

Original Article

Relationship between Personality Traits and Postpartum Depressive Symptoms in Women who Became Pregnant via Infertility Treatment

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The status of postpartum depression was elucidated herein with the use of the Edinburgh Postnatal Depression Scale (EPDS) in women in Shikoku, Japan who became pregnant and gave birth after undergoing infertility treatment, including assisted reproductive technology (ART). The assessment was performed during their children's 4-month health examination. The relationships between postpartum depression and the mothers' background factors and scores on the Big Five personality traits scale were also examined. Of the Big Five personality traits, the scores for neuroticism were significantly higher in the ART group (n=71) than in the general infertility treatment (n=118) and natural pregnancy (n=872) groups. No significant differences in EPDS scores were seen among these three groups. A logistic regression analysis showed that neuroticism was associated with an EPDS score ≥ 9 points, (which is suggestive of postpartum depression,) in all groups. Moreover, although a long-standing marriage had an inhibitory effect on postpartum depression in the natural pregnancy group, no such trend was seen in the ART group, which included many women with long-standing marriages. Particularly for women who become pregnant by ART, an individualized response that pays close attention to the woman's personality traits is needed.

Key words: infertility treatment, assisted reproductive technology, postpartum, postpartum depression, personality trait

The post-childbirth changes in the mothers' hormonal balance and major alterations in daily life can result in susceptibility to depressed mood and loss of enjoyment. Approximately 10% of postpartum women meet the diagnostic criteria for depression, and in some cases, this can interfere with their activities of daily living (ADLs). Mothers with postpartum depression have been reported to feel decreased attachment to their children during the pregnancy [1], and these mothers have been observed to have a negative effect on the child's development [2].

Suicide is the second-most common cause of death

among women between 6 weeks and 1 year after giving birth (4.2 individuals per 100,000) in Britain. In 2015 and 2016, suicide was the most common cause of death in postpartum mothers in Japan, and a relationship between suicide and postpartum depression has been noted. -[Erika Oota (2024, 7). *Comprehensive Research Report*. <https://mhlw-grants.niph.go.jp/201703001A0008.pdf> (niph.go.jp)].

Postpartum depression typically occurs within several months after birth. However, its prevalence at 1 year postpartum has been found to be similar to that at 1 month postpartum, and approximately half of women who exhibit postpartum depressive symptoms at 1 year

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postpartum do not exhibit these symptoms at 1 month postpartum [3]. Postpartum depressive symptoms may thus occur at any time during the postpartum year.

The Edinburgh Postnatal Depression Scale (EPDS), which is scored based on four possible responses to 10 items, is typically used to assess postpartum depression. Based on data for Japanese individuals, postpartum depression is considered likely when the EPDS score is ≥ 9 points [4]. The EPDS started to be widely used in Japan in 2017, with the nationwide introduction of 2-week-postpartum health examinations.

In Japan, approximately 1 in every 11.6 children born in 2021 were born by artificial reproductive technology (ART). [*Ministry of Health, Labour and Welfare* (2024. 7) https://www.mhlw.go.jp/stf/newpage_14408.html], and a higher percentage of women treated with ART (54.0%) had more than mild depressive symptoms [5]. However, an investigation conducted in Japan revealed that the experience of infertility treatment, including ART, had no effect on postpartum depressive symptoms [6], thus providing discrepant findings. In Italy, no difference in the incidence of depression at 1 month postpartum was seen between women who became pregnant through infertility treatment, (including ART,) and women who had a natural pregnancy [7]. In the United States, no difference in the incidence of depression at 6 months postpartum was identified between infertility treatment and natural pregnancy groups [8]. On the other hand, in Italy, the EPDS scores of women at 3 months postpartum were higher in those who became pregnant by ART than in those who became pregnant naturally [9]. These studies from Europe and the U. S. have thus shown that the evaluations of the association between ART and postpartum depressive symptoms has shown inconsistent results and has varied depending on the postpartum period and other factors.

Although “vulnerable personality” has been pointed out as a common factor in postpartum depressive symptoms in Asia and non-Asian countries [10], our search of the relevant literature identified no studies of the effects of infertility treatment on postpartum depressive symptoms while taking the mothers’ personality traits into account. We conducted the present study to clarify the relationship between infertility treatment, (including ART,) and postpartum depressive symptoms, considering the mothers’ personality characteristics.

Subjects and Methods

An anonymous, self-administered questionnaire was distributed to 2,038 mothers who had received a written and oral explanation of the purpose of the study and provided their consent. The women had visited any of the seven health centers in City A in Shikoku, Japan, between May 2019 and March 2020 for their children’s 4-month-postpartum health examination. The mothers were asked to complete the questionnaire, put it in an envelope, seal the envelope by themselves, and place it in a collection box located in the facility. This study was approved by the Ethics Committee of the Graduate School of Nursing, Okayama University Graduate School of Health Science (approval no.: D18-07).

Questionnaire content.

(1) The subjects’ background.

The subjects were asked about the following background factors: age, years married, type and duration of infertility treatment, parity, type of pregnancy, gestational age at delivery and delivery mode, abnormalities during pregnancy or delivery, birth weight, whether they had any medical condition(s), whether they were employed, and the status of support from family members and others (other than their husbands).

(2) Big Five scale. The Big Five scale describes an individual’s personality. It is composed of a total of 60 items used to evaluate five personality traits: extraversion, neuroticism, openness, conscientiousness, and agreeableness [11]. Responses were obtained from among seven possible responses, ranging from “very applicable” to “not applicable at all.”

(3) The Japanese version of the EPDS. The EPDS is a screening test for postpartum depression. A score ≥ 9 points for the 10 items is classified as reflecting the likely presence of postpartum depression.

Statistical analyses. Descriptive statistics were determined and the χ^2 test was performed for the subjects’ basic attributes, social background, and obstetric factors. The relationships between items were evaluated using Pearson’s correlation coefficient. The statistical analyses were performed using Stata ver. 18 (Lightstone, Tokyo) with the level of statistical significance set at $p < 0.05$.

Results

The subjects’ background characteristics. Responses

were obtained from 1,165 women (recovery rate, 57.2%). After the exclusion of 102 women's questionnaires because of inadequate responses and another two due to a history of psychiatric disorders, a total of 1,061 women's responses were subjected to analysis (valid response rate, 91.1%; Table 1). A total of 189 of the subjects had become pregnant through infertility treatment. Of these, 118 constituted the 'general infertility treatment group,' which was comprised of subjects who had become pregnant by the timing method or artificial insemination, and 71 constituted the 'ART group,' which was comprised of the subjects who had become pregnant through *in vitro* fertilization or intra-cytoplasmic sperm injection. The 'natural pregnancy group,' comprised of 872 subjects, was designated the control group.

The mothers' ages and years married were significantly higher in the ART group versus the other two groups. The duration of infertility treatment was significantly longer in the ART group compared to the

general infertility treatment group. The rates of primiparity and cesarean section were both significantly higher in the ART group than in the natural pregnancy and general infertility treatment groups. The proportion of subjects with an abnormality during pregnancy or delivery was significantly lower in the general infertility treatment group than in the natural pregnancy group.

The proportion of subjects with a medical condition was significantly higher in the ART group than in the natural pregnancy group. The proportion of subjects who were employed was significantly higher in the ART group than in the other two groups.

Personality traits. Of the five basic traits evaluated based on the subjects' scores on the Big Five scale, the scores for neuroticism were significantly higher in the ART group than in the other two groups (Table 2). No significant differences with respect to extraversion, openness, conscientiousness, or agreeableness were

Table 1 Background characteristics of the participants

	Natural pregnancy N = 872 (a)	Infertility treatment			P-value
		Overall N = 189 (b)	General infertility treatment N = 118 (c)	ART N = 71 (d)	
Age (years)	31.3 ± 4.6 [18–43]	35.3 ± 4.3 [23–45]	34.5 ± 4.3 [23–43]	36.7 ± 3.9 [28–45]	a vs. b, a vs. d, a vs. c: <0.001, c vs. d: <0.05
Years married	4.2 ± 6.2 [0–17]	5.8 ± 3.2 [1–20]	5.1 ± 2.9 [1–17]	7.0 ± 3.4 [1.5–20]	a vs. b, a vs. d, a vs. c: <0.001, c vs. d: <0.005
Duration of infertility treatment (months)	—	18.9 ± 25.3 [3–120]	9.5 ± 13.4 [12–72]	43.3 ± 29.2 [3–120]	c vs. d: <0.001
Primiparous/multiparous					
Primiparous	47.0% [410/872]	57.7% [109/189]	52.5% [62/118]	66.2% [47/71]	a vs. b: <0.01, c vs. d, a vs. c: <0.05
Multiparous	52.8% [460/872]	42.3% [80/189]	47.5% [56/118]	33.8% [24/71]	
No response	0.2% [2/872]	—	—	—	
Gestational age at delivery (weeks)					
<37	5.0% [44/872]	6.9% [13/189]	7.6% [9/118]	5.6% [4/71]	n.s.
≥37	94.7% [826/872]	92.6% [175/189]	91.5% [108/118]	94.4% [67/71]	
No response	0.3% [2/872]	0.5% [1/189]	0.8% [1/118]	—	
Delivery mode					
Vaginal delivery	81.1% [707/872]	66.7% [126/189]	74.6% [88/118]	53.5% [38/71]	a vs. b, c vs. d, a vs. c: <0.001
Planned cesarean section	10.4% [91/872]	18.0% [34/189]	13.6% [16/118]	25.4% [18/71]	
Emergency cesarean section	8.1% [71/872]	14.8% [28/189]	11.0% [13/118]	21.1% [15/71]	
No response	0.3% [3/872]	0.5% [1/189]	0.8% [1/118]	—	
Abnormality during pregnancy or delivery					
Yes	16.9% [146/872]	22.2% [42/189]	26.3% [31/118]	15.5% [11/71]	a vs. c: <0.05
No	82.2% [717/872]	76.7% [145/189]	72.0% [85/118]	84.5% [60/71]	
No response	1.0% [9/872]	1.1% [2/189]	1.7% [2/118]	—	
Birth weight (g)	3,007.1 ± 379.0 [1,492–4,284]	3,051.3 ± 476.2 [1,094–4,446]	3,018.4 ± 487.1 [1,094–4,116]	3,107.6 ± 454.9 [1,828–4,446]	a vs. d: <0.05
Medical complications					
No	92.0% [802/872]	84.7% [160/189]	87.3% [103/118]	80.3% [57/71]	a vs. b, a vs. d: <0.005
Yes	7.6% [66/872]	14.8% [28/189]	12.7% [15/118]	18.3% [13/71]	
No response	0.4% [4/872]	0.5% [1/189]	—	1.4% [1/71]	
Employment					
Yes	60.1% [524/872]	77.8% [147/189]	68.6% [81/118]	93.0% [66/71]	c vs. d, a vs. d: <0.001
No	37.8% [330/872]	21.7% [41/189]	30.5% [36/118]	7.0% [5/71]	
No response	2.1% [18/872]	0.5% [1/189]	0.9% [1/118]	—	
Supported by family members and others					
No	15.8% [138/872]	19.6% [37/189]	22.0% [26/118]	15.5% [11/71]	n.s.
Yes	83.8% [731/872]	80.4% [152/189]	78.0% [92/118]	84.5% [60/71]	
No response	0.3% [3/872]	—	—	—	

Values are expressed as the mean ± SD [range]. n.s., not significant.
ART, Assisted Reproductive Technology.

observed among the three groups.

Depression at 4 months postpartum. The median EPDS scores at 4 months postpartum were 3 points [0-17] (median [range]) in the ART group, 2 points [0-19] in the general infertility treatment group, and 4

points [0-19] in the natural pregnancy group; none of these differences were significant (Table 3). Moreover, an examination of EPDS scores according to the presence or absence of each background factor showed no significant between-group differences.

Table 2 Personality traits (Big Five Scale)

	Natural pregnancy N = 872 (a)	Infertility treatment			P-value
		Overall N = 189 (b)	General infertility treatment N = 118 (c)	ART N = 71 (d)	
Big Five Scale					
Extraversion	56 [24–82]	56 [32–84]	56 [33–83]	55 [32–84]	n.s.
Neuroticism	49 [15–84]	50 [17–79]	49.1 [17–75]	52.5 [25–79]	a vs. b, a vs. d: <0.01, c vs. d: <0.05
Openness	48 [18–84]	48 [21–73]	48 [23–73]	47.5 [21–67]	n.s.
Conscientiousness	48 [14–74]	48 [28–81]	48 [28–74]	48 [31–81]	n.s.
Agreeableness	53 [17–80]	54 [31–84]	54 [37–73]	54 [31–84]	n.s.

Data are expressed as the median [range]. ART, Assisted Reproductive Technology.
n.s., not significant.

Table 3 Participants' characteristics and EPDS scores

		Natural pregnancy N = 872 (a)	Infertility treatment			P-value
			Overall N = 189 (b)	General infertility treat- ment N = 118 (c)	ART N = 71 (d)	
Overall		4 [0-19]	3 [0-19]	2 [0-19]	3 [0-17]	n.s.
Age (years)	< 35 (I)	4 [0-19]	3 [0-17]	3 [0-13]	4 [0-17]	n.s.
	≥ 35 (II)	3 [0-15]	2 [0-19]	2 [0-19]	3 [0-17]	n.s.
	P-value (I, II)	n.s.	n.s.	n.s.	n.s.	
Years married	< 5 (I)	3 [0-18]	2 [0-17]	2 [0-13]	3 [0-17]	a vs. b, a vs. c: <0.05
	≥ 5 (II)	4 [0-19]	3 [0-19]	3 [0-19]	4 [0-17]	n.s.
	P-value (I, II)	n.s.	n.s.	n.s.	n.s.	
Parity	Primiparous (I)	4 [0-18]	3 [0-17]	2 [0-13]	3 [0-17]	a vs. b, a vs. c: <0.05
	Multiparous (II)	4 [0-19]	3 [0-19]	3 [0-19]	5.5 [0-17]	c vs. d: <0.05
	P-value (I, II)	n.s.	n.s.	n.s.	n.s.	
Gestational age at delivery (weeks)	< 37 (I)	3 [0-15]	4 [0-10]	2.5 [0-15]	5 [0-10]	n.s.
	≥ 37 (II)	4 [0-19]	3 [0-19]	2 [0-19]	3 [0-17]	a vs. c: <0.05
	P-value (I, II)	n.s.	n.s.	n.s.	n.s.	
Delivery mode	Vaginal (I)	4 [0-19]	3 [0-19]	2 [0-19]	3 [0-15]	a vs. b, a vs. c: <0.05
	Planned cesarean section (II)	4 [0-14]	4 [0-17]	3.5 [0-8]	6 [0-17]	n.s.
	Emergency cesarean section (III)	3.5 [0-18]	3 [4-12]	3 [0-11]	4 [1-12]	n.s.
	P-value (I, II, III)	n.s.	n.s.	n.s.	n.s.	
Abnormality during pregnancy	Yes (I)	4 [0-18]	3 [0-17]	3 [0-17]	3 [0-17]	n.s.
	No (II)	4 [0-19]	3 [0-19]	2 [0-19]	3 [0-17]	n.s.
	P-value (I, II)	n.s.	n.s.	n.s.	n.s.	
Birthweight (g)	< 2,500 (I)	3 [0-15]	3 [0-17]	1.5 [0-10]	7 [2-17]	c vs. d: <0.05
	≥ 2,500 (II)	4 [0-19]	3 [0-19]	3 [0-19]	3 [0-17]	n.s.
	P-value (I, II)	n.s.	n.s.	n.s.	n.s.	
Medical complications	No (I)	4 [0-18]	3 [0-19]	2 [0-19]	3 [0-17]	a vs. c: <0.05
	Yes (II)	4 [0-19]	4 [0-17]	3 [0-11]	5.5 [0-17]	n.s.
	P-value (I, II)	n.s.	n.s.	n.s.	n.s.	
Employment	Yes (I)	4 [0-19]	3 [0-19]	3 [0-19]	3 [0-17]	a vs. b, a vs. c: <0.05
	No (II)	3 [0-18]	4 [0-15]	3 [0-13]	5 [0-13]	n.s.
	P-value (I, II)	n.s.	n.s.	n.s.	n.s.	
Supported by family and others	No (I)	4 [0-15]	3 [0-12]	3 [0-8]	5 [0-12]	n.s.
	Yes (II)	3 [0-19]	3 [0-19]	2 [0-19]	3 [0-17]	n.s.
	P-value (I, II)	n.s.	n.s.	n.s.	n.s.	

Data are expressed as the median [range]. n.s., not significant.
ART, Assisted Reproductive Technology.

However, when the examination was limited to the multiparous women, the EPDS score was significantly higher ($p < 0.05$) in the ART group (5.5 points [0-17]) than in the general infertility treatment group (3 points [0-19]). In an analysis of only the mothers whose children weighed $< 2,500$ g at birth, the EPDS score was significantly higher in the ART group: (7 points [2-17]) compared to the general infertility treatment group (1.5 points [0-10]) ($p < 0.05$).

When the examination was limited to the subjects who had been married < 5 years, or the primiparous subjects, the subjects with a gestational age of ≥ 37 weeks at delivery, those who had undergone a vaginal delivery, those with a medical condition, and those who were employed, the EPDS scores of all of these subject groups were significantly higher in the subjects with a natural pregnancy compared to the general infertility treatment group ($p < 0.05$, all).

Personality traits and depression at 4 months post-

partum. Our analysis of the relationship between the mothers' EPDS scores and their Big Five scores for neuroticism, revealed a moderate positive correlation ($r = 0.456$, $p < 0.001$) (Fig. 1). Moderate positive correlations were seen in the ART group ($r = 0.528$, $p < 0.001$), general infertility treatment group ($r = 0.409$, $p < 0.001$), and natural pregnancy group ($r = 0.466$, $p < 0.001$). No correlation was observed between the mothers' EPDS scores and their Big Five scores for extraversion, openness, conscientiousness, or agreeableness for the subjects as a whole or for any group.

Background factors and depression at 4 months postpartum.

The factors related to EPDS scores were applied to a logistic regression analysis (Table 4). An analysis of the relationship to EPDS scores, the dependent variable, was performed using the following as independent variables: years married (0: < 5 years, 1: ≥ 5 years), primiparous/multiparous (0: primiparous, 1: multiparous), gestational age at delivery (0: < 37 weeks,

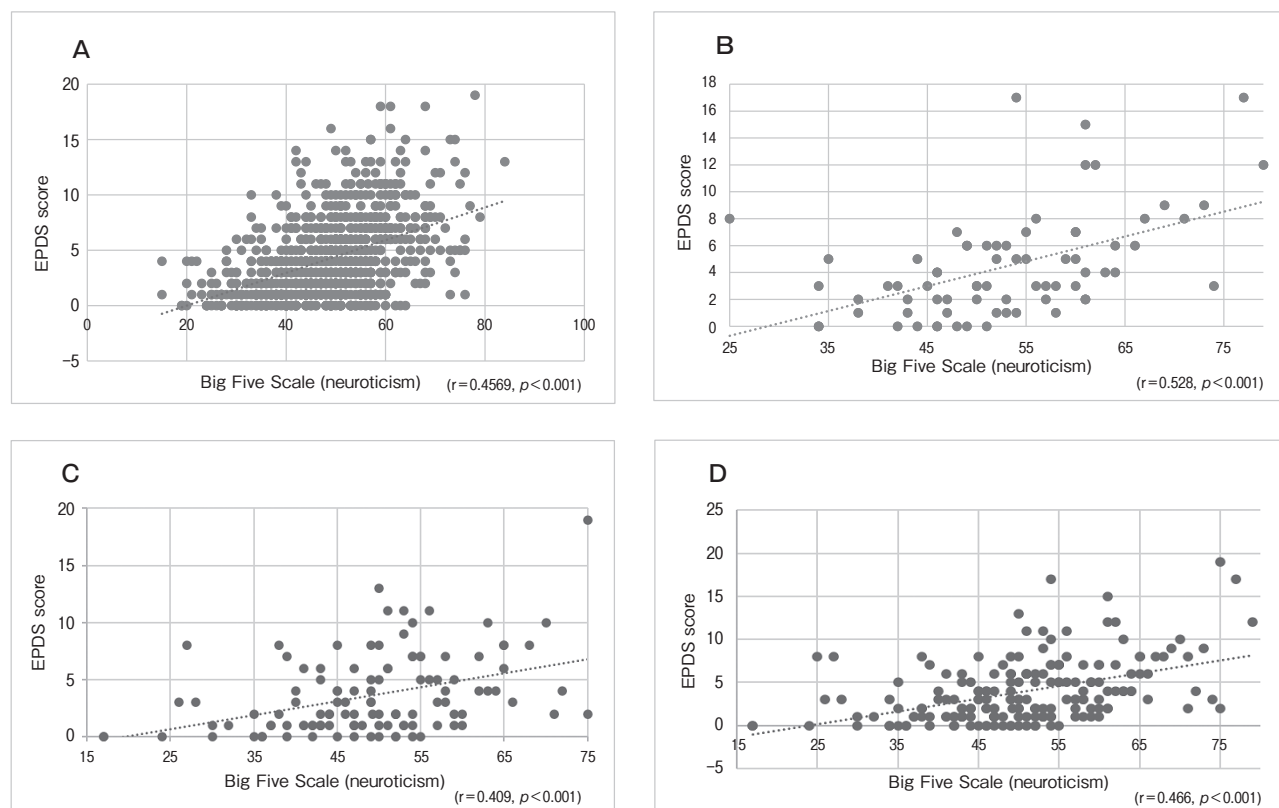


Fig. 1 Big Five Scale (neuroticism) and EPDS scores. **A**, All subjects; **B**, ART group; **C**, General infertility treatment group; **D**, Natural pregnancy group.

EPDS, Edinburg Postnatal Depression Scale; ART, Assisted Reproductive Technology.

Table 4 Logistic regression analysis with EPDS score as the dependent variable

	Overall		Natural pregnancy		ART		General infertility treatment	
	Odds ratio	P-value	Odds ratio	P-value	Odds ratio	P-value	Odds ratio	P-value
Big Five Scale (neuroticism)	1.08 (1.06–1.10)	0	1.07 (1.05–1.09)	0	1.17(1.02–1.34)	0.027	1.12 (1.06–1.20)	0
Years married	0.90 (0.83–0.97)	0.008	0.89 (0.80–0.99)	0.026	1.11 (0.76–1.59)	0.618	0.80 (0.64–1.00)	0.06
Primiparous/multiparous	1.35 (0.98–1.86)	0.063	1.37 (0.92–2.03)	0.124	2.45 (0.16–37.3)	0.519	1.24 (0.42–3.70)	0.695
Whether subject had a medical condition	0.88 (0.44–1.75)	0.719	0.64 (0.30–1.38)	0.256	0.41 (0.02–8.15)	0.558	3.97 (0.37–43.1)	0.257
Birth weight	1.00 (0.99–1.00)	0.927	1.00 (0.99–1.00)	0.618	1.00 (0.99–1.00)	0.377	1.00 (0.99–1.00)	0.292

Values are expressed as the odds ratio (95% confidence interval).

EPDS, Edinburg Postnatal Depression Scale.

Logistic regression analysis with EPDS score (≥ 9 or < 9) as the dependent variables.

ART, Assisted Reproductive Technology.

1: ≥ 37 weeks), delivery mode (0: vaginal delivery, 1: cesarean section), birth weight (0: $< 2,500$ g, 1: $\geq 2,500$ g), whether the subject had a medical condition (0: no, 1: yes), whether the subject was employed (0: yes, 1: no), and neuroticism on the Big Five scale (0: $<$ mean, 1: $\geq$ mean).

The analysis results demonstrated that whether for the subjects as whole or for the natural pregnancy, ART, or general infertility treatment groups alone, the subjects with a score above the mean for the Big Five neuroticism factor had an EPDS score ≥ 9 points. The respective odds ratios (ORs) and 95% confidence intervals (CIs) were 1.08 and 1.06–1.10 ($p=0.000$) for the subjects as a whole, 1.07 and 1.05–1.09 ($p=0.000$) for the natural pregnancy group, 1.17 and 1.02–1.34 ($p=0.027$) for the ART group, and 1.12 and 1.06–1.20 ($p=0.000$) for the general infertility treatment group. For the subjects as a whole and the natural pregnancy group alone, the subjects who had been married for the longer term, *i.e.*, (≥ 5 years) were significantly less likely to have an EPDS score ≥ 9 points: OR 0.9, 95%CI: 0.83–0.97 ($p=0.008$) for the subjects as a whole, and OR 0.89, 95%CI: 0.80–0.99 ($p=0.026$) for the natural pregnancy group. This trend was not seen in the general infertility treatment group or ART group.

Discussion

ART and personality traits. This study is the first to analyze the relationship between personality traits and postpartum depressive symptoms in women who became pregnant by infertility treatment, including ART. The results of our analyses revealed high scores for the neuroticism personality trait among the women whose pregnancies were achieved with ART. A high degree of stability, a personality trait that straddles developmental stages, is also known to be associated

with ART [12]. Particularly, neuroticism, a negative emotion, and extraversion, a positive emotion, have been shown not to change easily [13]. We speculate that it may be that women whose neuroticism is high by nature are susceptible to infertility, particularly infertility that is significant enough to necessitate treatment with ART. Georgina *et al.* reported that a tendency for depression or anxiety may affect the success of infertility treatment [14, 15].

Personality traits continue to develop throughout one's entire life [16], and the personality traits of adulthood change. The subjects in the present study's ART group were older; a high percentage had no children, and these women had been undergoing treatment longer than the subjects in the general infertility treatment group. Consequently, they likely experienced stress, anxiety, anger, guilt, and repression in association with the treatment more often than the subjects in the general infertility treatment group. It has also been suggested that repeated failure of infertility treatment increases anxiety and depression [17], and the dominant personality trait may therefore have changed to neuroticism. However, even though the subjects in the present study who were treated with ART succeeded in having children, which was the objective of the treatment, and 4 months had passed since they had given birth, the Big Five scores for neuroticism were significantly higher in this group than in the natural pregnancy and general infertility treatment groups. In any event, the relationship between neuroticism and infertility merits further investigation.

ART and depression at 4 months postpartum. In Japan, the opportunities that public health nurses have to come in contact with postpartum mothers occur during the newborn visit, the postpartum maternal visit, the infant visit, and the health examination at 3–4 months postpartum [18]. The examination at 4 months

postpartum is therefore a valuable opportunity to obtain information on the mental and physical health of the mother. In the present subjects, no significant differences in EPDS scores at 4 months were present among the ART, general infertility treatment, and natural pregnancy groups. High EPDS scores have been reported at various postpartum time points among women whose pregnancies were achieved with ART [9], and an absence of any changes in scores has also been reported [19,20]. Glazebrook *et al.* reported that the EPDS scores of their subjects whose pregnancies were achieved with ART were not always low, and they surmised that, compared to the women in their study who became pregnant naturally, those treated with ART had been married longer, suggesting that their relationship with their husband was more firmly established [21]. In the present study, the women in the ART group had been married significantly longer than those in the other groups, making a similar inference valid.

However, although the EPDS scores were favorable for the subjects in present the natural pregnancy group who were married longer, no such trend was seen in the ART group. It may be that for the ART group, the experience of cooperation in undergoing treatment with ART strengthened the relationship between husband and wife, regardless of how long they had been married. Another possibility is that only couples with a good relationship were able to persevere through ART treatment and succeed in having a child.

When only multiparous women were examined herein, it was revealed that the EPDS scores were significantly higher in the ART subjects compared to the general infertility treatment subjects. Women who already had children and became pregnant with ART may have continued infertility treatment in addition to rearing children and working. The use of ART places psychological, economic, and physical burdens on the mother and her partner, and childbirth therefore involves anxiety and strife. Moreover, the present study's subjects who underwent ART this treatment were older than those in the other groups, and a higher percentage were employed. Moreover, over the first 4 months postpartum, the burden of taking care of older children can be compounded by the mother's anxiety about returning to work. Factors such as these may explain why the EPDS scores were high in the present ART group.

When the analysis was limited to mothers whose

children weighed <2,500 g at birth, the EPDS score was significantly higher in the ART group (7 points) than in the general infertility treatment group. Another study also indicated that when pregnancy occurs by ART, having an infant with a lower birth weight may result in psychological distress compared to when the pregnancy occurs by non-ART [22]. It may be that (i) women who use ART to become pregnant are more prone to having high ideals with regard to children, and (ii) an attitude that makes it difficult to accept a low-birth-weight infant may result in higher EPDS scores.

Personality traits and postpartum depression. A moderate positive correlation was demonstrated herein between the EPDS scores and neuroticism, one of the Big Five personality traits. The logistic regression analysis also showed that neuroticism was related to the mother's EPDS scores. In a prospective cohort study of a general community-dwelling population, a high percentage of subjects with depressive symptoms was present in the group with high Big Five neuroticism scores and in the groups with low scores for extraversion, conscientiousness, openness, and agreeableness [23]. In another study of a general community-dwelling population, a high score for neuroticism and low scores for extraversion and conscientiousness were associated with the future occurrence of depressive symptoms [23]. Women with high scores for neuroticism and low scores for conscientiousness and extraversion have been reported to be at high risk of psychopathological symptoms throughout the perinatal period [24].

Reports such as these indicate that using the Big Five scale to evaluate the personalities of mothers engaged in child-rearing is important for predicting perinatal and postpartum depressive symptoms. In particular, women with increased neuroticism and low extraversion and conscientiousness should be considered a high-risk group requiring continuous long-term support.

The results of this study also suggest that a personality evaluation with the Big Five scale may be useful for pregnant and parturient women who have undergone treatment with ART, particularly when the woman is multiparous or gives birth to a low-birth-weight infant. If the woman's neuroticism level is high, continuous support from the early stage is needed.

A limitation of this study, is that only data from the 4 months postpartum time point were analyzed. A longitudinal survey is needed. Such a study could reveal the status of Big Five scores before pregnancy in women

for whom ART is used and to determine whether these scores change during pregnancy. Supporting women during the child-rearing period after treatment with ART requires the identification of the periods when personality trait screening will be most effective, such as during pregnancy, shortly before childbirth, and for a sufficient length of time after childbirth.

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