuously in Japan for the foreseeable future; (2) expected delivery date between August 1, 2011 and mid-2014; and (3) ability to comprehend the Japanese language and complete the self-administered questionnaire. We excluded those residing outside the study areas even if they visited the cooperating healthcare providers within the study areas. The participation acceptance rate was 78.5%.

Follow-ups were conducted on four occasions up to 6 months postpartum: during early pregnancy, mid-late pregnancy, and at 1 and 6 months after delivery. Mothers completed a self-administered questionnaire on demographic characteristics, socioeconomic status, medical and obstetric history, physical and mental health, lifestyle, and other topics. Detailed descriptions of the variables are presented below. Our staff distributed and collected questionnaires at the maternity hospital during participants' health check-ups at 1 month after delivery. When collection was not possible at

that time, questionnaires were returned by mail. At 6 months after delivery, questionnaires were distributed and collected mainly by mail.

Study Sample

We used the jecs-qa-20210401 dataset (jecs-ta-20190930), released in April 2021. It includes 103,057 pregnancies, from which 5647 multiple participations, 948 multiple births, and 3521 miscarriages or still births were then excluded. Of the remaining 92,941 expectant mothers, 11,278 participants were further excluded due to no response or missing data on the questionnaires about maternal age, cognitive social capital during pregnancy, and depression at 1 and 6 months postpartum. Consequently, we retrieved data for 81,663 mothers for our analysis (Figure 1).

All procedures for the JECS comply with the ethical standards of the relevant national and institutional committees on research involving human participants and with the Helsinki Declaration of 1975, as revised in 2008. All procedures involving human subjects in the JECS protocol were reviewed and approved by the Ministry of the Environment's Institutional Review Board on Epidemiological Studies (100910001) and the ethics committees of all participating institutions. Written informed consent was obtained from all participants. This specific research was also approved by the Ethics Committee of the University of Toyama (No. R2018024).

Measures

Exposure

Given the data available, the exposure variables in this study were neighborhood trust, neighborhood reciprocity, generalized trust, and generalized reciprocity of the selected mothers during mid-late pregnancy (mean $\pm$ S.D., 28.2 $\pm$ 6.4 weeks of gestation). These four variables were assessed using study-specific questions.

The item for neighborhood trust was “Do you think your neighbors trust each other?” and that for neighborhood reciprocity was “Do you think your neighbors help each other?” Both items were measured on a 4-point scale (1 = agree,

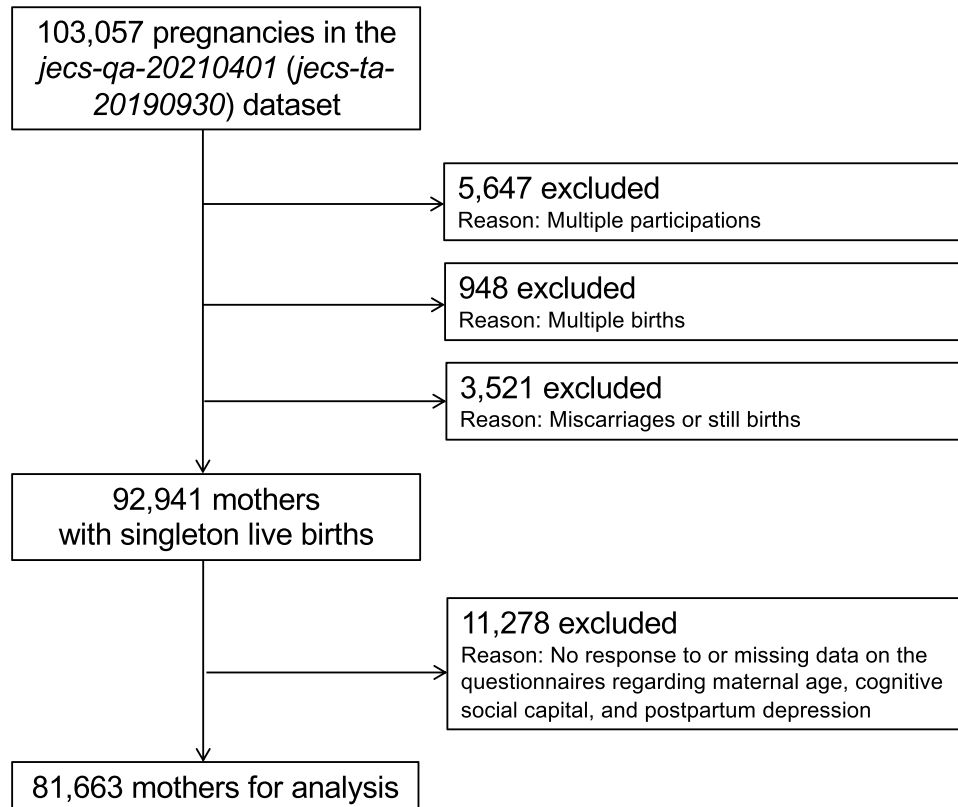


Figure 1 Flow diagram of the study.

2 = somewhat agree, 3 = somewhat disagree, 4 = disagree). These items were derived from the questionnaire used in the Project on Human Development in Chicago Neighborhoods.³⁷ To treat the exposure variables as categorical variables in our analysis, we categorized neighborhood trust and neighborhood reciprocity as high, relatively high, relatively low, and low, scored as 1, 2, 3, and 4, respectively.

The item for generalized trust was “Would you say that most people can be trusted?” and the item for generalized reciprocity was “Would you say that most of the time people try to be helpful or that they are mostly just looking out for themselves?” These items were derived from the Trust in People Scale.³⁸ Both were measured on a 9-point scale (1 = helpful, 5 = neither 1 nor 9, 9 = looking out for themselves). Again, to treat these exposure variables as categorical variables, we categorized generalized trust and generalized reciprocity as high (scored 1 or 2), relatively high (3 or 4), neutral (5), relatively low (6 or 7), and low (8 or 9).

Outcome

The outcome variables were postpartum depression that the selected mothers reported at 1 and 6 months after delivery, as assessed using the Japanese version of the Edinburgh Postnatal Depression Scale (EPDS). The original EPDS was developed to screen women for postpartum depression while ensuring a higher relevance for depression reporting and greater ease of use than other depression assessment tools. It comprises 10 items rated using a 4-point scale (0–3), with a total score of 0–30.³⁹ The Japanese version corresponds with the original 10-item EPDS and has high internal consistency (Cronbach’s $\alpha = 0.78$) and test-retest reliability ($r = 0.92$), with an optimal cut-off score of 8/9, at which both sensitivity and specificity are high (0.75 and 0.93, respectively).⁴⁰ Another Japanese study confirmed the optimal cut-off score at the same point with high sensitivity and specificity (0.82 and 0.94–0.95, respectively).⁴¹ Thus, we applied a cut-off score of 8/9 to judge postpartum depression severity in this study.

Covariates

Referring to previous studies on depression and cognitive social capital,^{5,29,42,43} we selected potential confounders that might influence the association between exposure and outcome and treated them as covariates. However, we did not select mediators because they might introduce overadjustment bias between exposure and outcome.⁴⁴

The covariates were categorized by the classification used in previous JECS studies investigating Japanese mothers’ mental health.^{5,45} Among them, those measured during early pregnancy (mean $\pm$ S.D., 16.7 $\pm$ 7.6 weeks of gestation) were pre-pregnancy body mass index (BMI) (< 18.5 , 18.5–25, or > 25 kg/m²), marital status (married or non-married), physician-diagnosed history of major psychiatric diseases (ie, depression, anxiety disorder, or schizophrenia) (yes or no), physician-diagnosed history of any physical diseases (yes or no), parity (primiparous or multiparous), negative attitude toward pregnancy (yes or no), psychological distress measured by using the Kessler Psychological Distress Scale (K6)⁴⁶ with a cut-off score ≥ 13 (yes or no),^{47,48} living with partner (yes or no), parents (yes or no), or parents-in-law (yes or no),⁴⁹ and area of residence (area A–O). Those measured during the mid-late pregnancy (mean $\pm$ S.D., 28.2 $\pm$ 6.4 weeks of gestation) were maternal age (≤ 25 , > 25 – < 36 , or ≥ 36 years old), education status (≤ 12 years [ie, high school graduate], > 12 – < 16 years, or ≥ 16 years [ie, undergraduate or graduate]), employment status (employed or unemployed), household income level (< 4 , 4– < 6 , or ≥ 6 million JPY/year), smoking status (yes or no), drinking status (yes or no), recent experience of stressful life events (yes or no), experience of verbal abuse and/or domestic violence from partner (yes or no),⁵⁰ parity (primiparous or multiparous), and pet ownership (none, dog(s) only, cat(s) only, both dog(s) and cat(s)).⁵¹ For more details, see [Supplementary Table 1](#).

Statistical Analysis

We used descriptive statistics for the variables (numbers and percentages) to present the participating mothers’ demographic characteristics measured during pregnancy. We then performed logistic regression analysis to estimate the risks of severe postpartum depression at 1 and 6 months postpartum according to the degree of cognitive social capital. In the crude models, we used only an outcome–exposure pair. In the adjusted model, all covariates listed above were included in the model, using the forced entry method. The area of residence was set as a random effect in the adjusted models. Missing data were also included in the multivariable model as dummy-coded variables. Odds ratios (ORs) and 95%

confidence intervals (CIs) were calculated using the highest cognitive social capital category as a reference. In tests for trends, the exposure variables were treated and evaluated as continuous variables. The only difference between the 1-month and 6-month analyses was which variable was used as the outcome. All data were analyzed using SAS ver. 9.4 software (SAS Institute Inc., Cary, NC, USA).

Results

Table 1 shows the participants' descriptive characteristics (for more details), see [Supplementary Tables 2–5](#). Of 81,663 mothers, 86.73% were more than 25 years old, 95.09% were married, and 5.01% had a physician-diagnosed history of major psychiatric disease such as depression, anxiety disorder, or schizophrenia. The median EPDS score at 1 month postpartum was 4 (range: 0–30, interquartile range = 3–7, mean = 5.09, S.D. = 3.48) and that at 6 months was 4 (range: 0–30, interquartile range = 2–6, mean = 4.59, S.D. = 3.39).

Table 1 Descriptive Characteristics (n = 81,663)

Variables	N	%
Maternal age (years old)^b		
≤ 25	10,829	13.26
> 25–≤ 35	54,232	66.41
> 35	16,602	20.33
Pre-pregnancy maternal body mass index (kg/m²)^a		
< 18.5	13,155	16.11
18.5–< 25	60,135	73.64
≥ 25	8332	10.20
Missing value	41	0.05
Marital status^a		
Married	77,654	95.09
Non-married	3393	4.15
Missing value	616	0.75
Education status (years)^b		
≤ 12 (ie, high school graduate)	28,258	34.60
12–< 16	34,815	42.63
≥ 16 (ie, undergraduate or graduate)	18,364	22.49
Missing value	226	0.28
Employment status^b		
Employed	44,298	54.24
Unemployed	36,809	45.07
Missing value	556	0.68
Household income level (million JPY/year)^b		
< 4	30,037	36.78
4–< 6	25,558	31.30
≥ 6	20,991	25.70
Missing value	5077	6.22

(Continued)

Table 1 (Continued).

Variables	N	%
Smoking status^b		
Yes	3206	3.93
No	77,882	95.37
Missing value	575	0.70
Drinking status^b		
Yes	2232	2.73
No	78,847	96.55
Missing value	584	0.72
Recent experience of stressful life events^b		
Yes	35,273	43.19
No	45,868	56.17
Missing value	522	0.64
Experience of verbal abuse and/or domestic violence from partner^b		
Yes	10,900	13.35
No	70,464	86.29
Missing value	299	0.37
Physician-diagnosed history of major psychiatric diseases^a		
Yes	4094	5.01
No	77,261	94.61
Missing value	308	0.38
Physician-diagnosed history of any physical diseases^a		
Yes	67,494	82.65
No	13,861	16.97
Missing value	308	0.38
Parity^a		
Primiparous	34,307	42.01
Multiparous	45,311	55.49
Missing value	2045	2.50
Negative attitude toward pregnancy^a		
Yes	5780	7.08
No	75,288	92.19
Missing value	595	0.73
Maternal psychological distress (K6 score $\geq$ 13)^a		
Yes	2685	3.29
No	78,477	96.10
Missing value	501	0.61
Living with partner^a		
Yes	75,605	92.58
No	5750	7.04
Missing value	308	0.38

(Continued)

Table 1 (Continued).

Variables	N	%
Living with parent(s)^a		
Yes	8399	10.28
No	72,956	89.34
Missing value	308	0.38
Living with parent(s)-in-law^a		
Yes	9492	11.62
No	71,863	88.00
Missing value	308	0.38
Pet ownership^b		
None	66,788	81.78
Dog(s) only	9253	11.33
Cat(s) only	4226	5.17
Both dog(s) and cat(s)	1396	1.71
Area of residence^a		
A	6531	8.00
B	6971	8.54
C	10,813	13.24
D	4639	5.68
E	5363	6.57
F	5807	7.11
G	4597	5.63
H	4422	5.41
I	3191	3.91
J	6380	7.81
K	4151	5.08
L	2457	3.01
M	5540	6.78
N	6174	7.56
O	4627	5.67

Notes: ^aMeasured during early pregnancy (mean $\pm$ S.D., 16.7 $\pm$ 7.6 weeks of gestation).

^bMeasured during mid-late pregnancy (mean $\pm$ S.D., 28.2 $\pm$ 6.4 weeks of gestation).

Abbreviations: K6, Kessler Psychological Distress Scale; JPY, Japanese Yen.

Table 2 shows the results of the logistic regression analysis reported as crude and adjusted ORs for postpartum depression (EPDS score ≥ 9) at 1 month after delivery with the corresponding 95% CIs (Table 2). Taking the highest cognitive social capital as reference (= 1.00), the overall ORs of postpartum depression showed a gradual increase as the degree of cognitive social capital decreased. For instance, the adjusted ORs (95% CIs) of postpartum depression increased from 1.00 to 1.94 (1.76–2.14) for neighborhood trust. Likewise, the adjusted ORs (95% CIs) increased from 1.00 through to 2.90 (2.62–3.20) for generalized trust. A clear linear trend was observed for each cognitive social capital subscale, with tests for trends confirming its statistical significance ($p < 0.001$). Figure 2 shows that the prevalence of postpartum depression increased as social capital decreased. For instance, a prevalence of 8.61% was associated with high neighborhood trust compared with 20.14% associated with low neighborhood trust. Similarly, a prevalence of 7.67% was associated with high generalized trust and that of 27.52% was associated with low generalized trust.

Comparable tendencies were also observed at 6 months after delivery (Table 3). The adjusted ORs (95% CIs) of postpartum depression increased, as the degree of neighborhood reciprocity decreased, from, for instance, 1.00 through to 1.78 (1.62–1.97) for neighborhood reciprocity. Likewise, for generalized reciprocity, the adjusted ORs (95% CIs)

Table 2 Cases, Subtotal, and Odds Ratios (95% Confidence Intervals) of Postpartum Depression (EPDS Score ≥ 9) at 1 Month After Delivery According to the Degree of Cognitive Social Capital ($n = 81,663$)

	Degree of Cognitive Social Capital					p value for Trend
	High	Relatively High	Neutral	Relatively Low	Low	
Neighborhood trust						
Cases, <i>n</i>	594	4289	————	3266	3323	
Subtotal, <i>n</i>	6897	38,112	————	20,154	16,500	
Crude odds ratio	1.00 (Ref.)	1.35 (1.23–1.47)	————	2.05 (1.87–2.25)	2.68 (2.44–2.94)	< 0.001
Adjusted odds ratio	1.00 (Ref.)	1.25 (1.14–1.37)	————	1.70 (1.55–1.87)	1.94 (1.76–2.14)	< 0.001
Neighborhood reciprocity						
Cases, <i>n</i>	703	4380	————	3192	3197	
Subtotal, <i>n</i>	7895	37,604	————	20,149	16,015	
Crude odds ratio	1.00 (Ref.)	1.35 (1.24–1.47)	————	1.93 (1.77–2.10)	2.55 (2.34–2.78)	< 0.001
Adjusted odds ratio	1.00 (Ref.)	1.30 (1.19–1.42)	————	1.70 (1.56–1.87)	1.95 (1.78–2.14)	< 0.001
Generalized trust						
Cases, <i>n</i>	801	2846	4210	2125	1490	
Subtotal, <i>n</i>	10,440	27,194	27,503	11,111	5415	
Crude odds ratio	1.00 (Ref.)	1.41 (1.30–1.53)	2.18 (2.01–2.35)	2.85 (2.61–3.10)	4.57 (4.16–5.02)	< 0.001
Adjusted odds ratio	1.00 (Ref.)	1.35 (1.24–1.47)	1.89 (1.74–2.05)	2.20 (2.01–2.41)	2.90 (2.62–3.20)	< 0.001
Generalized reciprocity						
Cases, <i>n</i>	443	2283	5065	2467	1214	
Subtotal, <i>n</i>	5520	22,477	36,273	13,129	4264	
Crude odds ratio	1.00 (Ref.)	1.30 (1.17–1.44)	1.86 (1.68–2.06)	2.65 (2.38–2.95)	4.56 (4.06–5.13)	< 0.001
Adjusted odds ratio	1.00 (Ref.)	1.26 (1.12–1.40)	1.63 (1.47–1.81)	2.05 (1.83–2.29)	2.73 (2.41–3.10)	< 0.001

Notes: Adjusted for maternal age, pre-pregnancy body mass index (BMI), marital status, education status, employment status, household income level, smoking status, drinking status, recent experience of stressful life events, experience of verbal abuse and/or domestic violence from partner, physician-diagnosed history of major psychiatric diseases, physician-diagnosed history of any physical diseases, parity, negative attitude toward pregnancy, maternal depression measured by using the Kessler Psychological Distress Scale (K6), living with partner, living with parent(s), living with parent(s)-in-law, pet ownership, and residence area.

Abbreviations: EPDS, Edinburgh Postnatal Depression Scale; Ref, reference.

increased from 1.00 up to 2.70 (2.36–3.09) for generalized reciprocity. A statistically significant linear trend was also found for the four cognitive social capital subscales ($p < 0.001$). In a similar manner, as shown in Figure 2, the prevalence of postpartum depression increased from 8.13% for relatively high neighborhood reciprocity to 15.74% for low neighborhood reciprocity and from 6.61% for high generalized reciprocity to 25.21% for low generalized reciprocity.

Discussion

In an effort to address the paucity of evidence, this study used a large sample size ($n > 80,000$) from 15 regional centers across Japan to examine the association between cognitive social capital during mid-late pregnancy and postpartum depression at 1 and 6 months after delivery. The EPDS scores obtained in this study were generally consistent with results from previous Japanese studies.^{8,52} Analysis revealed an inverse association between cognitive social capital and postpartum depression, regardless of the measurement time point. Our findings are consistent with those of previous studies. A clear inverse association was previously found between cognitive social capital (ie, trust and reciprocity) and depression in different populations, including general adult populations (eg,^{19,26,29,30,53}) and older adult populations (eg,^{23,54,55}). Individuals with higher trust and reciprocity toward their neighbors and/or others are less likely to experience depression. This may be because higher trust and reciprocity can enhance one's social relationships with and perceptions of others, which in turn is expected to be a preventive factor for stress.^{23,24,30} Expectant mothers who show higher cognitive social capital might have a stronger sense of social and reciprocal relationships than those who show lower cognitive social capital and thus would likely have a lower level of depression at 1 and 6 months postpartum.

This study found a strong inverse association of postpartum depression with generalized trust and reciprocity and that the likelihood of postpartum depression increased more sharply as the degrees of generalized trust and reciprocity declined in both postpartum periods. For instance, the adjusted ORs for postpartum depression at 1 month after delivery

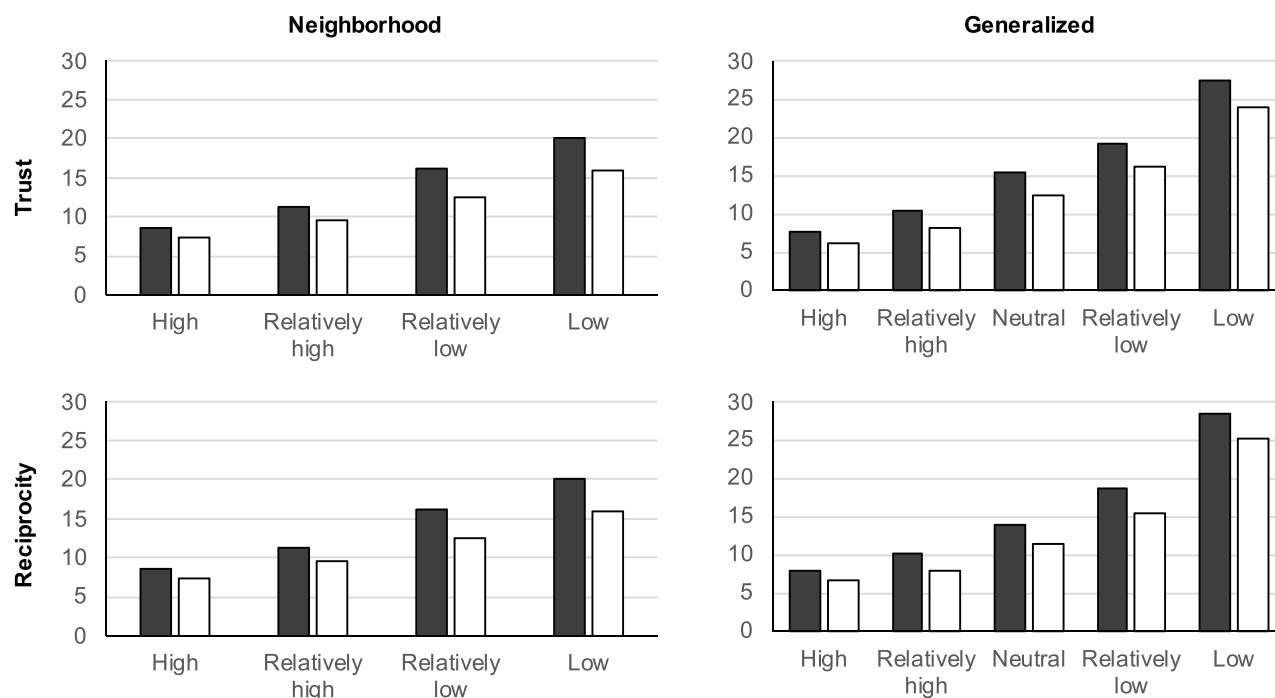


Figure 2 Prevalence (%) of postpartum depression (EPDS score ≥ 9) at 1 month (solid bars) and 6 months (open bars) after delivery according to the degree of each type of cognitive social capital.

according to the different degrees of generalized trust increased from “high” to “low” (see Table 2). Also, the same tendency was observed for the adjusted ORs for 6-month postpartum depression according to the degree of generalized reciprocity (see Table 3). A reason why lower generalized trust and reciprocity during pregnancy leads to a higher likelihood of postpartum depression might be that those with lower trust and reciprocity toward others tend to be exposed to other negative sociopsychological factors, such as low social support, low self-esteem, and stressful life events,^{42,43} which often lead to postpartum depression.

In a similar manner, the adjusted ORs for postpartum depression at 1 and 6 months after delivery increased as the degrees of neighborhood trust and reciprocity decreased. A plausible reason for this could be that, in a reliable neighborhood or community, people are more likely to have a sense of belonging and to receive social support (eg, emotional support), which might lower the level of stress and thus depressive symptoms, given that stress is considered to be a potential mechanism that links trust (and reciprocity) and health outcomes.^{25,30,32,53}

Notably, the inverse association found between generalized and neighborhood trust and reciprocity and postpartum depression in mothers in this study was equivalent at 1 and 6 months postpartum, even though the prevalence was higher at 1 month postpartum, as in previous studies.^{8,56} This suggests that the association is similar between postpartum depression that is more likely to resolve spontaneously and postpartum depression that is more likely to become chronic.

Women with postpartum depression can experience a variety of symptoms (eg, increasing maternal cognitive impairment, emotional difficulty, and/or behavioral problems, such as rejection or abuse of the infant), but many of these symptoms are preventable.⁷ Our findings imply that if expectant mothers’ perceived trust and reciprocity could be improved, their risk of postpartum depression might possibly be reduced. Other useful insights into potential interventions for expectant mothers could come from studies that targeted mothers with an infant and examined their cognitive social capital or suggested an intervention to improve it. For instance, a study in Nicaragua found that regular monitoring of child growth and development was positively associated with mothers’ trust in people in general.⁵⁷ Home visits (by nurses) to offer advice on mother and infant health can lead to nurses to trustful relationships between nurses and the mothers and home-visitors, which can in turn facilitate mothers’ trust in others.⁵⁸

Table 3 Cases, Subtotal, and Odds Ratios (95% Confidence Intervals) of Postpartum Depression (EPDS Score ≥ 9) at 6 Month After Delivery According to the Degree of Cognitive Social Capital (n = 81,663)

	Degree of Cognitive Social Capital					p value for Trend
	High	Relatively High	Neutral	Relatively Low	Low	
Neighborhood trust						
Cases, n	510	3686	—	2524	2634	
Subtotal, n	6897	38,112	—	20,154	16,500	
Crude odds ratio	1.00 (Ref.)	1.34 (1.22–1.48)	—	1.79 (1.62–1.98)	2.38 (2.15–2.63)	< 0.001
Adjusted odds ratio	1.00 (Ref.)	1.29 (1.17–1.43)	—	1.60 (1.44–1.77)	1.91 (1.72–2.12)	< 0.001
Neighborhood reciprocity						
Cases, n	642	3767	—	2425	2520	
Subtotal, n	7,895	37,604	—	20,149	16,015	
Crude odds ratio	1.00 (Ref.)	1.26 (1.15–1.37)	—	1.55 (1.41–1.69)	2.11 (1.93–2.31)	< 0.001
Adjusted odds ratio	1.00 (Ref.)	1.25 (1.14–1.37)	—	1.46 (1.33–1.61)	1.78 (1.62–1.97)	< 0.001
Generalized trust						
Cases, n	630	2232	3384	1808	1300	
Subtotal, n	10,440	27,194	27,503	11,111	5415	
Crude odds ratio	1.00 (Ref.)	1.39 (1.27–1.53)	2.19 (2.00–2.39)	3.03 (2.75–3.33)	4.92 (4.44–5.45)	< 0.001
Adjusted odds ratio	1.00 (Ref.)	1.34 (1.22–1.47)	1.86 (1.70–2.04)	2.31 (2.09–2.55)	2.90 (2.60–3.23)	< 0.001
Generalized reciprocity						
Cases, n	365	1798	4098	2018	1075	
Subtotal, n	5520	22,477	36,273	13,129	4264	
Crude odds ratio	1.00 (Ref.)	1.23 (1.09–1.38)	1.80 (1.61–2.01)	2.57 (2.28–2.88)	4.76 (4.19–5.40)	< 0.001
Adjusted odds ratio	1.00 (Ref.)	1.21 (1.08–1.37)	1.57 (1.40–1.77)	1.98 (1.75–2.24)	2.70 (2.36–3.09)	< 0.001

Notes: Adjusted for maternal age, pre-pregnancy body mass index (BMI), marital status, education status, employment status, household income level, smoking status, drinking status, recent experience of stressful life events, experience of verbal abuse and/or domestic violence from partner, physician-diagnosed history of major psychiatric diseases, physician-diagnosed history of any physical diseases, parity, negative attitude toward pregnancy, maternal depression measured by using the Kessler Psychological Distress Scale (K6), living with partner, living with parent(s), living with parent(s)-in-law, pet ownership, and residence area.

Abbreviations: EPDS, Edinburgh Postnatal Depression Scale; Ref, reference.

In Japan, many municipalities offer home-visit support programs for mothers in the postpartum period. For instance, in the Visit All Families with Infants Program, health care or child welfare personnel provide information about childcare support within 4 months postpartum, and in the Home-visiting Childcare Support Services Program, public health nurses, midwives or other childcare experts provide guidance and support on childrearing for families with children who need it.⁵⁹ However, to our knowledge, only one study in 2012 evaluated whether these intervention programs increased mothers' cognitive social capital and concluded that the Visit All Families with Infants Program had no such effect on mothers' social trust.⁶⁰ Therefore, the effect of providing home-visit support on mothers' cognitive social capital is still unclear, and further empirical study is needed to evaluate whether such interventions have positive impacts on mothers' perceived trust and reciprocity and the extent of any such impact.

An alternative measure to enhance mothers' neighborhood trust and reciprocity could involve encouraging mothers to join neighborhood activities. Previous studies have found that certain neighborhood activities engendered and strengthened mothers' (neighborhood) trust and reciprocity because they helped them interact with activity organizers and other participants and nurtured a feeling of physical and psychological closeness to them. These neighborhood activities were characterized by, for instance, enabling mothers to join activities without prior registration or notice, providing activities that met their parenting and childcare needs, and providing opportunities for them to develop their social network.^{61,62}

Taking these findings together, we suggest that one possible intervention is to provide social support to mothers during pregnancy or to increase their opportunities for social participation during this time (ie, structural social capital). The reasoning behind this is that structural social capital can have a moderating effect on cognitive social capital, which itself can be associated with an individual's depressive symptoms.²³ Accordingly, we recommend implementing interventions that can manipulate structural social capital, which can be readily accessed by expectant mothers and offer them opportunities to interact with others.

This study has several strengths. First, we used a dataset of a large sample group ($n > 80,000$), which was collected from 15 study areas in Japan and covered a broad range of geographic conditions as well as different sample sizes and economic levels among the study areas. The characteristics of the mothers and children in the JECS are largely comparable to those in the national survey, the Vital Statistics,³⁶ and our findings are likely to represent the population of Japan. Second, as mentioned earlier, previous studies on the association between cognitive social capital and depression have largely focused on general adult or older adult populations, and few have targeted expectant mothers and explored postpartum depression. Accordingly, this study contributes to the literature by providing compelling findings of an inverse association between expectant mothers' cognitive social capital and postpartum depression.

This study also has some limitations. First, structural social capital was not measured in this study, and the extent to which the aforementioned interventions might effectively improve expectant mothers' cognitive social capital can be inferred only from the findings of previous studies. Future research will need to address structural social capital, including the possibility that it serves as a potential confounding factor. Second, we used the EPDS, which is a self-report screening tool for postpartum depression and thus does not replace clinical assessment,³⁹ and some mothers may overestimate their depressive symptoms in a self-assessment.⁶³ Therefore, the result using the EPDS may differ from what a clinical diagnosis of postpartum depression provides. This may mean that our findings are subject to common method bias. Third, social capital was measured by a self-administered questionnaire. Because one of the characteristics of depression is negative cognition, people with depression are more likely to estimate their social capital as being lower.⁶⁴ Therefore, the odds obtained in this study may be an unjustified overestimation. Fourth, although our model was adjusted using physician-diagnosed history of major psychiatric diseases during mid-late pregnancy (ie, depression, anxiety disorder, or schizophrenia) and the K6 score, it is impossible to fully adjust the model. Fifth, in relation to this, there are undoubtedly confounders that would influence an expectant mother's cognitive social capital and/or postpartum depression that this study and the JECS did not collect data on. Possible examples of unmeasured variables include the EPDS score during pregnancy and the mother's social and living environment while growing up. Controlling the exposure and/or outcome by accounting for those unmeasured variables could have yielded different results. Finally, as mentioned above, we did not measure the EPDS during early pregnancy, which prevented us from calculating incidence (new onset) as well as prevalence. Given that one of the strengths of cohort studies is the ability to assess incidence, this was a missed opportunity.

Conclusion

This study found an inverse association between mothers' cognitive social capital during pregnancy and postpartum depression at 1 and 6 months after delivery. Our empirical findings imply that understanding the degree of an expectant mother's cognitive social capital can help to predict potential depression in the postpartum period or reduce the likelihood of psychological disorders.

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Disclosure

The authors report no conflicts of interest in this work.

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