

Effect of Preoperative Pain Catastrophizing on Postpartum Depression and Chronic Postsurgical Pain After Cesarean Section: A Prospective Cohort Study

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Objective: We aimed to analyze the effects of pain catastrophizing on Chronic postsurgical pain (CPSP) and postpartum depression (PPD) in cesarean section (CS).

Methods: Women who underwent CS at our hospital between January 15th 2023 and August 15th 2023 were included. Pain catastrophizing was assessed before the surgery. The outcomes were the incidence of CPSP and PPD at 3, 6 and 12 months postoperatively. Bivariate logistic regression was used to identify risk factors for CPSP and PPD. Confounding factors were adjusted to determine the association between preoperative pain catastrophizing and CPSP and PPD.

Results: A total of 658 women were followed up after CS. The incidence of CPSP at 3, 6 and 12 months postoperatively were 18.8% (124/658), 9.3% (61/658) and 3.5% (23/658), respectively. The incidence of PPD at 3, 6 and 12 months were 14.0% (92/658), 6.8% (45/658) and 5.9% (39/658), respectively. Univariate analysis revealed significant differences between the CPSP and no-CPSP groups, as well as the PPD and no-PPD groups, in terms of BMI incision length, intraoperative hemorrhage, inadequate analgesia, and pain catastrophizing at 3, 6, and 12 months postoperatively ($P < 0.05$). Spearman correlation analysis showed that pain catastrophizing was correlated with CPSP at 3, 6, 12 months and PPD at 3 months ($P < 0.05$). Binary logistic regression analysis showed that, after controlling for confounding variables, pain catastrophizing was associated with an increased risk of CPSP at 3 months (odds ratio [OR] = 2.501, 95% confidence interval [CI] = 1.265–4.926) and PPD at 3 months (OR = 2.144, 95% CI = 1.116–4.117), but not CPSP (OR = 0.645, 95% CI = 0.265–1.568) and PPD at 6 months (OR = 0.531, 95% CI = 0.249–1.131) or CPSP (OR = 0.818, 95% CI = 0.959–1.501) and PPD (OR = 0.979, 95% CI = 0.936–1.024) at 12 months after surgery.

Conclusion: Although the long-term effects of pain catastrophizing require further research, medical professionals still need to conduct brief psychoeducation in the preoperative period, conducting routine PCS screening to identify high-risk patients to reduce the incidence of CPSP and PPD after CS.

Keywords: cesarean section, chronic postsurgical pain, postpartum depression, pain catastrophizing

Background

Chronic Postsurgical Pain (CPSP) and Postpartum Depression (PPD) After Cesarean Section

Cesarean section (CS) is the most commonly performed surgical procedure worldwide, and its global prevalence continues to rise. The World Health Organization (WHO) estimates that the global CS rate will increase from the current 21.1% to 28.5% by 2030, reaching approximately 38 million cesarean births annually.¹ With changes in birth policies, the

CS rate in China has already exceeded 40%.² Postoperative pain is a major concern for women undergoing CS. Poorly managed pain following the procedure adversely affects recovery, hindering mobility, limiting the ability to care for a newborn, and prolonging hospital stays.³ Additionally, inadequately controlled acute pain is a well-established risk factor for CPSP.⁴ The International Association for the Study of Pain defines CPSP as a pain that develops or intensifies after a surgical procedure, persists for at least 3 months, and is localized to the surgical area.⁵ The incidence of CPSP following surgical operations ranges from 3.3% to 46.1%, representing a significant clinical problem due to its negative impact on quality of life.^{6,7} Despite the high frequency of CPSP, chronic pain after CS has not been well-studied. The vast number of CS performed worldwide suggests that CPSP will become an increasing public health concern. Thus, improved strategies for managing CPSP following CS could greatly benefit the lives of many women.

PPD is one of the most common psychiatric disorders of the perinatal period and one of the most important complications of CS. PPD has a global prevalence rate of 17.22%, with the highest risk of onset occurring within the first 3 months postpartum.⁸ PPD not only affects maternal physical and mental health but also reduces lactation, affects the mother-child relationship, and has long-term implications for the child's health.⁹ Given these consequences, it is crucial to identify factors that contribute to PPD symptoms in new mothers.

Effect of Preoperative Pain Catastrophizing on CPSP

Pain catastrophizing is a cognitive pattern characterized by negative thoughts and feelings about pain, including magnification, rumination, and helplessness.¹⁰ Pain catastrophizing has been shown to prolong postoperative opioid use and exacerbate postoperative acute pain.¹¹ It has been shown to be associated with increased acute pain after CS in a prospective cohort study and worse outcomes in analgesic effect and satisfaction.¹² However, the relationship between pain catastrophizing and chronic pain after CS remains unclear. A meta-analysis of 41 studies demonstrated a significant association between pain catastrophizing and CPSP after surgery.¹³ Therefore, exploring the relationship between pain catastrophizing and CPSP may be of great significance for pain management after CS.

Effect of Preoperative Pain Catastrophizing on PPD

CPSP, pain catastrophizing, and mental health disorders such as depression frequently co-occur and are challenging to manage. Evidence suggests that pain catastrophizing may contribute to depressive symptoms, potentially mediating the relationship between chronic pain and depression.¹⁴ In a longitudinal study of chronic pain, pain intensity or catastrophizing change, depressive symptoms change in the same direction.¹⁵ Patients with a high level of pain catastrophizing are prone to a sense of helplessness in the face of pain and amplify the negative emotions brought about by pain. PPD is a significant health concern for postpartum women, with a prevalence of 23.5% among healthy mothers in a recent study.¹⁶ The risk is higher in women who undergo CS due to surgical trauma and related complications.¹⁷ Exploring the influence of preoperative pain catastrophizing on PPD is therefore of considerable clinical importance.

We investigated the effects of preoperative pain catastrophizing on the incidence of CPSP and PPD in Chinese women undergoing CS. Preoperative pain catastrophizing were assessed 2 hours before surgery, and data such as intraoperative bleeding, incision length, and postoperative pain control were collected. CPSP and PPD were assessed at 3 and 6 months, respectively, and their associations with preoperative pain catastrophizing were analyzed.

Methods

Setting and Participants

A prospective cohort study was conducted on a consecutive sample of patients who underwent CS and were discharged from Mianyang Central Hospital, School of Medicine, University of Electronic Science and Technology of China, between January 15th, 2023, and August 15th, 2023. Written informed consent was obtained from all participants prior to inclusion in the study. The study was conducted in accordance with the Declaration of Helsinki and the World Medical Association and was approved by the Ethics Committee of Mianyang Hospital Affiliated with the University of Electronic Science and Technology of China (Reference Number: S20230369-01) on January 11th, 2023. The aim was to analyze the effects of preoperative pain catastrophizing on CPSP and PPD in CS. The inclusion criteria were: (I) age >

18 years, (II) gestational age of 37–42 weeks, and (III) ability to provide informed consent. Participants with chronic pain during pregnancy, mental disorders, serious obstetric complications, other underlying medical conditions or refusal for participation were excluded.

Instruments

Sociodemographic Information Questionnaire

Demographic data collected included age, BMI, repeat cesarean delivery, emergency surgery, anesthesia method, ASA classification, length of incision, duration of surgery, intraoperative hemorrhage, birth weight, complications, inadequate analgesia after surgery, CPSP at 3,6 and 12 months, and PPD at 3, 6 and 12 months.

Pain Catastrophizing Scale

The Pain Catastrophizing Scale (PCS) was used to evaluate rumination, magnification, and pessimism. The PCS is a reliable and valid tool for pain and psychometric studies.¹⁸ Each item is scored on a scale of 0 (not at all) to 4 (all the time), yielding a total score range of 0 to 52, with higher scores indicating greater levels of pain catastrophizing. In the current sample, the PCS demonstrated high internal consistency (Cronbach's alpha=0.91). A total PCS score of 30 was considered clinically significant for pain catastrophizing.¹⁹

Chronic Postsurgical Pain

Pain severity was measured using a Numeric Rating Scale (NRS), ranging from 0 to 10, where 0 indicates no pain and 10 indicates the maximum imaginable pain.¹⁷ CPSP was defined as pain developing after surgery in or near the surgical site and persisting for ≥ 3 months, with an NRS score of 1 or higher at rest and/or during movement.²⁰

Postpartum Depression

The Edinburgh Postnatal Depression Scale (EPDS) was used to assess PPD. This instrument consists of ten multiple-choice questions (with four options). The options for each item were scored from 0 to 3 based on symptom severity. The range of scores was 0–30. Higher scores indicate a greater number of depressive symptoms. Good internal consistency for the EPDS was observed in the current sample (Cronbach's alpha=0.89). PPD symptoms were measured at 3,6 and 12 months postpartum, with scores > 13 indicating the presence of depressive symptoms.²¹

Data Collection

Data were collected by personnel trained in standardized protocols. The structured questionnaire, including general demographic information and PCS, was administered during the preoperative anesthesia assessment within 2 hours before surgery. The purpose of the study was explained to the patients and informed consent was obtained. Participants willing to participate in the survey completed the questionnaire independently, under the unified guidance of the researchers. Anesthesia methods, ASA, incision length, operation duration, intraoperative bleeding, birth weight, and complications were collected from electronic medical records before discharge. Insufficient analgesia was recorded if the NRS score exceeded 3 points at 24/48 hours after surgery.

Two investigators, who were trained in the use of standardized telephone interviews, conducted follow-up assessments at 3,6 and 12 months postoperatively. Three months after surgery, patients were contacted by telephone to assess the presence of pain. Patients reporting pain at 3 months were followed up for 6 and 12 months. The patients were blinded to their perioperative care to avoid potential bias. After confirming no evidence of disseminated or recurrent disease, each patient was asked about any pain experienced at or near the surgical site and whether this pain developed specifically after the surgery. Patients who answered “no” to these questions did not proceed with further questions, while those who answered “yes” completed the interview questionnaire.

Data Analysis

Data were coded, entered, and analyzed using IBM SPSS Statistics for Windows, version 26 (IBM Corp). Continuous variables were expressed as mean \pm standard deviation(SD) or as median and interquartile range. Categorical variables

were presented as numbers and percentages. Univariate analysis was performed between the CPSP and non-CPSP groups and the EPDS and non-EPDS groups. Continuous variables were analyzed using the Mann–Whitney *U*-test or the independent samples *t*-test, depending on normality. The chi-square test was used to compare categorical variables. Spearman correlation analysis was used to examine the relationships between PCS, CPSP, and PPD at 3 and 6 months after surgery. Variables with $P < 0.05$ were entered into multivariate stepwise backward logistic regression to identify predictors of CPSP and PPD. Odds ratio(OR) with corresponding 95% confidence interval(CI) were calculated for each variable to assess the variable's impact on CPSP prediction. The goodness-of-fit of the logistic regression model was evaluated using the Hosmer-Lemeshow test. Statistical significance was set at $P < 0.05$.

Results

A total of 706 patients were recruited in this study. Twelve declined to participate, and 14 were excluded for the following reasons: no pain during the CS ($n=3$), severe complications ($n=5$), and being transferred to the intensive care unit ($n=6$). Among the remaining 680 patients, 13 dropped out during in-hospital follow-up, 1 was re-hospitalization and 8 were lost to follow-up during the telephone interviews conducted after surgery. This left data from 658 patients for analysis. A flowchart illustrating the patient inclusion process is provided in [Figure 1](#).

Prevalence and Characteristics of CPSP and PPD

Data from 658 participants were analyzed, representing a response rate of 93.2% (658/706). The average age of the participants was 31.51 ± 4.31 years. More than half of the participants had a BMI within the acceptable range of 18.5 to 28 (53.3%). Most underwent primary cesarean delivery (74.5%), emergency surgery (96.7%), intravertebral anesthesia (92.2%), and were classified as ASA III (92.1%).

In this cohort, 35.6% (234/658) reported PCS before surgery, 18.8% (124/658) reported CPSP at 3 months, 9.3% (61/658) at 6 months and 3.5% (23/658) at 12 months after surgery. The incidence of PPD at 3, 6 and 12 months was 14.0% (92/658), 6.8% (45/658) and 5.9% (39/658), respectively. Details of incision length, duration of surgery, intraoperative hemorrhage, birth weight, complications, and inadequate postoperative analgesia in the parturient women are summarized in [Table 1](#).

Statistical analysis showed significant differences between the CPSP and non-CPSP groups and between the PPD and non-PPD groups at 3 months post-surgery in variables such as BMI, repeat cesarean delivery, length of incision, intraoperative hemorrhage, inadequate analgesia after operation, and PCS ($P < 0.05$) ([Table 2](#)). At 6 months after the surgery, there were statistically significant differences in BMI, Length of incision, Intraoperative hemorrhage, Inadequate analgesia within after operation and PCS between the CPSP and the non-CPSP group, as well as between the PPD and the non-PPD group ([Table 3](#)). Similar differences were observed at 12 months after surgery ([Table 4](#)).

Correlation Analysis of Preoperative Pain Catastrophizing with CPSP and PPD

Spearman correlation analysis revealed significant correlations between preoperative PCS and CPSP at 3, 6, 12 months, PPD at 3 months after surgery ($r=0.858, 0.165, 0.158$ and 0.192 respectively; $P < 0.05$). However, no significant correlation was observed between PCS and PPD at 6 and 12 months ($r=0.058, 0.038$ respectively; $P > 0.05$) ([Table 5](#)).

Binary Logistic Regression Analysis of CPSP and PPD at 3 Months After CS

As [Table 6](#) shows, after adjusting for covariates (BMI, repeat cesarean delivery, length of incision, intraoperative hemorrhage, birth weight, and inadequate analgesia within the postoperative period), the PCS before surgery was independently associated with CPSP and PPD at 3 months after CS. The two models showed good calibration by Hosmer-Lemeshow goodness of fit statistic with $\chi^2 = 7.197, P = 0.409$ (CPSP at 3 months) and $\chi^2 = 0.238, P = 1.015$ (EPDS at 3 months), respectively. This indicates that the models demonstrated moderate discriminatory power and good calibration.²²

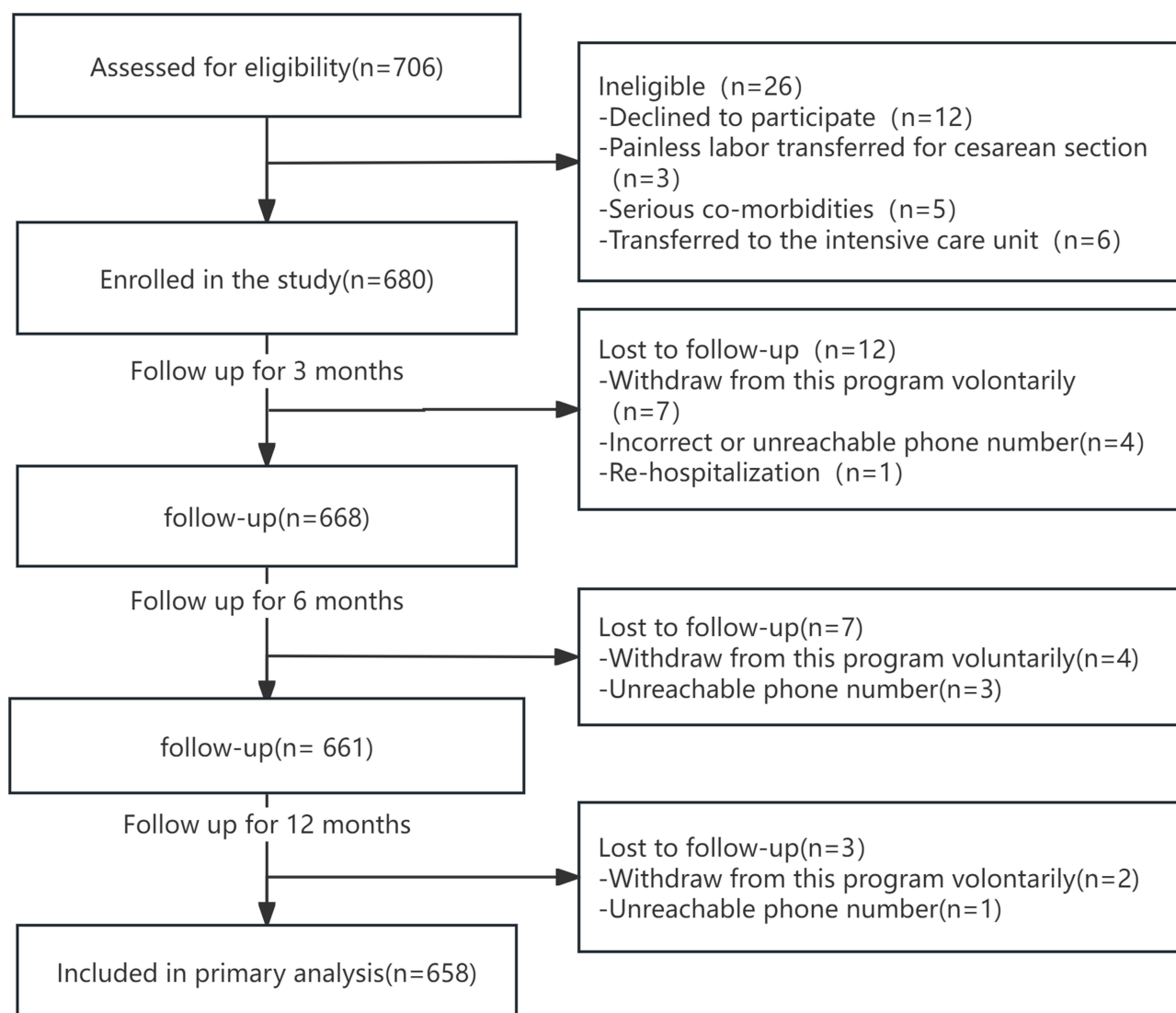


Figure 1 Patient enrollment flow chart.

Binary Logistic Regression Analysis of CPSP and PPD at 6 and 12 Months After CS

Binary logistic regression of CPSP and EPDS at 6 months after surgery showed that PCS was not independently associated with CPSP(OR 0.645,95% CI 0.265–1.568)and EPDS(OR 0.531, 95% CI 0.738–1.131) at 6 months after surgery, after adjusting for BMI, length of incision, intraoperative hemorrhage, birth weight, inadequate analgesia within

Table 1 Demographic and Clinical Information of the Respondents (n=658)

Variables		N	%
Age, years, mean (SD)		31.51±4.31	
BMI (Kg/m ²)	<18.5	92	14.0
	18.5~28	351	53.3
	≥28	215	32.7
Repeat cesarean delivery	Yes	168	25.5
	No	490	74.5

(Continued)

Table 1 (Continued).

Variables		N	%
Emergency surgery	Yes	636	96.7
	No	22	3.3
Anesthesia method	Intravertebral anesthesia	607	92.2
	General anesthesia	51	7.8
ASA	I	5	0.8
	II	47	7.1
	III	606	92.1
Length of incision,cm	<12	211	32.1
	12-15	427	64.9
	>15	20	3.0
Duration of surgery, min, mean (SD)		57.61±27.45	
Intraoperative hemorrhage, mL	<200	176	26.8
	200-500	395	60.0
	>500	87	13.2
Birth weight, Kg	<2.5	60	9.1
	2.5-3.5	453	68.8
	3.6-3.9	119	18.1
	≥4.0	26	4.0
Complication	Yes	198	30.1
	No	460	69.9
Inadequate analgesia within after operation	Yes	589	89.5
	No	69	10.5
PCS	Yes	234	35.6
	No	424	64.4
CPSP 3 months	Yes	124	18.8
	No	534	81.2
CPSP 6 months	Yes	61	9.3
	No	597	90.7
CPSP 12 months	Yes	23	3.5
	No	635	96.5
EPDS 3 months	Yes	92	14.0
	No	566	86.0
EPDS 6 months	Yes	45	6.8
	No	613	93.2
EPDS 12 months	Yes	39	5.9
	No	619	94.1

Abbreviations: BMI, body mass index; ASA, American society of Anesthesiologists (ASA) physical status classification system; PCS, Pain catastrophizing Scale; CPSP, chronic postsurgical pain; EPDS, Edinburgh Postnatal Depression Scale.

Table 2 Demographic, Clinical, and Psychological Factors Associated with CPSP and EPDS at 3 Months After Cesarean Section (n=658)

Variables		3 Months				3 Months			
		CPSP Group (n=124)	No CPSP Group (n=534)	t/x ²	p	EPDS Group (n=92)	No EPDS Group (n=566)	t/x ²	p
Age, years, mean(SD)		30.68±4.22	31.71±4.31	-2.415	0.016	30.53±4.10	31.67±4.33	1.02	0.315
BMI (Kg/m ²)	<18.5	18	74	6.538	0.000	13	79	21.704	0.000
	18.5-28	66	285			50	301		
	≥28	40	175			29	186		

(Continued)

Table 2 (Continued).

Variables		3 Months				3 Months			
		CPSP Group (n=124)	No CPSP Group (n=534)	t/x ²	p	EPDS Group (n=92)	No EPDS Group (n=566)	t/x ²	p
Repeat cesarean delivery	Yes	16	152	-12.607	0.000	15	153	-4.681	0.031
	No	108	382			77	413		
Emergency surgery	Yes	119	517	3.017	0.082	88	548	3.68	0.055
	No	5	17			4	18		
Anesthesia method	Intravertebral anesthesia	114	493	0.008	0.928	66	541	0.267	0.605
	General anesthesia	10	4			26	25		
ASA	I	2	3	-5.651	0.059	1	4	-4.063	0.131
	II	14	33			2	45		
	III	108	498			89	517		
Length of incision,cm	<12	18	193	-14.516	0.000	30	181	-20.062	0.000
	12—15	103	324			59	368		
	>15	3	17			3	17		
Duration of surgery,min,mean(SD)		60.12±36.41	57.03±24.91	1.127	0.261	59.27±28.35	57.34±25.27	0.363	0.547
Intraoperative hemorrhage,mL	<200	21	155	-57.64	0.000	1	175	-44.031	0.000
	200-500	93	302			66	329		
	>500	10	77			25	62		
Birth weight,Kg	<2.5	13	47	-1.903	0.211	16	44	-0.883	0.355
	2.5-3.5	41	412			19	434		
	3.6-3.9	55	64			43	76		
	≥4.0	15	11			14	12		
Complication	Yes	80	380	2.098	0.147	61	399	0.655	0.419
	No	44	154			31	167		
Inadequate analgesia within after operation	Yes	112	477	17.79	0.000	82	507	12.457	0.000
	No	12	57			10	59		
PCS	Yes	112	122	19.89	0.000	57	177	22.331	0.000
	No	12	412			35	389		

Abbreviations: BMI, body mass index; ASA, American society of Anesthesiologists(ASA) physical status classification system; PCS, Pain catastrophizing Scale; CPSP, chronic postsurgical pain; EPDS, Edinburgh Postnatal Depression Scale.

Table 3 Demographic, Clinical, and Psychological Factors Associated with CPSP and EPDS at 6 Months After Cesarean Section (n=658)

Variables		6 Months				6 Months			
		CPSP Group (n=61)	No CPSP Group (n=597)	t/x ²	p	EPDS Group (n=45)	No EPDS Group (n=613)	t/x ²	p
Age, years, mean(SD)		30.54±4.19	31.62±4.31	-1.861	0.063	31.64±4.36	30.99±4.23	3.412	0.066
BMI (Kg/m ²)	<18.5	8	84	-39.404	0.000	7	85	-100.168	0.000
	18.5-28	21	330			24	327		
	≥28	32	183			14	201		
Repeat cesarean delivery	Yes	14	154	-0.215	0.643	7	161	-2.477	0.116
	No	47	443			38	452		
Emergency surgery	Yes	59	577	2.314	0.128	43	593	1.662	0.197
	No	2	20			2	20		
Anesthesia method	Intravertebral anesthesia	56	551	0.01	0.920	43	564	0.78	0.377
	General anesthesia	5	46			2	49		
ASA	I	0	5	-1.026	0.599	0	5	-4.123	0.127
	II	3	44			3	44		
	III	58	548			42	564		
Length of incision,cm	<12	1	210	-75.219	0.000	15	196	-28.211	0.000
	12—15	42	385			28	399		
	>15	18	2			2	18		
Duration of surgery,min,mean(SD)		62.80±36.68	59.99±24.84	1.577	0.115	60.81±31.11	57.07±24.68	0.112	0.221

(Continued)

Table 3 (Continued).

Variables		6 Months				6 Months			
		CPSP Group (n=61)	No CPSP Group (n=597)	t/x ²	p	EPDS Group (n=45)	No EPDS Group (n=613)	t/x ²	p
Intraoperative hemorrhage,mL	<200	1	175	-59.333	0.000	12	164	-78.08	0.000
	200-500	34	361			19	376		
	>500	26	61			14	73		
Birth weight,Kg	<2.5	3	57	-1.407	0.221	2	58	-1.311	0.332
	2.5-3.5	1	452			21	432		
	3.6-3.9	42	77			20	99		
	≥4.0	15	11			2	24		
	Complication	Yes	42	418	0.035	0.852	34	426	0.736
Inadequate analgesia within after operation	No	19	179			11	187		
	Yes	59	530	7.833	0.005	40	549	5.628	0.018
PCS	No	2	67			5	64		
	Yes	37	197	17.972	0.000	15	219	19.932	0.000
	No	24	400			30	394		

Abbreviations: BMI, body mass index; ASA, American society of Anesthesiologists (ASA) physical status classification system; PCS, Pain catastrophizing Scale; CPSP, chronic postsurgical pain; EPDS, Edinburgh Postnatal Depression Scale.

Table 4 Demographic, Clinical, and Psychological Factors Associated with CPSP and EPDS at 12 Months After Cesarean Section (n=658)

Variables		12 Months				12 Months			
		CPSP Group (n=23)	No CPSP Group (n=635)	t/x ²	p	EPDS Group (n=39)	No EPDS Group (n=619)	t/x ²	p
Age, years, mean (SD)		28.91±3.47	31.61±4.31	3.32	0.069	31.64±4.36	30.99±4.23	3.412	0.066
BMI (Kg/m ²)	<18.5	1	91	36.448	0.000	1	91	85.42	0.000
	18.5-28	3	348			13	338		
	≥28	19	196			25	190		
Repeat cesarean delivery	Yes	9	159	0.625	0.618	14	154	-2.477	0.116
	No	14	476			25	465		
Emergency surgery	Yes	22	614	0.824	0.364	37	599	1.434	0.231
	No	1	21			2	20		
Anesthesia method	Intravertebral anesthesia	21	586	0.031	0.863	37	570	0.399	0.528
	General anesthesia	2	49			2	49		
ASA	I	0	5	0.471	0.493	0	5	1.660	0.436
	II	1	46			1	46		
	III	22	584			38	568		
Length of incision,cm	<12	1	210	94.514	0.000	11	200	38.031	0.000
	12-15	6	421			27	400		
	>15	16	4			1	19		
Duration of surgery, min, mean (SD)		61.78±35.68	60.99±24.84	1.067	0.315	60.81±31.11	57.07±24.68	0.112	0.221
Intraoperative hemorrhage,mL	<200	1	175	43.007	0.000	9	167	70.043	0.000
	200-500	5	390			17	378		
	>500	17	70			13	74		
Birth weight, Kg	<2.5	2	58	-1.407	0.221	1	59	0.431	0.332
	2.5-3.5	1	452			19	434		
	3.6-3.9	16	103			17	102		
	≥4.0	4	22			2	24		
	Complication	Yes	6	192	0.182	0.671	30	430	0.97
Inadequate analgesia within after operation	No	17	443			9	189		
	Yes	23	566	5.192	0.023	39	550	5.628	0.018
PCS	No	0	69			0	69		
	Yes	21	213	32.730	0.005	13	411	17.503	0.000
	No	2	422			26	208		

Abbreviations: BMI, body mass index; ASA, American society of Anesthesiologists(ASA) physical status classification system; PCS, Pain catastrophizing Scale; CPSP, chronic postsurgical pain; EPDS, Edinburgh Postnatal Depression Scale.

Table 5 Correlation Analysis of Preoperative Pain Catastrophization, Depression and Postoperative Chronic Pain(r)

	PCS	CPSP 3 Months	CPSP 6 Months	CPSP 12 Months	EPDS 3 Months	EPDS 6 Months	EPDS 12 Months
PCS	1	0.858*	0.165*	0.158*	0.192*	0.058	0.038
CPSP 3 months	0.858*	1	0.664*	0.395*	0.960*	0.028	0.521*
CPSP 6 months	0.165*	0.664*	1	0.595*	0.732*	0.848*	0.785*
CPSP 12 months	0.158*	0.395*	0.595*	1	0.424*	0.325*	0.758*
EPDS 3 months	0.192*	0.960*	0.732*	0.424*	1	0.672*	0.424*
EPDS 6 months	0.058	0.028	0.848*	0.325*	0.672*	1	0.429*
EPDS 12 months	0.038	0.521*	0.785*	0.758*	0.424*	0.429*	1

Note: * P<0.05.

Abbreviations: PCS, Pain catastrophizing Scale; CPSP, chronic postsurgical pain; EPDS, Edinburgh Postnatal Depression Scale.

Table 6 Binary Logistic Regression of the CPSP and EPDS in 3 Months Following Cesarean Section (n=658)

Characteristic	CPSP 3 Months						EPDS 3 Months					
	β	Standard Error	p	Odds Ratio	95% CI		β	Standard Error	p	Odds Ratio	95% CI	
					Lower	Upper					Lower	Upper
PCS	21.039	81.509	0.008	2.501	1.265	4.926	1.113	8.413	0.006	2.144	1.116	4.117

Notes: β , nonstandard regression coefficient. BMI, repeat cesarean delivery, Length of incision, Intraoperative hemorrhage, inadequate analgesia within after operation were adjusted.

Abbreviations: CI, confidential interval; PCS, Pain catastrophizing Scale; CPSP, chronic postsurgical pain; EPDS, Edinburgh Postnatal Depression Scale.

after surgery. The Hosmer-Lemeshow test showed $\chi^2= 11.286$, $P= 0.186$ (CPSP 6 months) and $\chi^2= 2.038$, $P = 0.980$ (EPDS 6 months) which were indicating that the models had a good goodness of fit (Table 7).The same result was observed 12 months after the surgery, as shown in Table 8.

Table 7 Binary Logistic Regression of the CPSP and EPDS in 6 Months Following Cesarean Section(n=658)

Characteristic	CPSP 6 Months						EPDS 6 Months					
	β	Standard Error	p	Odds Ratio	95% CI		β	Standard Error	p	Odds Ratio	95% CI	
					Lower	Upper					Lower	Upper
PCS	0.439	0.453	0.333	0.645	0.265	1.568	0.11	0.215	0.609	0.531	0.738	1.131

Notes: B, nonstandard regression coefficient. BMI, length of incision, intraoperative hemorrhage, inadequate analgesia within after operation were adjusted.

Abbreviations: CI, confidential interval; PCS, Pain catastrophizing Scale.

Table 8 Binary Logistic Regression of the CPSP and EPDS in 12 Months Following Cesarean Section (n=658)

Characteristic	CPSP 12 Months						EPDS 12 Months					
	β	Standard Error	p	Odds Ratio	95% CI		β	Standard Error	p	Odds Ratio	95% CI	
					Lower	Upper					Lower	Upper
PCS	0.019	0.047	0.223	0.818	0.959	1.501	0.021	0.023	0.349	0.979	0.936	1.024

Note: B, nonstandard regression coefficient. BMI, length of incision, intraoperative hemorrhage, inadequate analgesia within after operation were adjusted.

Abbreviations: CI, confidential interval; PCS, Pain catastrophizing Scale.

Discussion

With the increasing number of CS performed worldwide, CPSP has emerged as a significant postpartum complication. Similar findings were reported by Jin et al, who noted CPSP incidences of 18.3% at 3 months and 11.3% at 6 months in a prospective study of 527 women undergoing CS.²³ Borges et al followed 426 women who had CS and showed a 25.5% incidence of CPSP at 90 days after surgery.²⁴ CS plays a great role in the management of dystocia, pregnancy complications, and reducing maternal and infant mortality. However, due to the large incision and postoperative uterine contraction, severe acute and even CPSP can occur after surgery. CPSP not only affects the early rehabilitation and quality of life of parturients but also reduces lactation and affects the relationship between mother and infant.^{25,26} Therefore, any measure targeting chronic pain after CS is of interest.

Moreover, CPSP is often complicated with PPD. PPD is an important complication in the perinatal period, and it is more severe in CS than vaginal delivery.²⁷ A quantitative study conducted by Agarwal et al found a two-fold increase in PPD risk following CS.²⁸ Many patients with CPSP may experience depression, which may be due to elevated inflammatory factors, inducing oxidative stress responses that lead to depression.²⁹ CS can lead to a range of surgical complications, such as infection, postpartum hemorrhage, ureteral and bladder injury, chronic pelvic pain, and gastrointestinal dysfunction. Adverse effects, such as stress caused by traumatic surgical events, may increase the levels of certain inflammatory mediators, thereby increasing the probability of PPD. A meta-analysis of the correlation between CS and PPD showed that the incidence of PPD 3 months after CS was 13.2%.³⁰ In women who underwent CS for early-onset preeclampsia, the proportion was even as high as 20.9%.³¹ PPD is often complicated by CPSP, which not only affects the postoperative recovery of the mothers and reduces breastfeeding rate, but also affects the sleep and weight gain of the infants.^{32,33} As CS rates continue to rise globally, addressing these complications is imperative to improve maternal and infant health outcomes.

Furthermore, our most important finding was that preoperative PCS was an independent risk factor for CPSP and PPD at 3 months after surgery. However, given that the data at 6 months after surgery were not statistically significant, respectively, further and longer follow-ups are required to validate these findings. PCS has been shown to be associated with acute postoperative pain, and can lead to insufficient analgesia and affect analgesic satisfaction.¹² Meanwhile, both PCS and acute postoperative pain predicted severe CPSP. The link between pain catastrophizing and CPSP has been demonstrated in total knee arthroplasty,^{34,35} potentially mediated by elevated levels of inflammatory markers in patients with high pain catastrophizing.³⁶ In agreement with our findings, Terradus-Monllor et al found that the level of PCS significantly predicted CPSP at 3 months after surgery but was not significant at 6 months after surgery.³⁷ A longitudinal cohort study showed that oxidative stress may mediate the effect of preoperative psychological conditions such as PCS on CPSP 6 months after surgery, potentially offering insight into its mechanisms.²⁹ There is a strong correlation between pain catastrophizing and depression. A study of chronic pain in adolescents shows that depression plays a mediating role in pain catastrophizing, pain intensity, and functional disability.³⁸ Pain catastrophizing indirectly affects dysfunction and pain intensity through depressive symptoms. Zeng et al found that PCS was associated with increased postpartum EPDS scores in nulliparous women.³⁹ PCS tendencies are predictive of increased distress during labor. Similarly, pain severity has important associations with increased depressive symptoms in mothers and consequences for perinatal and infant outcomes. Considering the influence of PCS on CPSP and PPD, medical staff can implement a brief psychoeducation or cognitive behavioral therapy session in the preoperative period, conducting routine PCS screening to identify high-risk patients. Given the lack of statistical significance in multivariate data at 6 and 12 months, additional longitudinal studies with extended follow-up periods are necessary to explore the relationship between PCS, postoperative CPSP, and PPD.

Additionally, our study revealed statistically significant differences in BMI, repeat cesarean delivery, length of incision, intraoperative hemorrhage, and inadequate postoperative analgesia between the CPSP and non-CPSP groups and between the PPD and non-PPD groups at 3 months after surgery. For CS, higher BMI increases the risk of acute postoperative pain.⁴⁰ Obesity also complicates regional anesthesia and prolongs the decision time for emergency CS,⁴¹ further heightening CPSP risk. Parturients undergoing repeated CS, being more familiar with the delivery process, may adapt better to labor and experience reduced stress response, potentially lowering their risk of CPSP and PPD.⁴² Longer incision lengths are associated with extended repair time, which may be accompanied by longer postoperative pain and

affect postpartum psychological state. Meanwhile, intraoperative hemorrhage was associated with postoperative fatigue, as well as with postoperative EPDS score, which may influence postoperative chronic pain.⁴³ Inadequate postoperative analgesia implies inadequate postoperative acute pain control, which increases the risk of postoperative CPSP and PPD.⁴⁴ The results appear to be similar at 6 and 12 months postpartum, although it is important to note that there was no significant difference in repeat cesarean delivery at 6 and 12 months between the CPSP and non-CPSP groups and between the PPD and non-PPD groups. Given the multifactorial nature of CPSP and PPD, future research should consider additional sociodemographic, surgical, and anesthetic factors to comprehensively explore influencing variables.

Limitations

The primary strength of this study was the follow-up data collected from 658 women who underwent CS, extending to 12 months after surgery. However, this study had some limitations. First, the study was conducted at a single tertiary hospital in western China, which may limit the generalizability of the findings. Second, data collection relied on self-reported measures, introducing potential recall and social desirability biases. Lastly, other potential confounding factors that could affect PPD and CPSP, such as socioeconomic status, spousal/partner support, stress related to infant care, and previous psychiatric history, were not evaluated. Future research needs to include more variables to eliminate possible confounding factors and establish the causal relationship between variables.

Conclusion

This study investigated the incidences of CPSP and PPD at 3, 6 and 12 months after CS and analyzed differences between clinical groups. The most significant finding was that preoperative PCS was an independent risk factor for CPSP and PPD 3 months after surgery. However, given the lack of statistical significance at 6 and 12 months, additional longitudinal studies are required to explore the causal relationships between preoperative PCS, CPSP, and PPD in women undergoing CS.

Abbreviations

CS, Cesarean Section; CPSP, Chronic Postsurgical Pain; PPD, Postpartum Depression; PCS, Pain Catastrophizing Scale; NRS, Numeric Rating Scale; EPDS, Edinburgh Postnatal Depression Scale; ASA, American Society of Anesthesiologists; BMI, Body Mass Index; OR, Odds Ratio; CI, Confidence Interval; SD, Standard Deviation.

Data Sharing Statement

The data are available from the corresponding author Jun Li on reasonable request.

Ethics Approval and Consent to Participate

All procedures in this study were carried out with the approval of the Ethics Committee of Mianyang Hospital affiliated with the University of Electronic Science and Technology of China (Code:S20230369-01). Informed consent was obtained from all participants for the study.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors have declared that there are no competing interests in this work.

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