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REGULAR ARTICLE

Association between the sense of coherence 13-item version scale score of pregnant women in the second trimester of pregnancy and threatened premature birth

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Abstract
Objectives The purpose of this study is to determine whether the score of the sense of coherence 13-item version (SOC-13) scale in the second trimester of pregnancy is associated with threatened premature birth.
Methods All the subjects gave their informed written consent before their participation in the study. A self-reported questionnaire survey was conducted on the pregnant women at approximately 18 weeks of pregnancy. The questionnaire consisted of items on demographic characteristics, perinatal abnormalities, stress perception scale (SPS), and SOC-13 scale. Approximately 30 weeks of pregnancy after the first survey, we surveyed whether any treatment had been provided for threatened premature birth during the course of the current pregnancy. The study period was from December 2007 to February 2010. One hundred and seventy-seven pregnant women participated in the study, but only the data from 151 pregnant women were analyzed.
Results Forty-three (28.5 %) pregnant women had threatened premature birth and received some treatment. Logistic regression analysis was carried out with threatened premature birth as the dependent variable and age, childbirth history, smoking habit, history of miscarriage or premature birth in previous pregnancies, SPS score, and SOC-13 scale score as the independent variables. It was shown that SOC-13 scale score affected threatened premature birth ($p < 0.001$) and that a low SOC-13 scale score was associated with threatened premature birth.
Conclusions This study suggests that the SOC-13 scale score in the second trimester of pregnancy could be of great value in clinical health care of pregnant women with a risk of threatened premature birth in the subsequent course of pregnancy.

Keywords Pregnant women · Stress · Sense of coherence · Threatened premature birth

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Introduction

Pregnant women are sometimes in a psychological state different from that in nonpregnant women, and they may be stressed owing to various factors such as anxiety. Studies on the effects of stress during the course of pregnancy have been conducted since the 1970s, and the relationships of perinatal abnormalities, such as miscarriage [1], premature birth [2–4], low birth weight infants [5, 6], pregnancy-induced hypertension [7], depression in pregnancy [8], and postpartum depression [9–11], with stress have been reported. Premature birth, among other abnormalities, was reported to be a major outcome of psychosocial stress during pregnancy [12]. Assessment of the relationship of daily psychosocial and social stresses during pregnancy with prenatal abnormalities showed that pregnant women feeling stressed in daily life were at a higher risk of premature birth than nonstressed pregnant women [13–16]. On the other hand, however, it was also reported that psychosocial and social stresses during pregnancy are not necessarily associated with premature birth [17–19].

Another previous study showed no relationship between perinatal abnormalities and stress, even in cases of stress induced by large-scale disasters [20]. That is, although the relationships between stress and its effects on pregnant women's health were shown in some studies [1–16], the effects of stress on health were not necessarily the same even under similar stressful conditions.

Since stress is subjective and stress response differs depending on an individual's stress perception and ability to cope with stress [21], studies focusing on physiological indexes such as those used to objectively assess stress have been conducted recently [2, 22–24]. For example, one study found that women with high corticotrophin-releasing hormone (CRH) levels at 28–30 weeks of gestation delivered earlier than women with lower CRH levels [2]. There were also other studies that focused on the ability to cope with stress affecting stress responses. Sjöström et al. [25] used the "sense of coherence" (SOC) scale, which determines the ability to cope with stress, to examine the relationships of the perception of health in women during pregnancy and after childbirth with SOC scale score. They found that the factor that strongly affects the women's perception of their health was SOC scale score and that the severity of anxiety and depression was low when the SOC scale score was high. Thus, they considered that the SOC scale score would serve as an important indicator for determining the need to provide psychosocial and social support to pregnant women. Studies in Japan using the SOC scale, conducted mainly on adults [26] and university students [27], demonstrated the relationships of SOC scale score with physical and mental health statuses. Studies of pregnant women using the SOC scale have recently been reported in Japan as well [28, 29]. All these studies showed the relationships between SOC scale score and well-being in pregnant women.

Given this background, we previously investigated the relationship between the stress of pregnant women and threatened premature birth focusing on the SOC scale score for determining the ability to cope with stress and serum-secretory immunoglobulin A (s-IgA) level as a physiological index. We set threatened premature birth as a dependent variable. Age, childbirth history, smoking habits, history of miscarriage, history of premature birth or threatened premature birth, the scores of stress perception scale (SPS) and SOC scale, and s-IgA level in the first half of pregnancy were set as independent variables. We found that low serum s-IgA levels and low SOC scores in the first half of pregnancy were associated with threatened premature birth [30]. The results also indicated that the s-IgA level and SOC scale score in the first half of pregnancy would potentially serve as predictive indicators of threatened premature birth. However, our study does have some limitations, including its small sample size. Physiological indexes such as s-IgA level enabled us to evaluate stress objectively, but in clinical settings they cannot be measured easily. Therefore, in this study we examined whether the SOC scale score of pregnant women was associated with threatened premature birth, using a larger population than that in our previous study [30].

Materials and methods

Subjects

The subjects enrolled in the study were pregnant women receiving prenatal checkup at four maternity hospitals in prefectures A or B, which cooperated in the survey. The study period was from December 2007 to February 2010. The subjects' informed written consent was obtained by the investigator or hospital staff members. One hundred and seventy-seven pregnant women participated in the study, but 26 subjects were excluded from analyses owing to the following reasons: three had miscarriage during their present pregnancy, two had multiple pregnancies, two had habitual abortions, two had recurrent miscarriage, nine had complications (abnormal thyroid function, 3; asthma, 3; anti-phospholipid antibody syndrome, 2; and chorioamnionitis, 1), four went to another hospital, and six gave invalid responses (overlapping among the excluded subjects). As a result, only the data from 151 pregnant women were analyzed.

Methods

A self-reported questionnaire survey was conducted on the pregnant women until 22 weeks of pregnancy. The filled out questionnaires were collected later by the authors or returned by post. Questionnaire items consisted of demographic characteristics of the subjects, the presence/absence of previous perinatal abnormalities, and items related to SPS and SOC 13-item version scale. At approximately 30 weeks of pregnancy, we assessed the current course of pregnancy using the subjects' medical records to determine whether any treatment had been provided for threatened premature birth diagnosed by the doctor handling the pregnancy.

Demographic characteristics, including the subjects' age, childbirth history, presence/absence of pregnancy complications, and smoking habit, were examined. SPS score was used as the indicator of the degree of stress perception and SOC 13-item version scale score was used as the indicator of the ability to cope with stress. SPS score is used for the assessment of the degree of perception of stress in seven areas (job, family, neighborly relations, life

circumstances, society, economic status, and one's health) [31]. Each item is scored on an eleven-point (zero to ten) scale. Zero indicates nonstressed condition, with a higher score indicating a feeling of more severe stress. The total score range was from 0 to 70. Previous studies ascertained the reliability of this assessment method [30, 31], and Cronbach's coefficient α was 0.76 in this study. SOC 13-item version scale score was used as the indicator of the ability to cope with stress. The SOC scale was developed by Aaron Antonovsky, a social stress researcher and health sociologist, on the basis of salutogenesis [32]. It is a scale based on the concept of the ability to maintain health and cope with stress. Salutogenesis is a theory focusing on how health is recovered, maintained and increased, and the SOC scale score represents the degree to which one can stay healthy even under stress. The SOC scale is composed of 29 items with a seven-point Likert scale. On the seven-point scale, a high total score indicates that stress is less likely caused even under various stress stimuli [33]. That is, a person with a high SOC scale score is less likely to perceive a situation as stressful and is more likely to adapt positively to stressful situations. Individuals with a low SOC scale score are more likely to develop feelings of anxiety and maladaptive responses to stressful situations. In the present study, the SOC 13-item version scale developed by Yamazaki [34] was used, with a total score ranging from 7 to 91. The reliability of the SOC 13-item version scale was verified in a previous study [35]. A systematic review showed that Cronbach's α coefficient is in the range of 0.70–0.92. In the present study, Cronbach's α coefficient for the SOC 13-item version scale was 0.83. Hereinafter, the SOC 13-item version scale is referred to as the SOC-13 scale.

We received approval for this study from the ethical committee of the Kanazawa University Graduate School of Medical Science (approval number 117), and this study was conducted in accordance with the Declaration of Helsinki. All the subjects gave informed written consent before their participation in the study.

Statistical analysis

For the analysis of the relationship between two variables, Pearson's or Spearman's correlation coefficient was calculated. The Chi-squared test was used to determine the independence between two variables. The significance of the difference in the mean SPS or SOC-13 scale score between primiparas and multiparas was determined by the *t* test, and that among the three groups (≤24, ≥25, ≤34, and ≥35 years) by ANOVA. Receiver operating characteristic (ROC) analysis was carried out to divide the subjects into the low score group and high score group for SPS and SOC-13 scale. Logistic regression analysis was carried out for multivariable analysis. PASW Statistics version 18.0 for Windows (SPSS Inc., an IBM company) was used for these analyses.

Results

The demographic data of the pregnant women enrolled in the study included the following: mean age (± standard deviation), 29.7 years (±5.0) (range 17–44); mean weeks of pregnancy at the time of the study, 18.1 weeks (±3.1) (range 10–21). In terms of childbirth history, the subjects consisted of 67 primiparas (44.4 %) and 84 multiparas (55.6 %). In terms of their smoking history, 13 subjects (8.7 %) smoked currently, 53 (35.3 %) had a history of smoking but quit smoking when they found they were pregnant in the present or previous pregnancies, 84 (56.0 %) had no smoking history, and 1 (1.1 %) had no answer. Regarding their history of perinatal abnormalities, 25 (16.6 %) had a history of miscarriage, preterm delivery, or threatened premature birth. In the course of the present pregnancy, 43 (28.5 %) had threatened premature birth and received some treatment (threatened premature birth group).

The relationships between the demographic characteristics (age, childbirth history, smoking habit, and the presence/absence of a previous history of miscarriage, preterm delivery, and threatened premature birth) and pregnancy course are shown in Table 1. The primiparas accounted for a significantly high percentage of the threatened premature birth group than the multiparas ($p < 0.05$).

The mean SPS score and SOC-13 scale score (± standard deviation) were 22.9 (±10.1) and 61.4 (±11.1), respectively. A correlation was observed between SPS score and SOC-13 scale score with a correlation coefficient of $r = -0.351$ ($p < 0.01$).

The SPS score and SOC-13 scale score by childbirth history and age bracket are shown in Table 2. The SOC-13 scale score showed a significant difference between groups with different childbirth histories and of different age brackets. A comparison of SOC-13 scale scores by childbirth history showed that the SOC-13 scale score was significantly lower in the primiparas than in the multiparas ($p < 0.01$). A comparison of SOC-13 scale scores between groups was carried out by age bracket. Among the three groups aged 24 years or younger, between 25 and 34 years, and 35 years or older, the SOC-13 scale score was significantly lower in the group aged 24 years or younger than in the other two groups ($p < 0.05$ and $p < 0.05$). A weak correlation was observed between age and SOC-13 scale score with a correlation coefficient of $r = 0.224$ ($p < 0.01$).

In SPS score analysis, we used ROC analysis. The maximum sensitivity and specificity for subjects with an

SPS score higher than 22 and who received some treatment for threatened premature birth were 67.4 and 50.0 %, respectively, with an area under the ROC curve of 0.59. The subjects were divided into two groups, the low SPS score group (<22, $n = 68$) and the high SPS score group (≥22, $n = 83$). The relationship between SPS score and threatened premature birth was analyzed using the Chi-squared test. The percentage of subjects with threatened premature birth tended to be higher in the high SPS score group (34.9 %) than in the low SPS score group (20.6 %); this difference, however, did not reach statistical significance ($p = 0.052$).

Similarly, the maximum sensitivity and specificity for subjects with an SOC-13 scale score of less than 60 and who received some treatment for threatened premature birth were 69.2 and 69.8 %, respectively, with an area under the ROC curve of 0.77. The subjects were divided into two groups, the low SOC-13 scale score group (<60, $n = 63$) and the high SOC-13 scale score group (≥60, $n = 88$). The relationship between SOC-13 scale score and threatened premature birth was analyzed using the Chi-squared test. The percentage of the subjects with threatened premature birth was significantly higher in the low SOC-13 scale score group (47.6 %) than in high SOC-13 scale score group (14.8 %) ($p < 0.001$).

To analyze the factors that affect the pregnancy course, logistic regression analysis was conducted with threatened premature birth as the dependent variable, and age, childbirth history, smoking habit, histories of miscarriage and preterm delivery in previous pregnancies, and SPS score and SOC-13 scale score as the independent variables. The results indicated that a low SOC-13 scale score was associated with threatened premature birth ($p < 0.001$) (Table 3).

Table 1 The relationships between demographic data of the subjects and the course of pregnancy

Variables	*n*	Threatened premature birth $n = 43$ (%)	Non-threatened premature birth $n = 108$ (%)	*p* value*
Age (years)				
≤24	22	7 (31.8)	15 (68.2)	0.929
≥25, ≤34	108	30 (27.8)	78 (72.2)	
≥35	21	6 (28.6)	15 (71.4)	
Childbirth history				
Primiparas	67	25 (37.3)	42 (62.7)	0.032
Multiparas	84	18 (21.4)	66 (78.6)	
Smoking habits				
Currently smoking	13	3 (23.1)	10 (76.9)	0.879
Currently not smoking, but with a previous history of smoking	53	16 (30.2)	37 (69.8)	
No history of smoking	84	24 (28.6)	60 (71.4)	
History of miscarriage, premature birth, or threatened premature birth in previous pregnancies				
No	126	37 (29.4)	89 (70.6)	0.587
Yes	25	6 (24.0)	19 (76.0)	

Numbers shown in the above table are the numbers of subjects, and the numbers in parentheses represent percentage

* *p* value (Chi-squared test)

Discussion

The prevalence of threatened premature birth was 28.5 % among the 151 pregnant women who participated in the present study. Previous studies have reported the prevalences of threatened premature birth to be 20.0–30.0 % [36] and 26.9 % [37]. Therefore, the prevalence of

Table 2 The SPS score and SOC-13 scale score by age bracket and childbirth history

Variables	Age (years) (*n*)			*p* value	Childbirth history (*n*)		*p* value
	≤24 (22)	≥25, ≤34 (108)	≥35 (21)		Primiparas (67)	Multiparas (84)	
SPS	23.7 ± 10.2	22.3 ± 9.8	25.4 ± 11.5	0.405[a]	23.4 ± 10.0	22.6 ± 10.2	0.607[b]
SOC-13 scale	55.3 ± 10.9	62.3 ± 10.5	63.2 ± 12.8	0.019[a]	58.3 ± 11.4	63.8 ± 10.3	0.002[b]

Numbers shown in the above table are mean ± standard deviation

[a] *p* value by one-way analysis of variance and Tukey post hoc tests

[b] *p* value by Student's *t* test

* $p < 0.05$, ** $p < 0.01$

Table 3 Logistic regression model for threatened premature birth ($n = 150$)

Variable	Regression	p value	OR	95 % CI
Age[a]				
≥25, ≤34/≤24	0.707	0.248	2.027	0.611–6.726
≥35/≤24	0.640	0.428	1.896	0.389–9.239
Childbirth history[b]	−0.517	0.253	0.596	0.246–1.447
Smoking habits[c]				
Currently not smoking, but with a previous history of smoking/no history of smoking	0.145	0.749	1.156	0.476–2.804
With history of smoking/no history of smoking	0.103	0.897	1.108	0.234–5.253
History of miscarriage, premature birth, or threatened premature birth in previous pregnancies[d]	0.036	0.951	1.036	0.328–3.270
SPS[e]	−0.050	0.913	0.951	0.389–2.330
SOC-13[f]	−0.103	0.000	0.903	0.862–0.945
Coefficient	5.343	0.003		

OR odds ratio, *95 % CI* 95 % confidence intervals

[a] Age (1; ≤24, 2; ≥25, ≤34, 3; ≥35)

[b] Childbirth history (1 = primiparas, 2 = multiparas)

[c] Smoking habits (1 = No history of smoking, 2 = Currently not smoking, but with a previous history of smoking, 3 = Currently smoking)

[d] History of miscarriage, premature birth, or threatened premature birth in previous pregnancies (1 = no history, 2 = with history)

[e] SPS (1 = values; <22, 2 = values; ≥22)

[f] SOC-13 (the score of the sense of coherence 13-item version scale)

threatened premature birth in our study is in relatively close agreement with those reported earlier in Japan.

There are several studies that showed the relationship between stress and premature birth [12–16]. Because an individual's perception of stress and ability to cope with it affect the stress response, the effects of stress on health are not necessarily the same among individuals even under similar stress conditions. In the present study, SPS score was set as an indicator of stress perception and SOC-13 scale score was set as an indicator of the ability to cope with stress, and the relationships of these indicators with threatened premature birth were analyzed. A negative significant correlation was observed between SPS score and SOC-13 scale score, and no correlation was observed between SPS score and threatened premature birth, whereas a correlation was observed between SOC-13 scale score and threatened premature birth. Logistic regression analysis showed that a low SOC-13 scale score at approximately 18 weeks of pregnancy was the factor associated with threatened premature birth. Hence, threatened premature birth was demonstrated to correlate, not with stress perception, but with SOC-13 scale score, which is an indicator of the ability to cope with stress. That is, the analysis results specifically indicate the relationship between SOC-13 scale score and health status in the subsequent course of pregnancy, as typified by the relationship between the SOC scale score during pregnancy and women's perception of their well-being during pregnancy and after delivery [25].

In a previous study, the author suggested that s-IgA level and SOC scale score could serve as predictive indicators of threatened premature birth [30]. However, our study does have some limitations, including its small sample size. Physiological markers, such as s-IgA level, enable us to evaluate stress objectively, but in clinical settings they cannot be measured easily. Maternal health care must include medical as well as psychosocial care, and previous studies [38, 39] indicate the importance of psychosocial care. However, it may not be easy for midwives or nurses and other caregivers to identify which women are in need of psychosocial care during their pregnancy within the maternal health care. According to Antonovsky's theory, SOC is stable in adulthood as long as no radical life events occur [33]. In this study, it was shown that a low SOC-13 scale score at approximately 18 weeks of pregnancy correlated with threatened premature birth ($p < 0.001$). That is, identifying women with a low SOC-13 scale score at approximately 18 weeks of pregnancy would potentially make it possible to care for those at risk of threatened premature birth in the early stage, and it would be meaningful to pay attention to the SOC-13 scale score of pregnant women as an indicator of their ability to deal with stress.

In previous studies, low SOC scale scores were related to higher anxiety [25] and depression [28], and it was reported that SOC scale score was negatively linked with antenatal fear of childbirth: A high SOC scale score works as a resiliency factor that helps pregnant women cope with the stress of their upcoming childbirth and reduces fear of childbirth [40]. Furthermore, it was shown that the stress status during early pregnancy affects the pregnancy course and the health of the fetus [41], and that maternal complications were related to low SOC scale scores [42]. Since the factors that affect the health status of pregnant women are many and complex, the results of these studies may not show a causal relationship between SOC scale score and health status. However, the findings of this study with some literature overview [25, 28–30, 40–42] indicate that the SOC scale could be of great value in clinical health care of pregnant women. This study is considered to contribute to maternal well-being in the future.

Our study has two limitations. First, we focused on threatened premature birth among various abnormalities during

pregnancy, because premature birth is a major outcome of stress during the course of pregnancy [12]. It will also be important to clarify the relationship of SOC-13 scale score with other stress-related abnormalities. Second, since the factors for threatened premature birth are complex, the results of this study may not indicate a causal relationship between SOC scale score and threatened premature birth. Accordingly, detailed observation of more physiological and psychosocial factors is required to prove this causal relationship. In a future study, the clinical usefulness of the SOC-13 scale in maternal health care should be confirmed with the outcome by using the SOC-13 scale and caring for pregnant women at risk of threatened premature birth in the early stage.

In conclusion, this study suggests that the SOC-13 scale score in the second trimester of pregnancy could be of great value in clinical health care of pregnant women with a risk of threatened premature birth in the subsequent course of pregnancy.

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Conflict of interest We have no conflict of interest to disclose.

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