Sexual & Reproductive Healthcare 39 (2024) 100930

Contents lists available at ScienceDirect

Sexual & Reproductive Healthcare

journal homepage: www.elsevier.com/locate/srhc

Sense of coherence, its components and depressive and anxiety symptoms in expecting women and their partners – A FinnBrain Birth Cohort Study

Carlos Sirkiä [a,b,*], Eero Laakkonen [c], Elisabeth Nordenswan [a], Linnea Karlsson [a,d,e], Riikka Korja [b,a], Hasse Karlsson [a,d,e], Eeva-Leena Kataja [a,e]

[a] FinnBrain Birth Cohort Study, Turku Brain and Mind Center, Department of Clinical Medicine, University of Turku, Turku, Finland
[b] Department of Psychology, University of Turku, Turku, Finland
[c] Department of Teacher Education, University of Turku, Turku, Finland
[d] Centre for Population Health Research, Turku University Hospital and University of Turku, Turku, Finland
[e] Departments of Psychiatry and Paediatrics and Adolescent Medicine, Turku University Hospital and University of Turku, Turku, Finland

ARTICLE INFO

Keywords:
Sense of coherence
SOC
Prenatal
Pregnancy
Depression
Anxiety

ABSTRACT

Objective: Expecting mothers with high sense of coherence (SOC) exhibit improved physical, emotional, and childbearing health. However, the dimensions of SOC and the factor structure of the SOC-13 scale during prenatal period is slightly known. Especially the differences in experiencing SOC and its components (comprehensibility, manageability, meaningfulness) among both expecting parents (mothers and fathers) is poorly understood. The association between SOC and mood disorder symptoms (depression and anxiety) during pregnancy is scarcely studied.

Methods: The structure of the SOC-13 scale, differences in SOC experiences, and the associations between SOC and depressive and anxiety symptoms were studied in a sample of 2784 pregnant women (mothers) and 1661 men/partners (fathers) belonging to the FinnBrain Birth Cohort Study. Self-reports (SOC-13, EPDS, SCL-90: ANX) from gestational week 24 were used. Confirmatory factor analysis (CFA) and invariance testing was carried out to investigate the factorial structure of SOC-13 among both groups (mothers and fathers). Group comparisons were used to study differences in the level of SOC among mothers vs. fathers, low vs. high depression and anxiety subgroups, and multiparous vs. nulliparous mothers.

Results: A two-factor model for SOC-13 consisting of *comprehensibility-manageability* and *meaningfulness* fitted the data best. Mothers reported higher levels of meaningfulness, whereas fathers reported higher levels of comprehensibility-manageability. SOC was significantly higher among fathers vs. mothers, but mothers with depressive symptoms reported higher SOC than fathers with depressive symptoms.

Conclusions: During pregnancy, SOC can be viewed as a two-dimensional (vs. one- or three-dimensional) concept, and mothers and fathers have differences in the components of SOC. Importantly, mothers vs. fathers with depressive symptoms express higher overall SOC indicating that pregnancy may relate to higher than usual SOC especially among women with psychological distress. Understanding how expecting mothers and fathers experience SOC during pregnancy, particularly in relation to depressive symptoms, helps midwives and maternity care providers to focus health promoting support more precisely.

Introduction

Sense of coherence (SOC), a theoretical construct and the cornerstone of medical sociologist Aaron Antonovsky's salutogenic orientation, refers to the origins of somatic and mental health and focuses on resources for maintaining health and health-promoting processes [1–5]. SOC describes a health-protective life orientation with three interrelated components: (1) *comprehensibility* (i.e. the feeling that the world makes sense; that information about the environment is ordered, consistent and explicable), (2) *manageability* (i.e. the feeling that sufficient resources are available for meeting internal and external stimuli and demands), and (3) *meaningfulness* (i.e. the feeling that the demands are challenges, worthy of investment and engagement) [1,2,6]. SOC may be viewed as a health promoting resource, strengthening resilience and developing a

* Corresponding author at: University of Turku, FinnBrain Birth Cohort Study Teutori, Lemminkäisenkatu 3, 20500 Turku, Finland.
E-mail address: carlos.sirkia@utu.fi (C. Sirkiä).

https://doi.org/10.1016/j.srhc.2023.100930
Received 19 July 2023; Received in revised form 22 October 2023; Accepted 23 November 2023
Available online 24 November 2023

positive subjective state of health [3]. SOC has been associated especially with psychological, mental and emotional, aspects of health [7].

In addition to general health, SOC has been related to health during pregnancy. For instance, the higher the SOC among pregnant women is, the better they rate their well-being, and the lower their anxiety and depressive levels are [8]. Similarly, strong SOC has been associated with lower pregnancy-specific distress [9], lower fear of childbirth [10–12], lower rates of premature birth [13] and pregnancy loss [14], and less postpartum stress reactions [15]. The scoping review by Ferguson et al. [16] identified significant associations between strong SOC and increased emotional health, improved health behaviours, and increased normal birth choices and outcomes. Moreover, Ngai and Ngu [17] reported that family sense of coherence and social support have a direct impact on pregnant women's mental health by promoting quality of life and reducing depressive symptoms. Przestrzelska et al. [18] found that significant predictors of low SOC in pregnant women were low age, multiparity, lack of social support, especially from the husband/partner, and the risk of depression during pregnancy.

Preliminary evidence suggests that SOC relates to the health and well-being of expectant fathers as well. For example, Finnbogadóttir and Persson [19] reported that the single strongest risk factor for men's depression in early pregnancy was having a low level of SOC followed by sleeping difficulties. Age, employment status, financial distress, self-reported health, smoking, use of alcohol or sexual satisfaction, in turn, were not risk factors for depression.

To better understand factors that promote parental wellbeing during pregnancy, more studies are needed that investigate SOC during prenatal period and especially among both expectant parents. Further, studies investigating SOC among expectant mothers and/or fathers suffering from clinical depressive and anxiety symptoms are needed to identify the possible psychological factors that could be intervened already during pregnancy.

Sense of Coherence Scale

The SOC scale is a systematic self-report closed questionnaire, designed to measure the level of a person's sense of coherence [6]. The original SOC scale consists of 29 items (SOC-29), whereas the shortened version consists of 13 items (SOC-13) [6]. Both scales have been widely used, and the scales have translations to at least 49 languages [20]. The internal consistency of the SOC scales has been found to be acceptable/good, with the Cronbach's alpha ranging between 0.70 and 0.95 using the SOC-29, and 0.70–0.92 using the SOC-13 [3]. Although being widely used, critics and limitations of the scale exist as well [3].

The factorial structure of the SOC scale in the three dimensions (i.e. comprehensibility, manageability and meaningfulness), as Antonovsky [6] originally suggested, is not completely solid [3]. Some studies have reported a unidimensional one-factor structure [21–24], whereas, in other studies, a multidimensional two-factor model [25–27] or, most commonly, a three-factor model [28–35] has been proposed. Although the factorial structure of the SOC scale may be multidimensional rather than unidimensional [3], the structure has varied depending on the scale used (SOC-29, SOC-13 or some modification of the scale), as well as, on the population studied.

To the best of our knowledge, only one previous study has examined the factorial structure of the SOC scale during the prenatal period. Ferguson et al. [36] reported a unidimensional nature of the SOC-13 in a large population of pregnant women (N = 718). However, the construct validity of the SOC-13 was difficult to establish using existing models partly due to the poor performance (i.e. low factor loadings) of some items. In addition, the limitations of the sample (i.e. biased towards high education and high household incomes) may have affected the results [36]. Furthermore, no previous study has focused on how expectant mothers as well as their partners, expectant fathers, experience SOC during prenatal period and how SOC might be associated with depressive and/or anxiety symptoms among both upcoming parents.

Aims of the study

The main aims of this study are to investigate the structure of the SOC-13 scale, differences in SOC experiences, and the associations between SOC and depressive and anxiety symptoms in a large general population sample of pregnant women (mothers) and their partners (fathers). The goal is to test, whether a unidimensional (one-factor) or a multidimensional (two- or three-factor) model fit the data best. Secondly, the goal is to explore the possible sex differences in the SOC-13 total scores, in the component subscores, and/or in the individual item scores during pregnancy. Thirdly, the goal is to explore how SOC is associated with low vs. high depressive and anxiety symptoms, among expectant mothers and fathers.

Materials and methods

This study is part of the FinnBrain Birth Cohort Study (https://www.finnbrain.fi) that was established to study prospectively the effects of prenatal stress on child brain development and health [37]. Recruitment for the study took place at three maternal welfare clinics of a geographically defined area performing pregnancy ultrasound scans for the women referred to give birth at Turku University Hospital in the Southwest Finland Hospital District and the Åland Islands in Finland. The Cohort follows a Pilot Study collected in 2010 (N = 203 families). The recruitment took place between December 2011 and April 2015 and relied on a personal contact by research nurses who were placed on the recruitment sites. The study used in-person recruitment during ultrasonography appointments that are routinely offered free of charge for every pregnant mother in Finland and are arranged by municipal maternity clinics at gestational week 12. The nurses approached families with sufficient knowledge of Finnish or Swedish following a normal ultrasound screening result. Of those informed about the study, a total of N = 3808 mothers and N = 2623 fathers or other partners of the mother decided to participate to the study. After recruitment, the participants filled in a set of self-report questionnaires three times during pregnancy (gestational weeks 14, 24 and 34) and at delivery. Both mothers and fathers gave written informed consent on their own and on their child's behalf. The cohort population comprises consecutive women attending the ultrasounds at gestational week 12, their children-to-be-born and fathers of the children/partners of the mothers. The Ethics Committee of the Hospital District of Southwest Finland (ETMK: 57/180/2011, § 370) approved the study protocol 14th June 2011. The full description of the cohort study and the ethical considerations are found in Karlsson et al. [37]. To find the description of the FinnBrain pilot phase study, see Pajulo et al. [38].

Sample characteristics

The study sample consists of 2784 (62.6 %) women (mothers) and 1661 (37.4 %) men (fathers) who filled the self-report measures at gestational week 24, total study sample being 4445 participants. Of all the participants decided to participate in the FinnBrain Birth Cohort Study, 1024 mothers and 962 fathers were drop out by the time of gestational week 24. The flow chart and the profile of the cohort in different phases of the study is described in more detail in Karlsson et al. [37].

The age of the mothers ranged between 17 and 46 years (M = 31.0 years, SD = 4.49). The age of the fathers ranged between 17 and 61 years (M = 32.6 years, SD = 5.34). There were 1385 (49.7 %) nulliparous and 1255 (45.1 %) multiparous mothers. In 144 cases the information on parity was missing. Since mothers and fathers took part in the study voluntarily and the participation was based on the written consent separately, the number of mothers and fathers participating the study was therefore unequal. The demographic characteristics of the study population are presented in Table 1.

Table 1
Demographic characteristics of the study population of women and men.

		Women (n = 2784) % (n)	Men (n = 1661) % (n)
Native language	Finnish	90.7 %	87.9 %
	Swedish	9.3 %	12.1 %
Marital status	Married	93.5 %	94.4 %
	In a relationship	4.7 %	5.0 %
	Not in a relationship	1.4 %	0.2 %
	Divorced	0.3 %	0.2 %
	Registered partnership	0.1 %	0.1 %
Education	Primary school	2.5 %	4.5 %
	Vocational school or High school	32.5 %	40.9 %
	Polytechnics	28.7 %	26.5 %
	University or higher	34.9 %	26.1 %
Employment status	Full time	65.5 %	82.7 %
	Part time	9.0 %	2.5 %
	Unemployed	4.0 %	4.2 %
	Student	7.5 %	6.3 %
	Other [1]	13.8 %	4.2 %

[1] Includes categories such as being on a parental leave or disability pension

Measures

Sense of coherence was evaluated using the 13-item Sense of Coherence Scale (SOC-13) [6]. The participants completed the SOC-13 [6] during the second trimester, at gestational week 24. Each item is scored on a 7-point Likert scale from 1 to 7. Items 1, 2, 3, 7 and 10 are formulated "negatively" and have, thus, to be reversed in scoring. The total score of the SOC-13 ranges between 13 and 91, with a high score expressing a strong sense of coherence. The component of *comprehensibility* (CO) consists of items 2, 6, 8, 9 and 11. The component of *manageability* (MA) consists of items 3, 5, 10 and 13. The component of *meaningfulness* (ME) consists of items 1, 4, 7 and 12. The missing item-level data was replaced by the mean score of the particular item. In 78 cases (35 women and 43 men), the answers to all the 13 items were missing and these were excluded from the data regarding the SOC-13 scale analyses. In 15 cases (8 women and 7 men) 2–4 answers were missing, and in 135 cases (88 women and 47 men) only one answer was missing. Cronbach's alpha for the SOC-13 scale in the whole study population was $\alpha = 0.85$; in women $\alpha = 0.85$, and in men $\alpha = 0.86$, thus indicating a good level of internal consistency.

Depressive symptoms were evaluated with 10-item Edinburgh Postnatal Depression Scale (EDPS) [39] at gestational week 24. Each item is scored on a 4-point Likert scale from 0 to 3. Seven of the items are formulated "negatively" and have to be reversed in scoring. The total score of the EDPS ranges between 0 and 30, with a high score expressing more depressive symptoms. Based on literature reviews [40–42], the clinical cut-off point representing high depressive symptoms was set to total score of 10 or more. Cronbach's alpha for the EPDS scale in the whole study population was $\alpha = 0.83$; in women $\alpha = 0.84$, and in men $\alpha = 0.81$.

Anxiety symptoms were evaluated with Symptom Checklist −90 (SCL-90) [43] at gestational week 24. The 10-item subscale of anxiety (SCL-90: ANX) was used. Each item is scored on a 5-point Likert scale from 0 to 4. The total score of the SCL-90: ANX ranges between 0 and 40. From this total score, an average score is calculated by dividing the total score by the number of items answered. The average score ranges from 0.00 to 4.00 points. Higher average score expresses more anxiety symptoms. Based on previous reports of the SCL-90 subscales [44,45], the clinical cut-off was set to moderately symptomatic level, the average score of 0.75 or more indicating high anxiety symptoms. Cronbach's alpha for the SCL-90: ANX scale in the whole study population was $\alpha = 0.85$; in women $\alpha = 0.84$, and in men $\alpha = 0.86$.

The general prevalence and courses of depressive and anxiety symptoms in the FinnBrain Birth Cohort study are described in Korja et al. [46].

Statistical analyses

The inspection of the demographic characteristics and the SOC-13 mean score comparisons between women and men (including high vs. low depression/anxiety subgroups), as well as nulliparous and multiparous women, were carried out using IBM SPSS Statistics software version 25. Confirmatory factor analysis (CFA) and invariance testing were conducted using Mplus software version 8.4 [47].

Confirmatory factor analysis (CFA)

Three different factorial structures were tested: (1) one-factor solution (Factor: CO + MA + ME items), (2) correlated two-factor solution (Factor 1: CO + MA items, Factor 2: ME items), and (3) correlated three-factor solution (Factor 1: CO items, Factor 2: MA items, Factor 3: ME items). The factorial structures were selected based on previous reports of the measure [6,21,25,27,30,31]. Since previous studies among Finnish populations [21,30,31,48,49], as well as, others [25,32,33,34,50,51] have consistently shown the high correlations between error terms in item 2 (belonging to CO items) and item 3 (belonging to MA items), it was assumed to be the case in our study, as well. Therefore, the covariance between error-terms of items 2 and 3 was allowed in all three factor models.

The CFA was carried out in two phases. First, all three models (with and without the error-covariance between the items 2 and 3) were tested in the whole sample (N = 4445), to examine which of the three models fitted the data best. Second, the model that was found to fit the data best was then examined separately among women (N = 2784) and men (N = 1661). Measurement invariance was evaluated to examine whether the SOC-13 scale and selected factor model operates equally among women and men.

In confirmatory factor analyses, data was used without mean replacements in missing values, and all CFA models were estimated using the full information maximum likelihood estimation method with robust standard errors, which can effectively handle missing at random data and departures from normality. Goodness-of-fit of the models was evaluated using Chi-square goodness-of-fit test (a non-significant test-result indicates acceptable fit) and well-established model fit criteria [52,53,54]: Comparative Fit Index and Tucker Lewis Index (CFI and TLI values above 0.90–0.95 result acceptable model fit), Root Mean Square Error of Approximation (RMSEA values below 0.06 result acceptable model fit) and Standardized Root Mean Square Residual (SRMR values below 0.08 result acceptable model fit). In the model comparisons between nested models, the Satorra-Bentler corrected Chi-square difference test (ΔS-Bχ^2(Δdf)) and the difference between the CFI-values (ΔCFI) was used. In the Chi-square difference test, the non-significant result ($p > .05$) supports more restricted model. In the model comparisons, Chi-square test has well-known property of over-sensitively rejecting the nested model, so the use of difference between the CFI-values has been recommended as an alternative [55]. The suggested cut-off value ΔCFI < 0.01 was used here. Small value indicates support for the more restricted model.

Results

The SOC-13 mean total score in the whole study sample was M = 66.12 (SD = 10.64, Range = 66.00). The mean total score was significantly higher among men (M = 67.34, SD = 10.55, Range = 65.00) as compared to women (M = 65.41, SD = 10.73, Range = 64.00) (t(4443) = 5.74, $p < .001$, d = 0.17). Men scored significantly higher ($p < .05$) in individual items 2 (CO), 3 (MA), 6 (CO), 8 (CO), 9 (CO), 10 (MA), 11 (CO) and 13 (MA) and women in individual items 1 (ME), 4 (ME) and 7 (ME). There were no significant differences in the SOC-13 total score or

subscores among nulliparous and multiparous women. When examining individual item scores, differences were found in two cases: nulliparous women scored higher in individual items 5 (t(2598) = 2.37, p <.018, d = 0.09) and 12 (t(2599) = 2.23, p <.026, d = 0.09). The mean scores and standard deviations of the individual items and three components of the SOC-13 scale among women and men are presented in Table 2.

Confirmatory factor analysis (CFA)

The fit for the one-factor model was rather poor. Adding of covariance between the error-terms of the item 2 and item 3 significantly improved the model fit of the one-factor model (ΔS-B$\chi^2(1) = 733.92$, p <.001; ΔCFI = 0.072) with the estimated error-correlation being at level r = 0.49 (p <.001). The fit of the two-factor and three-factor models were similarly rather poor, and in both of these models the covariance between the error terms of the items 2 and 3 was also needed to reach the acceptable model-fit. In the two-factor model, the model with error-covariance was supported (ΔS-B$\chi^2(1) = 744.27$, p <.001, ΔCFI = 0.073) with the estimated error-correlation being at level $r = 0.49$ (p <.001). In the three-factor model, the model with error-covariance was supported (ΔS-B$\chi^2(1) = 822.24$, p <.001, ΔCFI = 0.073) with the estimated error-correlation being at level r = 0.49 (p <.001). In the two-factor model, the correlation between factor 1 (CO + MA) and factor 2 (ME) was 0.78. In the three-factor model, the correlation between factor 1 (CO) and factor 2 (MA) was 0.99, factor 1 (CO) and factor 3 (ME) was 0.76, and factor 2 (MA) and factor 3 (ME) was 0.82. Due to the very high correlation of factor 1 and factor 2 in the three-factor model, the two-factor model was preferred. The model fit statistics for one-factor, two-factor, and three-factor models, with and without the adjustment of allowing the error terms of the items 2 and 3 to correlate, are presented in Table 3.

Measurement invariance testing

To further investigate whether women and men interpret the SOC-13 items in a conceptually similar way, measurement invariance testing was made. First, the factor structure of the two-factor CFA was tested separately for the groups of women and men, and the model was accepted for both groups. According to the fit indices, the model fit was slightly better for the group of men. Second, measurement invariance was tested step by step using models with more stringent restrictions: metric, scalar and strict invariance models, added with models of invariance of factor variances and means. Two-factor CFA was accepted for both the whole data and the two groups. Based on the CFI-difference, the metric model (i.e. equal loadings between sexes) was accepted (ΔCFI < 0.01), whereas, the scalar model (i.e. equal loadings and equal intercepts between the gender groups) was not supported (ΔCFI > 0.01). The most non-invariant item-intercepts were explored using the information of the model modification indexes. The partial scalar model was formed by setting the intercepts of the items 12 and 13 to be free. Based on the CFI-difference, the partial scalar model was accepted (ΔCFI < 0.01). Invariance analyses were continued with the models of strict invariance and equality of the factor variances (equal error variances of the items and equal factor variances across the groups, respectively), which were both accepted (ΔCFI < 0.01). Assuming the most parsimonious accepted invariance model, the equality of the factor means was rejected ($\chi^2(2) = 287.7$, ΔCFI = 0.017). When the group of women was set as the reference group (i.e. factor means fixed to zero), the group of men had significantly lower level in factor ME (M = -0.391, p<.001, d = 0.37) and higher level of CO-MA (M = -0.359, p <.001, d = 0.34). The results of the measurement invariance testing are presented in Table 4.

Table 2
Means (M) and standard deviations (SD) for all the SOC-13 items, total scores and component subscores among women and men.

	Women (n = 2784)		Men (n = 1661)			
	M	SD	M	SD	p (t-test)	Cohen's d
Item 1 (ME)	5.81	1.30	5.44	1.50	0.000	0.27
Item 2 (CO)	4.42	1.26	4.68	1.25	0.000	0.21
Item 3 (MA)	4.52	1.39	4.84	1.33	0.000	0.24
Item 4 (ME)	5.45	1.10	5.34	1.11	0.001	0.10
Item 5 (MA)	5.29	1.45	5.35	1.45	0.145	0.05
Item 6 (CO)	5.34	1.41	5.42	1.41	0.045	0.06
Item 7 (ME)	5.20	1.04	4.97	1.15	0.000	0.21
Item 8 (CO)	5.06	1.51	5.49	1.39	0.000	0.29
Item 9 (CO)	5.07	1.64	5.35	1.48	0.000	0.18
Item 10 (MA)	4.74	1.35	4.97	1.36	0.000	0.17
Item 11 (CO)	4.17	1.30	4.51	1.30	0.000	0.26
Item 12 (ME)	5.26	1.36	5.24	1.41	0.671	0.01
Item 13 (MA)	5.10	1.52	5.70	1.27	0.000	0.42
Subscore CO	24.03	4.88	25.46	4.79	0.000	0.29
Subscore MA	19.63	4.08	20.89	3.85	0.000	0.31
Subscore ME	21.72	3.37	20.96	3.72	0.000	0.21
Total score	65.41	10.73	67.34	10.72	0.000	0.18

CO = comprehensibility, MA = manageability, ME = meaningfulness.

Table 3
The model fit statistics for the alternative factor structure models of the SOC-13 scale.

Model	χ^2	df	RMSEA	CFI	TLI	SRMR
One-factor model with no adjustment	2189.78***	65	0.087	0.838	0.805	0.056
One-factor model with the adjustment of error-covariance between items 2 & 3	1239.18***	64	0.065	0.910	0.891	0.043
Two-factor model with no adjustment	1761.31***	64	0.078	0.870	0.842	0.050
Two-factor model with the adjustment of error-covariance between items 2 & 3	812.733***	63	0.052	0.943	0.929	0.035
Three-factor model with no adjustment	1754.87***	62	0.079	0.871	0.837	0.050
Three-factor model with the adjustment of error- covariance between items 2 & 3	791.60***	61	0.052	0.944	0.929	0.035

*** p <.001, RMSEA = Root Mean Square Error of Approximation, CFI = Comparative Fit Index, TLI = Tucker Lewis Index, SRMR = Standardized Root Mean Square Residual.

Sense of coherence's relation to depressive and anxiety symptoms

The means and standard deviations of EDPS and SCL-90: ANX total scores are presented in Table 5. The correlations between EPDS and SCL-90: ANX total scores to SOC-13 total and factor scores among women and men are presented in Table 6. To control the possible effect of age to the association between SOC-13 and EPDS, SCL-90: ANX measures, partial correlation with age as a control variable was made. However, no notable differences in correlation coefficients were noticed, and all correlations remained statistically significant. Therefore, the Pearson correlations without the controlled variable of age, are reported (Table 6). The correlation between SOC-13 and age in the data was very small (r = < 0.07).

Mothers with low EPDS scores (<10) had higher SOC-13 total score (t(2745) = 24.56, p <.001, d = 0.98), higher Factor 1 score (t(4277) = 24.22, p <.001, d = 0.74), and higher Factor 2 score (t(4277) = 17.63, p

Table 4
Measurement invariance testing based on multigroup two-factor CFA (women vs. men).

Model	χ^2	df	*p*	CFI	TLI	RMSEA	$\Delta_{S\text{-}B}\ \chi^2$(df); *p*	ΔCFI
Men (n = 1618)	312.22	63	< 0.001	0.948	0.935	0.049	–	–
Women (n = 2749)	548.74	63	< 0.001	0.942	0.928	0.053	–	–
Model 1: Configural	858.47	126	< 0.001	0.944	0.930	0.052	–	–
Model 2: Metric	906.34	137	< 0.001	0.941	0.933	0.051	45.90(11); < 0.001	0.003
Model 3: Scalar	1156.58	148	< 0.001	0.922	0.918	0.056	283.25(11); < 0.001	0.019
Model 3b: Partial scalar	1017.53	146	< 0.001	0.933	0.928	0.052	120.80(9); < 0.001	0.008
Model 4: Strict	1126.56	159	< 0.001	0.926	0.927	0.053	106.86(13); <0.001	0.007
Model 5: Equal factor variances	1162.82	161	< 0.001	0.923	0.925	0.053	39.88(2); <0.001	0.003
Model 6: Equal factor means	1418.96	163	< 0.001	0.903	0.908	0.059	287.70(2); < 0.001	0.017

In model 3b the intercepts for items 12 and 13 are free. $\Delta_{S\text{-}B}\chi^2$(df): Satorra-Bentler corrected χ^2-difference test.

Table 5
Descriptive statistics of EPDS and SCL-90: ANX total scores at gestational week 24 for the whole study sample and among mothers and fathers separately.

		M	SD	Minimum	Maximum	Range
All (N = 4369)	EPDS	4.45	3.87	0	25	25
	SCL-90: ANX	3.45	4.14	0	36	36
Mothers (n = 2744)	EPDS	4.98	4.04	0	25	25
	SCL-90: ANX	3.92	4.26	0	30	30
Fathers (n = 1625)	EPDS	3.54	3.37	0	24	24
	SCL-90: ANX	2.66	3.80	0	36	36

M = Mean, SD = Standard deviation

Table 6
Correlation matrix of the sense of coherence (SOC-13) and depressive symptom (EPDS) and anxiety symptom (SCL-90: ANX) scales among mothers and fathers.

	SOC-13 Total score	SOC-13 Factor 1 score	SOC-13 Factor 2 score	EPDS Total score	SCL-90: ANX Total Score
SOC-13 Total score	**1.00**	0.954***	0.770***	-0.602***	-0.529***
SOC-13 Factor 1 score [1]	0.945***	**1.00**	0.599***	-0.602***	-0.523***
SOC-13 Factor 2 score [2]	0.791***	0.604***	**1.00**	-0.438***	-0.398***
EPDS Total score	-0.626***	-0.631***	-0.473***	**1.00**	0.634***
SCL-90: ANX Total Score	-0.503***	-0.515***	-0.368***	0.657***	**1.00**

Above the diagonal (bolded) are the Pearson correlations for mothers (n = 2784).
Below the diagonal (bolded) are the Pearson correlations for fathers (n = 1661).
*** *p* <.001.
[1] Factor 1 = *comprehensibility–manageability*, [2] Factor 2 = *meaningfulness*.

<.001, d = 0.54) than mothers with high EPDS total score (≥10). Similarly, fathers with low EPDS scores had higher SOC-13 total score (t(1615) = 17.19, *p* <.001, d = 0.86), higher Factor 1 score (t(1615) = 17.01, *p* <.001, d = 0.85), and higher Factor 2 score (t(1615) = 13.58, *p* <.001, d = 0.68) than fathers with high EPDS total score.

In the groups of mothers and fathers with low EDPS total score (<10), fathers had higher SOC-13 total score (t(3885) = 3.65, *p* <.001, d = 0.12) as well as higher Factor 1 score, (t(3885) = 8.46, *p* <.001, d = 0.27) than mothers, and mothers had higher Factor 2 score (t(3885) = 7.87, *p* <.001, d = 0.25) than fathers. Conversely, in the groups of mothers and fathers with high EDPS total score (≥10), mothers had higher SOC-13 total score (t(475) = 2.43, *p* <.05, d = 0.22) as well as higher Factor 2 score (t(475) = 6.61, *p* <.001, d = 0.61) than fathers: in Factor 1 score, no statistically significant differences were found. The means and standard deviations of SOC-13 total scores, as well as the two factor scores based on the groups of high and low EPDS total scores are presented in Table 7.

Mothers with low SCL-90: ANX average score had higher SOC-13 total score (t(2742) = 23.31, *p* <.001, d = 0.89), higher Factor 1 score (t(2742) = 23.00, *p* <.001, d = 0.88), and higher Factor 2 score (t(2742) = 17.14, *p* <.001, d = 0.65) than mothers with high SCL-90: ANX average score. Similarly, fathers with low SCL-90: ANX average score had higher SOC-13 total score (t(1623) = 16.79, *p* <.001, d = 0.83), higher Factor 1 score (t(1623) = 17.30, *p* <.001, d = 0.86), and higher Factor 2 score (t(1623) = 11.23, *p* <.001, d = 0.56) than fathers with high SCL-90: ANX average score.

In the groups of mothers and fathers with low SCL-90: ANX average score (<0.75), fathers had higher SOC-13 total score (t(3782) = 3.74, *p* <.001, d = 0.12) as well as higher Factor 1 score, (t(3782) = 8.61, *p* <.001, d = 0.28) than mothers, and mothers had higher Factor 2 score (t(3782) = 7.89, *p* <.001, d = 0.26) than fathers. In the groups of mothers and fathers with high SCL-90 ANX average score (≥0.75), mothers had higher Factor 2 score (t(583) = 4.80, *p* <.001, d = 0.40) than fathers: in Factor 1 score and in SOC total score, no statistically significant differences were found. The means and standard deviations of SOC-13 total scores, as well as the two factor scores based on the groups of high and low SCL-90: ANX average score are presented in Table 8.

Discussion

In this study, the structure of the thirteen-item Sense of Coherence Scale (SOC-13), differences in SOC experiences, and the associations between SOC and depressive/anxiety symptoms were examined in a large general population sample of pregnant women (mothers) and their partners (fathers) participating to the longitudinal FinnBrain Birth Cohort Study.

This study has three main findings. Firstly, confirmatory factor analysis showed that the soundest factorial structure was a multidimensional two-factor (vs. one- or three-factor) correlated adjusted model. Although the three-factor vs. two-factor model had slightly better model fit indices, it was noted that the correlation between the factors representing *comprehensibility* items and *manageability* items in the three-factor model was excessive high ($r = 0.99$). Therefore, the two-factor model was selected to present the best fit. The two components of SOC were *comprehensibility–manageability* (Factor 1) and *meaningfulness* (Factor 2). The preference to two-factor model in the SOC scale has been reported in one very recent study [26] as well as at least in two earlier studies [25,27]. Our study shows, for the first time, that the multidimensional two-factor model of the SOC scale describes the experiences of SOC during the prenatal period among pregnant mothers, as well as, expectant fathers. In previous pregnancy-related studies, only unidimensional factor structure of the SOC scale and concerning only

Table 7
Means (M) and standard deviations (SD) of SOC-13 total scores and two factor scores in the groups of low and high EDPS total scores among mothers and fathers.

	Low EPDS total score (<10)					High EPDS total score (≥10)				
	Mothers (n = 2374)		Fathers (n = 1513)		t-test[1]	Mothers (n = 373)		Fathers (n = 104)		t-test[1]
	M	SD	M	SD		M	SD	M	SD	
SOC-13 Total score	67.15	9.52	68.30	9.61	***	54.11	9.67	51.45	10.43	*
SOC-13 Factor 1 score [2]	45.08	7.58	47.16	7.30	***	34.88	7.40	34.51	7.81	Ns.
SOC-13 Factor 2 score [3]	22.14	3.14	21.29	3.53	***	19.01	3.47	16.38	4.01	***

* = p <.05.
*** = p <.001.
Ns. = not significant.
[1] = independent *t*-test between mothers and fathers.
[2] Factor 1 = *comprehensibility–manageability*, [3] Factor 2 = *meaningfulness*.

Table 8
Means (M) and standard deviations (SD) of SOC-13 total scores and two factor scores in the groups of low and high SCL-90: ANX average scores among mothers and fathers.

	Low SCL-90: ANX average score (<0.75)					High SCL-90: ANX average score (≥0.75)				
	Mothers (n = 2374)		Fathers (n = 1513)		t-test[1]	Mothers (n = 373)		Fathers (n = 104)		t-test[1]
	M	SD	M	SD		M	SD	M	SD	
SOC-13 Total score	67.26	9.58	68.45	9.66	***	55.65	9.85	54.01	10.07	Ns.
SOC-13 Factor 1 score [2]	45.16	7.62	47.31	7.29	***	36.08	7.64	36.08	7.51	Ns.
SOC-13 Factor 2 score [3]	22.17	3.16	21.28	3.57	***	19.34	3.39	17.67	4.11	***

*** = *p* <.001.
Ns. = not significant.
[1] = independent *t*-test between mothers and fathers.
[2] Factor 1 = *comprehensibility–manageability*, [3] Factor 2 = *meaningfulness*.

pregnant mothers, has been reported [36]. Additionally, our invariance testing represents similar results that have been reported recently concerning measurement invariance of SOC-13 across gender and a wide age range (16–83 years) [26]. The measurement invariance test results of our study in a large birth cohort support the invariance of the scale (see Table 4). In our study, age did not have a confounding effect to SOC, and the association between SOC and age was very weak. Secondly, it was also found that during pregnancy men scored significantly higher than women on the SOC-13 total score, however, the difference being rather minimal (1.93 points) considering the scale of 13–93 points. This was found regardless of parity. Similar findings emerge for example from the study by Ekelin et al. [56] who found that among women and men there were no statistical differences in the level of SOC before and after ultrasound examination, but in both cases (i.e. before and after the examination) men had statistically slightly higher total score of SOC-13 than women (mean difference being 2.0 or 2.4 points). When examining the SOC-13 total score among women only, we found no differences between nulliparous and multiparous mothers which results are similar to previous reports [8,36,56,57]. Lastly, expecting mothers with low depressive/anxiety symptoms had stronger SOC than expecting mothers who had high symptoms. Similarly, expecting fathers with low depressive/anxiety symptoms had stronger SOC than expecting fathers who had high symptoms. When comparing the level of SOC between mothers and fathers with high depressive symptoms, we found that mothers with high depressive symptoms had stronger overall SOC than fathers with high depressive symptoms which we find particularly interesting.

The results of this study support findings from previous research in which strong SOC has been related to positive mental health and to the lack of psychiatric symptoms [3,58], and SOC during pregnancy has been found to have associations with fewer depressive and/or anxiety symptoms [8,19,36]. Most interestingly, our study showed that the level of SOC differs between pregnant women and their partners. Women reported significantly higher levels of *meaningfulness*, whereas men reported significantly higher levels of *comprehensibility–manageability*. In addition to group comparisons, this was found in the measure invariance testing. Considering that in previous population-based studies [21,49,59] no such tendency has been found, it seems that the prenatal period may influence the experience of SOC differently among women and men. Furthermore, our study indicates for the first time that among those expectant parents who report high depressive symptoms during pregnancy, women (mothers) have stronger SOC than men (fathers).

Based on a large Finnish population-based study, Bernabé et al. [21] have concluded that the components of comprehensibility, manageability and meaningfulness should be merged when measuring SOC. The results of our study indicate that the time of pregnancy makes an exception to the experience of life orientation and sense of coherence. This concerns the fundamental experience how the world, life and environment are being viewed during prenatal period. The time of pregnancy and becoming a parent seem to shape this experience in differing ways among expectant mothers and fathers. Evidence suggests that sense of coherence and its components are associated with personality traits [60] and that a substantial proportion of genetic variation in SOC is shared with mental health, self-esteem and personality indicators [61]. SOC in relation to depressive and anxiety symptoms during perinatal period of life becomes, therefore, particularly interesting focus of research and concerns health care systems and family well-being as well. Based on our study, sense of coherence appears to be associated with depressive and anxiety symptoms differently among

mothers-to-be and fathers-to-be, and SOC is reported higher among women vs. men with high levels of psychological distress during prenatal period. This gives valuable information for health and social care professionals working with expectant mothers and fathers. Focusing on psychological resources promoting health and on the experience of meaningfulness might help especially those women who experience symptoms of depression.

Strengths and limitations

The strength of our study is a large pregnancy cohort including both women and men. Only a few previous SOC related studies [19,56,62,63] have included expectant fathers/partners/men. Only one of these studies [56] focused on normal cohort study sample whereas in others [19,62,63] the level of SOC was examined in relation to pregnancy-specific abnormalities and complications. Therefore, our study widens the knowledge on expectant fathers' experiences during pregnancy in a general population level. Moreover, our study is the first study to report the factorial structure of the SOC-13 scale among the study population of both expectant parents.

The limitations of our study concern using only one measurement point of SOC (i.e. second trimester) narrowing the conclusions that can be made of the level of SOC during pregnancy. Contradictory to the general theory of SOC by Antonovsky [1,2], there are some indications that SOC may not be stable during and/or after pregnancy [57,64,65]. Therefore, to gain a broader view from this perspective, using more than only one measurement point of SOC and follow-up would be most optimal setting.

Conclusions

During the time of pregnancy, SOC may be best characterized as a two-dimensional concept consisting of the components of comprehensibility–manageability and meaningfulness. Mothers report higher level of meaningfulness, and fathers report higher level of comprehensibility–manageability. Generally, expecting fathers report higher overall SOC than expecting mothers. However, mothers with depressive symptoms report higher SOC than fathers with depressive symptoms. The knowledge of how expectant parents experience SOC during prenatal period is important considering the becoming parenthood, parent–child relationship, as well as family well-being more widely. Understanding how expecting mothers and fathers experience SOC differently, particularly in relation to depressive symptoms, helps midwives and maternity care providers to focus health promoting support more precisely.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

The authors wish to thank the participating FinnBrain families for their contribution and the staff and assisting personnel for their work for the logistics of the project. We also wish to thank professor Heikki Hämäläinen for the supervision and comments on the work. The study was funded by **The Academy of Finland**, **Finnish State Grants for Clinical Research** and **Turku University Foundation** which all are gratefully acknowledged.

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