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ORIGINAL ARTICLE

Progress of PTSD symptoms following birth: a prospective study in mothers of high-risk infants

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OBJECTIVE: To understand how postpartum posttraumatic stress disorder (PTSD) symptoms in mothers of high-risk infants progress and identify what factors predict postpartum PTSD.
STUDY DESIGN: We prospectively obtained self-reported psychological data from neonatal intensive care unit discharged infants' mothers (NICU mothers) at the infants' corrected ages of 1 (T0), 3 (T1) and 12 months (T2) and mothers of healthy infants (controls). Maternal sociodemographic and infant-related factors were also investigated.
RESULT: PTSD was present in 25 and 9% of NICU mothers and controls, respectively. We identified four PTSD patterns: none, persistent, delayed and recovered. The postpartum PTSD course was associated with trait anxiety. Whether the infant was the first child who predicted PTSD at year 1 (adjusted odds ratio = 7.62, 95% confidence interval = 1.07 to 54.52).
CONCLUSION: Mothers of high-risk infants can develop early or late PTSD, and its course can be influenced by factors besides medical status. We therefore recommend regular screenings of postpartum PTSD.

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INTRODUCTION

The number of high-risk infants who require neonatal intensive care unit (NICU) care is increasing. In South Korea, demand for NICU beds has increased from 3.2 to 3.4 to 4.1 to 4.5 per 1000 live births between 2006 and 2010.[1,2] Accordingly, mothers of high-risk infants are increasing, commonly experiencing fear, sadness, guilty and anxiety.[3] A number of researchers have hypothesized that childbirth-related stress could cause posttraumatic stress disorder (PTSD) symptoms.[4] Numerous studies have demonstrated that postpartum PTSD can interfere with the mother–infant relationship[5–8] and increase the risks of infants' emotional or behavioral problems.[6,9,10]

It is known that 1 to 7% of mothers with full-term delivery experience PTSD.[11–14] In addition to numerous stressful events during the perinatal period, including preeclampsia, premature or prolonged labor, operation and infection, the mothers of high-risk infants are exposed to another major traumatic stressor: NICU care of their babies. Although NICU hospitalization is not expressly included as an extreme stressor in the PTSD criteria described in the 4th edition of the Diagnostic and Statistical Manual of Mental Disorders-Text Revision,[15] it is a traumatic event for mothers.[6,16,17] Compared with mothers with healthy babies, mothers of high-risk infants tend to exhibit a higher prevalence of PTSD.[18–20] Previous studies have reported that the prevalence of PTSD in mothers of high-risk infants who require NICU care is 24 to 44%.[19,20]

Mothers' psychological stress is associated with developmental outcome of high-risk infant.[8–10] However, there is a paucity of prospective studies on postpartum maternal PTSD. Prospective studies in mothers with full-term deliveries have yielded mixed results. Some reported a decline of PTSD after 1 year,[12,21] but the other reported no change.[22] The only prospective study examining PTSD in mothers of high-risk infants described no improvement after 14 months of delivery, yet only 21 participants completed that study.[23] Here, we prospectively investigated PTSD in NICU hospitalized infants' mothers using the modified Perinatal PTSD Questionnaire (PPQ) for two aims: (1) how symptoms of postpartum PTSD progress, and (2) what factors predict postpartum PTSD at 1 year after trauma exposure.

METHODS

Participants and procedures

The study was approved by the Institutional Review Board of the Severance Hospital, the Yonsei University Health System. The mothers of infants discharged from NICU (NICU mothers) were recruited from a rehabilitation clinic of a university hospital between April and October 2009. Infants visited the clinic after discharge from the NICU at their corrected ages of 1, 3 and 12 months for developmental evaluation.[24] Each NICU mother participated in this study at visit 1, which was their infant's corrected ages of 1 month (T0), visit 2 (3 months, T1) and visit 3 (12 months, T2). The inclusion criteria for NICU mothers were as follows: age of 18 to 45 years and no significant medical/surgical history that affected their performance on the self-report questionnaires. Participants were excluded if they had difficulties understanding or responding to Korean language or any problem executing the self-report questionnaires. For comparison, we assessed mothers who had delivered healthy infants (controls) and visited an obstetrics clinic for their postpartum health examinations. Control mothers completed self-report measures once (1 month after their delivery). The inclusion and exclusion criteria of controls were same as those of the NICU mothers. Written informed consent was obtained after the study was described to the subjects. All the study procedures were carried out in accordance with the most recent version of the Declaration of Helsinki.

Maternal sociodemographic and infant-related data were obtained by questionnaires and chart reviews of all the participants. Maternal data included age, marital status, duration of marriage, educational level, method of delivery, history of medical illness, history of psychiatric illness and current use of tobacco and alcohol. The infant-related data included gender, gestational age, birth weight, duration of NICU hospitalization,

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Apgar score, twins, birth order and emergency room visit or rehospitalization during the study period.

PTSD symptoms of subjects were measured with the PPQ, which consists of 14 items that measure three dimensions: unwanted intrusions or re-experiencing of delivery, avoidance or emotional numbing and hyperarousal.[25] In the modified PPQ described by Callahan *et al.*,[18] each PPQ item is rated on five-point Likert scale (scored 0 to 4). We considered mothers with modified PPQ scores $\geqslant 19$ and < 19 as having and not having PTSD, respectively.[18,26]

We also measured the participants' depression and anxiety. Depressive symptoms were evaluated with the Edinburgh Postnatal Depression Scale, which is a 10-item self-report questionnaire used to screen for postpartum depression.[27,28] Anxiety symptoms were measured with the State-Trait Anxiety Inventory (STAI). Assessment of the state anxiety (STAI-S) was performed three times (T0, T1 and T2) but the trait anxiety (STAI-T) was checked one time at T0 because STAI-T is considered as a measure of the respondent's temperamental anxiety and is assumed to be stable over time.[29,30]

Statistical analyses

We divided NICU mothers into two groups based on their PPQ scores at baseline (T0): (1) PTSD ($\geqslant$19 PPQ) and (2) no PTSD (< 19 PPQ). We conducted analyses of variance or independent *t*-tests for continuous variables and χ^2-tests for categorical variables to compare maternal and infant-related variables among controls, NICU mothers with PTSD and NICU mothers with no PTSD. Significant differences between groups were further verified by *post hoc* tests for continuous variables. For *post hoc* analyses of categorical variables, we performed χ^2-tests between pairs of two groups (2×2), and then each *P*-value was multiplied by three to adjust for the multiple comparison problems (Bonferroni's method).

To observe how PTSD progressed over 1 year, we conducted mixed model analyses to accommodate for missing values. This analysis was used to examine the fixed effects of time, group and group $\times$ time interaction. Each visit time (T0, T1 and T2) was defined as having a range across each time of ± 1 month. Accordingly, any cases in which visit times were out of the range of ± 1 month from each reference time were considered as missing data. To identify predictive factors for postpartum PTSD after 1 year, we performed multiple logistic regression analysis for mothers with PTSD at year 1 (T2). STAI-S, STAI-T and Edinburgh Postnatal Depression Scale scores were not included in this regression model because of collinearity problems with the PPQ.[31] The following suspected predictive factors for PTSD were included in the multiple logistic regression model: maternal age, educational level (< 14 years or not), gestational age at birth, Apgar scores at 5 min, birth order (first-born baby or not), twins or not and the presence of emergency room visit or rehospitalization after NICU discharge.

Data analyses were conducted using SPSS for Windows version 20 (IBM Corporation, Armonk, NY, USA) and SAS version 9.2 (SAS Institute, Cary, NC, USA), and the statistical significance was set at $P < 0.05$.

RESULTS

A total of 251 mothers (193 NICU mothers and 58 controls) were screened for study participation, and 22 NICU mothers and 5 controls refused to be enrolled in the study. Thus, 171 NICU mothers and 53 controls were enrolled in this study. Among the enrolled NICU mothers, 1 withdrew her consent and 40 others did not visit our clinic after T0 until after T2. Therefore, we finally included 130 NICU mothers and 53 controls in this study. In our prospective process, the numbers with missing data at T0, T1 and T2 were 10, 22 and 49, respectively. At baseline evaluation (T0), participants with PTSD accounted for 25% (30/120) of NICU mothers and 9% (5/53) of controls. Table 1 compares the maternal and infant-related variables among the three groups (controls, no PTSD and PTSD at T0 among NICU mothers). The baseline psychological scores are presented in Table 2. Depression and anxiety symptoms in NICU mothers with PTSD were significantly higher than those in NICU mothers with no PTSD and controls. Within the NICU mothers group, there were no difference in maternal and infant-related factors between the PTSD and no PTSD subgroups.

During the follow-up evaluation of NICU mothers, we found a significant group $\times$ time interaction (F (6,126) = 7.52, $P < 0.001$) that showed four different patterns: (1) a resilient group that never exhibited PTSD symptoms during the study (G1, $n = 87$), (2) a delayed group that developed PTSD after T0 (G2, $n = 12$), (3) a persistent group that consistently exhibited PTSD symptoms

Table 1. Maternal and infant-related characteristics at baseline (T0)

		Controls (n = *53*)	*NICU*		P-*value*
			No PTSD (n = *90*)	*PTSD* (n = *30*)	
Maternal factors					
Age (years)	Mean (s.d.)	31.32 (3.21)	31.87 (3.50)	31.83 (3.23)	0.628
Duration of marriage (years)	Mean (s.d.)	2.92 (2.29)	2.83 (2.22)	3.89 (3.75)	0.156
Currently married	*n* (%)	53 (100.0)	89 (98.9)	30 (100.0)	0.629
Low educational level ($\leqslant$14 years)	*n* (%)	(Not surveyed)	32 (36.0)	10 (33.3)	0.489
Occupied	*n* (%)	31 (60.8)	34 (39.5)	14 (50.0)	0.054
C-section	*n* (%)	20 (37.7)	55 (61.1)	17 (56.7)	0.024[a]
Medical/surgical history	*n* (%)	8 (15.1)	14 (15.6)	4 (13.3)	0.957
Alcohol history	*n* (%)	5 (9.4)	34 (37.8)	12 (40.0)	0.001[b]
Smoking history	*n* (%)	0 (0.0)	3 (3.3)	0 (0.0)	0.293
Psychiatric history	*n* (%)	0 (0.0)	1 (1.1)	0 (0.0)	1.000
Infant-related factors					
Gestational age (weeks)	Mean (s.d.)	39.30 (1.28)	33.89 (3.76)	33.27 (3.91)	< 0.001[b]
Birth weight (kg)	Mean (s.d.)	3.30 (0.40)	2.03 (0.78)	2.01 (0.72)	< 0.001[b]
Duration of hospitalization (days)	Mean (s.d.)	4.48 (1.11)	39.44 (34.49)	39.60 (34.06)	< 0.001[b]
Apgar score, 1 min	Mean (s.d.)	7.52 (0.73)	5.75 (1.73)	5.72 (1.83)	< 0.001[b]
Apgar score, 5 min	Mean (s.d.)	8.65 (0.62)	7.30 (1.40)	7.38 (1.35)	< 0.001[b]
Male	*n* (%)	31 (58.5)	46 (51.1)	14 (46.7)	0.538
Twins	*n* (%)	0 (0.0)	11 (12.2)	7 (23.3)	0.003[b]
First-born baby	*n* (%)	40 (75.5)	56 (62.9)	19 (63.3)	0.277
ER visit or rehospitalization	*n* (%)	(Not surveyed)	33 (36.7)	8 (26.7)	0.220

Abbreviations: ER, emergency room; NICU, neonatal intensive care unit; PTSD, posttraumatic stress disorder. [a]Indicates significant difference between controls and the no PTSD group. [b]Indicates significant differences between controls and the no PTSD group and between controls and the PTSD group.

Table 2. Baseline evaluations of maternal psychological distress

	Controls (n = *53*)	*NICU*	
		No PTSD (n = *90*)	*PTSD* (n = *30*)
PPQ	9.06 (7.03)	9.33 (4.54)	25.23 (6.10)
STAI-T	39.21 (10.05)	39.81 (9.16)	48.63 (9.24)
STAI-S	37.57 (10.10)	41.43 (9.49)	49.07 (10.04)
EPDS	7.45 (5.65)	7.47 (4.32)	12.80 (3.66)

Abbreviations: EPDS, Edinburgh Postnatal Depression Scale; NICU, neonatal intensive care unit; PPQ, Perinatal PSTD Questionnaire; PTSD, posttraumatic stress disorder; STAI-S, State-Trait Anxiety Inventory-State; STAI-T, State-Trait Anxiety Inventory-Trait. Values are mean (s.d.). All measures were significantly different between controls and the PTSD group and between the no PTSD and PTSD groups.

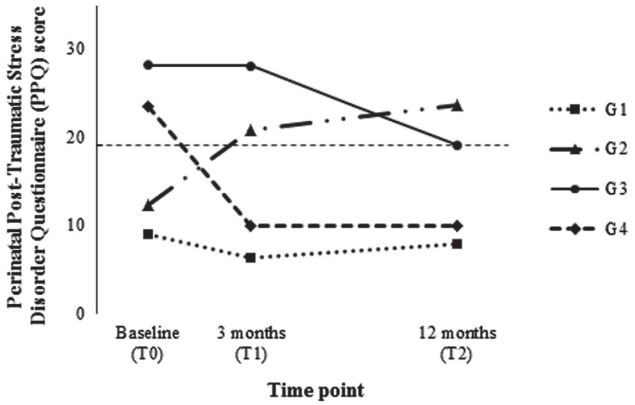

Figure 1. Progression of PTSD in NICU mothers. G1, resilient group; G2, delayed group; G3, persistent group; and G4, recovered group.

(G3, $n = 12$) and (4) a recovered group that improved after T0 (G4, $n = 19$) (Figure 1). The mixed model analyses also showed a significant effect of group (F (3,126) = 51.37, $P < 0.001$) and a trend toward a significant effect of time (F (2,126) = 2.94, $P = 0.056$). These four patterns of PTSD in NICU mothers were also demonstrated by STAI-S and Edinburgh Postnatal Depression Scale scores. In the mixed model for STAI-S, the effects of group (F (3,126) = 8.62, $P < 0.001$), time (F (2,126) = 6.87, $P = 0.002$) and group × time interaction (F (6,126) = 3.25, $P = 0.005$) were significant. As well, the Edinburgh Postnatal Depression Scale score analysis showed significant effects of group (F (3,126) = 15.26, $P < 0.001$), time (F (2,126) = 4.51, $P = 0.013$) and group × time interaction (F (6,126) = 6.52, $P < 0.001$). STAI-T scores were significantly different from each other in the four groups (F (3,116) = 7.64, $P < 0.001$). That is, the persistent PTSD group showed the highest level of trait anxiety (mean (s.d.), 51.64 (8.52)), the resilient group exhibited the lowest anxiety level (39.66 (9.11)), and the delayed PTSD and recovered groups had intermediate levels (41.38 (10.10) and 46.89 (9.41), respectively). Calculating the visit rate per time, we found that the persistent group at T1 and the resilient group at T2 showed the highest visit rates respectively, and the rates of the other groups were not different within each visit time.

Multiple logistic regression analysis was performed to identify predictive factors for PTSD at year 1; the results are shown in Table 3. Whether the infant was the mother's first born was a significant predictive factor after controlling for all the other variables included in the model (odds ratio = 7.62, 95% confidence interval 1.07 to 54.52). Although not statistically significant, the odds ratios were relatively high for twin status (odds ratio = 4.60, 95% confidence interval 0.60 to 35.43) and infants' emergency room visit or rehospitalization after NICU discharge (odds ratio = 2.82, 95% confidence interval 0.79 to 10.09).

Table 3. Prediction of PTSD in NICU mothers at year 1

	OR[a]	*95% CI*	P-*value*
Age of mothers	1.126	0.926–1.369	0.234
Low education of mothers (< 14 years)	2.326	0.593–9.126	0.226
First-born baby	7.619	1.065–54.520	0.043
Twin	4.598	0.597–35.425	0.143
Gestational ages at birth	0.982	0.809–1.192	0.854
APGAR score, 5 min	1.022	0.591–1.766	0.938
ER visit or rehospitalization	2.821	0.789–10.091	0.111

Abbreviations: CI, confidence interval; ER, emergency room; NICU, neonatal intensive care unit; OR, odds ratio; PTSD, posttraumatic stress disorder.
[a]Adjusted by all the other variables.

DISCUSSION

In this study, we prospectively investigated the course of postpartum PTSD in mothers of high-risk infants and performed analyses to identify predictive factors for PTSD at year 1. To our knowledge, there is no existing prospective study examining postpartum maternal PTSD measured with the modified PPQ, which is a clinically useful tool for evaluating postpartum emotional distress in mothers of high-risk infants. Over the year-long follow-up period, we observed four different patterns of PTSD courses in mothers of high-risk infants. Two-thirds of NICU mothers never experienced PTSD in the infants' first year of life (resilient group). Conversely, 9% suffered from persistent PTSD, another 9% experienced delayed PTSD, and the last 15% recovered from PTSD after the baseline examination at T0. The presence of PTSD at year 1 was predicted by whether the infant was the mother's first born.

The prevalence of PTSD at baseline (25%) was similar to that measure at year 1 (22.2%). However, a closer look at our results revealed that although 31 NICU mothers had PTSD at baseline and 12 of them had persistent PTSD for 1 year, the other 19 had recovered. In addition, 12 mothers who were originally in the no PTSD group developed symptoms after the baseline assessment. Our finding of variable PTSD courses could explain the previous mixed results of postpartum PTSD.[12,21–23] Moreover, our results are in line with the trajectories of adjustment levels following many kinds of psychological traumas.[32,33] The proportions of the resilient and recovered trajectories in a review of Bonanno *et al.*[33] were akin to those of our corresponding groups. In short, PTSD symptoms in the mothers of high-risk infants appeared to take courses analogous to those of PTSD following other traumas.

Although our delayed PTSD group (9%) was far greater than that of the Bonanno *et al.*[33] review (0 to 0.15%), Andrews *et al.*[34] reported that 15% of non-military PTSD cases showed delayed onset at least 6 months after trauma exposure. In a previous postpartum PTSD study of full-term delivery mothers, 6 of 7 who were diagnosed with PTSD at the 1-year follow-up were delayed cases.[14] The prevalence of PTSD after 1 year in the above study was associated with previous psychological problem and depression in early pregnancy. Boscarino *et al.*[35] studied World Trade Center disaster survivors and observed an association of delayed PTSD with lower self-esteem and more negative life events. We found a difference in trait anxiety level among the groups with different PTSD courses. The persistent and resilient PTSD groups

exhibited the highest and lowest levels of trait anxiety, respectively. Trait anxiety in our study seems to influence the threshold for postpartum PTSD in mothers of high-risk infants. In another prospective study, Holditch-Davis *et al.*[17] revealed some different courses in mothers of high-risk infants, which are explained by both the maternal psychological factors as well as infants' health statuses. Taken together, the course of postpartum PTSD could be influenced by both the traumatic event itself and other factors, including pre-traumatic characteristics. This association between the longitudinal course of PTSD and pre-traumatic characteristics is also consistent with a cross-sectional study of postpartum PTSD in subjects who experienced normal deliveries[11] and meta-analysis results of general PTSD studies.[36,37] Therefore, we need to establish a timely screening strategy for mothers to identify their psychological distress. At the same time, it should also be remarked that there were practical limitations of a full screening of mothers' pre-traumatic characteristics.[33] Future studies at various sites, which examine successful intervention programs for recovery, may provide more insight into clinicians within the context of their situations.

Among the mothers of high-risk infants, first child delivery predicted PTSD at year 1. This result can be interpreted in two ways. First, the delivery of high-risk infants may be a traumatic event for new mothers. Assuming that their first delivery was of a high-risk infant, the interaction between their child's NICU admission and their first delivery experience may influence the presence of PTSD at 1 year. Second, (yet only) a first child may be considered 'a valuable baby'. After discharge from the NICU, mothers' daily care of their baby could cause them to re-experience the trauma related to delivery or NICU hospitalization.[5,7] The mothers could be faced with numerous annoying and troublesome situations regarding their only baby's health problems and the mother–infant interaction.[7,38,39] This could distress mothers and facilitate the development and/or maintenance of PTSD, even 1 year after the initial trauma. It is interesting that the infants' baseline medical status, including birth weight and Apgar scores, did not predict PTSD at year 1. Several previous cross-sectional studies found that infants' medical status at birth predicted the mothers' PTSD within several weeks after delivery.[9,18,25,40,41] Our longitudinal study showed that infants' emergency room visit/rehospitalization during the follow-up period was weakly associated with the presence of PTSD at year 1, although the relationship was not significant. This result is also relevant to the above speculation that the first child status is a useful predictor of PTSD at year 1. The interaction between inexperienced mothers with their 'valuable' first-born babies may maintain or exacerbate PTSD. Unlike a previous study, we did not observe an association between psychiatric history and PTSD at year 1.[20] Because only one participant reported a previous psychiatric history, we were unable to evaluate the effect of this variable.

Our present study had several limitations. First, although we screened all NICU mothers who visited our rehabilitation clinic, we could neither meet all healthy infants' mothers who visited the obstetrics clinic nor know the number of non-screened mothers. Second, we surveyed the psychiatric history but not the subjects' history of lifetime traumatic events. Psychiatric history including previous traumatic experience is a known risk factor for postpartum PTSD.[4,42,43] Furthermore, only one subject reported having a history of psychiatric illness. In fact, owing to the characteristics of the hospital, we might include a larger portion of participants with higher educational or socioeconomic levels than usual. Thus, there was a possibility that, indeed, our participants seldom had a psychiatric history. In addition, an evaluation of social support during the postpartum period was not performed even though it is a known risk factor for postpartum PTSD.[4,14] At last, it also should be noted that our definition of PTSD was based on the modified PPQ scores, not the Diagnostic and Statistical Manual of Mental Disorders-Text Revision criteria.[18,26]

Early or late occurrence of postpartum PTSD could lead to poor mother–infant relationships and/or infants' emotional or behavioral problems.[5–10] Furthermore, given that the resolution of postpartum PTSD attenuates children's developmental problems,[9,44] alleviating maternal distress is crucial for ensuring mothers' mental health and the healthy development of their children. This study demonstrated the presence of delayed postpartum PTSD in a realistic clinical setting. Therefore, screening of postpartum PTSD in mothers of high-risk infants should be performed on regular basis, and timely treatment should be administered. In addition, it would be useful to establish preventive programs targeting mothers of high-risk infants without exacerbating their stigma, together with intervention programs to enhance positive emotions and thus to facilitate recovery from distress.[33,45]

On the basis of our results, we can conclude that (1) while the mothers can manifest PTSD soon after NICU hospitalization, PTSD symptoms can also be delayed and (2) the course of PTSD in mothers of high-risk infants can be influenced by infant factors, such as whether the infant was the first-born baby. We suggest that clinicians should regularly screen the mothers' distress and refer them to mental health professionals in a timely manner. More detailed studies should examine the longitudinal course of postpartum PTSD, especially among mothers with infants admitted to the NICU. Given today's low-fertility society, we must take a broad view of resolving maternal distress and provide mothers with appropriate intervention strategies beyond simply screening for postpartum PTSD.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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