

# The Influence of Obstetric Factors on the Occurrence of Pelvic Floor Dysfunction in Women in the Early Postpartum Period

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**Background:** This study aimed to analyze the effect of obstetric factors on the development of pelvic floor dysfunction (PFD) in women in the early postpartum period.

**Methods:** Clinical data of 300 women who were reviewed in our outpatient clinic from July 2016 to December 2019 in the postpartum period were retrospectively analyzed. The occurrence of pelvic organ prolapse (POP) and stress urinary incontinence (SUI) was assessed using the Pelvic Organ Prolapse Quantification System and International Consultation on Incontinence Questionnaire Short Form. Factors affecting the occurrence of PFD in women in the early postpartum period were analyzed using univariate and multifactorial logistic regression models.

**Results:** A total of 46 cases of POP (15.33%) and 82 of SUI (27.33%) occurred in 300 women at 6–8 weeks after birth. Unconditional logistic regression confirmed that age  $\geq 35$  years, vaginal delivery, BMI before delivery  $\geq 25$  kg/m<sup>2</sup>, perineal tear, protracted or prolonged second stage of labor, and fetal macrosomia were risk factors influencing the occurrence of POP (OR > 1, P < 0.05), whereas age  $\geq 35$  years, vaginal delivery, perineal tear, protracted or prolonged second stage of labor, fetal macrosomia, and SUI during pregnancy were risk factors influencing the occurrence of SUI (OR > 1, P < 0.05).

**Conclusion:** Obstetric factors such as age, mode of delivery, perineal tear, protracted or prolonged second stage of labor, and fetal macrosomia may increase the risk of developing PFD in women in the early postpartum period; hence, these risk factors should be correctly identified and promptly addressed to prevent the development of PFD.

**Keywords:** pelvic floor dysfunction, pelvic organ prolapse, stress urinary incontinence, obstetric factors

## Introduction

Pelvic floor dysfunction (PFD) refers to a weakening of the supporting tissue of the fascia, neuromuscles, and ligaments of the pelvic floor, which result in relaxation of the supporting tissues of the pelvic floor and dysfunction of the pelvic organs, such as the genital tract, lower urinary tract, and lower gastrointestinal tract, inducing a series of disorders, including pelvic organ prolapse (POP), stress urinary incontinence (SUI), sexual dysfunction, and fecal incontinence (FI).<sup>1–3</sup> In terms of physiological structure, the female pelvic floor is composed of multiple layers of fascia and muscles, both of which maintain several physiological functions such as defecation and urination.<sup>4</sup> When the supporting tissues such as pelvic floor and fascia become weak, and the pelvic floor and connective tissue become less supportive, frequent urination, abdominal distension and constipation may occur; in severe cases, disorders such as POP, SUI and sexual dysfunction may occur. If not treated and intervened reasonably, the aggravation of the condition may induce several adverse outcomes, which can seriously affect the quality of life of patients.<sup>5</sup> Therefore, early diagnosis and prevention of PFD is of great clinical significance.

An epidemiological survey has found that the incidence of PFD-related diseases is approximately 2–40% among adult women, and it has been increasing over the years, posing a threat to public health.<sup>6</sup> The occurrence factors of PFD are

complex, which are closely related to the mode of delivery, pregnancy and obesity, chronic injury, and the impact of uneven hormone distribution on the nutrient supply to pelvic floor tissues,<sup>7</sup> of which delivery and pregnancy are considered the primary causes; hyperextension produced during delivery and pregnancy can weaken fascial and muscle fiber elasticity and induce tearing of the muscle fibers, causing anterior and posterior vaginal wall prolapse and destruction of the pelvic floor supporting structures.<sup>8</sup> Meanwhile, changes in pelvic floor function during pregnancy are related to changes in hormones in the body. Zheng et al<sup>9</sup> showed that high levels of serum relaxin during pregnancy can act on pelvic floor collagen tissue, which may be one of the pathological mechanisms of PFD during pregnancy and postpartum, and it still takes a certain period for the hormone levels in the body to return to the normal level state after maternal delivery. Therefore, timely identification of risk factors for the occurrence of pelvic floor dysfunction is of great clinical significance for preventing and treating disease and promoting maternal rehabilitation. In this study, the clinical data of 300 women who were reviewed in our hospital (tertiary A-level hospital) at 6–8 weeks after delivery from July 2016 to December 2019 were screened, of which 46 cases of POP occurred, with an incidence rate of 15.33%, and 82 cases of SUI, and the following study was conducted to further analyze the factors influencing the occurrence of postpartum POP and SUI.

## Materials and Methods

### Clinical Data

Retrospective analysis of clinical data of 300 women who were all first pregnancies, aged 22–42 years (mean age: 28.84 ±3.15) at 6–8 weeks after delivery, with a mean gestational age of 39.32±1.04 weeks and BMI of 18–29 kg/m<sup>2</sup> before delivery (mean: 24.36±2.35 kg/m<sup>2</sup>), who were admitted to our outpatient clinic from July 2016 to December 2019, was performed. This study was approved by the medical ethics committee of our hospital.

### Inclusion Criteria

The inclusion criteria were as follows: ethnic Han; primipara; singleton pregnancy, full-term delivery; review at 6–8 weeks after delivery; no previous history of chronic diseases such as hypertension and diabetes; no previous history of large pelvic mass, pelvic surgery, abdominal surgery, urinary tract disease, renal disease, chronic cough, or chronic constipation; and complete clinical data. Exclusion criteria were as follows: genital tract inflammation, acute pelvic inflammation; multiple pregnancy; abnormal urinalysis results; presence of congenital organ developmental abnormalities, such as urethral malformation, abnormal urethra and bladder development, and urinary fistula; SUI caused by nervous system disease complicated with placental abruption, placenta previa, heart disease, etc.; and patients with hypertension or diabetes.

### Criteria for Determination

(1) POP. POP refers to a type of weak pelvic floor supporting tissue caused by various reasons, which results in the descending displacement of pelvic organs and abnormal positioning and functioning of organs. Patients were assessed using the POP-Q,<sup>10</sup> with POP-Q ≥ grade I considered to be abnormal. (2) SUI. SUI refers to the involuntary leakage of urine from the ureteral orifice during increased abdominal pressure, such as sneezing, coughing, laughing, or exercise. The degree of SUI was assessed by (ICIQ-SF)<sup>11</sup> involving four aspects, that is amount of leakage (0, 2, 4, 6 scores), frequency of leakage (0–5 scores), timing of leakage (not involved in scoring), and impact on daily life (0–10 scores). On a scale of 0–21, a total ICIQ-SF score of ≤7 was determined as mild, 8–13 as moderate, and 14–21 as severe.

### Study Methods

Questionnaires were designed to cover age, mode of delivery, BMI before delivery, performance of forceps-assisted delivery, perineal tear (a tear of the skin, mucous membrane, or deep tissue of the soft tissue between the anus and the external genital of a woman during delivery), persistent occipital transverse position, active stagnation or prolongation of the second stage of labor, fetal macrosomia (birth weight of the fetus ≥ 4000 g), and SUI during pregnancy. Trained

investigators assisted enrollees in completing the valeted questionnaires, which were collected immediately after completion.

## Statistical Analysis

Statistical Product and Service Solutions (SPSS) 22.0 software (IBM, Armonk, NY, USA) was used for data processing and statistical analysis, and the count data are expressed as percentages and were compared using the  $\chi^2$  test. Logistic regression analysis was used to analyze the significant variables in the univariate analysis, multivariate logistic regression was used to analyze risk factors, and the test level was set at  $\alpha=0.05$ .  $P < 0.05$  was considered to indicate statistical significance.

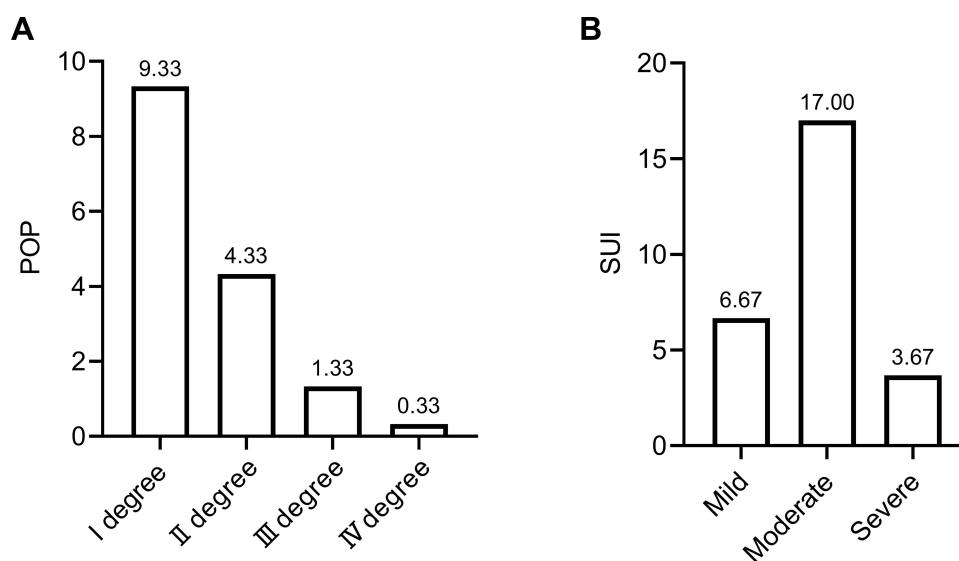
## Results

### Baseline Data

Among the 300 patients, 225 were aged  $<35$  years. There were 19 women with a history of abortion (including 14 who had abortion once, three who had abortions twice, and two who had abortions more than twice). Regarding BMI before pregnancy, 67 had BMI  $< 25$  kg/m<sup>2</sup> and 233 had BMI  $\geq 25$  kg/m<sup>2</sup>. Regarding the mode of delivery, 139 had vaginal delivery and 161 underwent cesarean delivery. In terms of BMI before delivery, 175 had BMI  $< 25$  kg/m<sup>2</sup> and 125 had BMI  $\geq 25$  kg/m<sup>2</sup>. There were 106 cases of forceps-assisted delivery, 101 cases of perineal tear (including 35 cases of degree I, 40 cases of degree II, 23 cases of degree III, and three cases of degree IV tear), 62 cases of persistent transverse occipital position, 36 cases of protracted or prolonged active phase, 44 cases of protracted or prolonged second stage of labor, 49 cases of fetal macrosomia, and 62 cases of SUI during pregnancy.

### Occurrence of PFD

There were 46 cases of POP (15.33%) in 300 women 6–8 weeks after giving birth, including 28 cases of grade I (9.33%), 13 cases of grade II (4.33%), 4 cases of grade III (1.33%), and 1 case of grade IV POP (0.33%). The incidence of SUI was 27.22% in 82 cases, including 20 cases of mild (6.67%), 51 cases of moderate (17.00%), and 11 cases of severe SUI (3.67%) (Figure 1).



**Figure 1** The specific proportion of PFD distribution. (A) POP; (B) SUI.

**Table 1** Univariate Analysis of Factors Influencing the Occurrence of POP (n)

Factor		POP Group (n=46)	Non-POP Group (n=254)	$\chi^2$	P
Age (years)	<35	22	203	21.397	0.000
	≥35	24	51		
Mode of delivery	Vaginal delivery	38	101	28.752	0.000
	Cesarean delivery	8	153		
BMI before delivery (kg/m <sup>2</sup> )	<25	20	155	4.933	0.026
	≥25	26	99		
Forceps-assisted delivery	Yes	16	90	0.007	0.932
	No	30	164		
Perineal tear	Yes	25	76	10.406	0.001
	No	21	178		
Persistent occipital transverse position	Yes	10	52	0.038	0.845
	No	36	202		
Stagnation or prolongation of the active period	Yes	6	30	0.056	0.813
	No	40	224		
Protracted or prolonged second stage of labor	Yes	15	29	13.975	0.000
	No	31	225		
Fetal macrosomia	Yes	19	30	24.791	0.000
	No	27	224		
SUI during pregnancy	Yes	10	52	0.038	0.845
	No	36	202		

## Analysis of Factors Influencing the Occurrence of Postpartum POP

### Univariate Analysis

There were significant differences in age, mode of delivery, pre-delivery BMI, perineal tear, protracted or prolonged second stage of labor, and proportion of fetal macrosomia in the POP group compared with those in the non-POP group ( $P < 0.05$ ) (Table 1).

### Multifactorial Analysis

After assigning the occurrence of POP as the dependent variable and the factors showing significant differences in the univariate analysis as independent variables (Table 2), unconditional multinomial logistic regression analyses were performed, which revealed that age  $\geq 35$  years, vaginal delivery, BMI before delivery  $\geq 25$  kg/m<sup>2</sup>, perineal tear, protracted or prolonged second stage of labor, and fetal macrosomia were potential risk factors for the occurrence of POP ( $OR > 1$ ,  $P < 0.05$ ) (Table 3).

## Analysis of Factors Influencing the Occurrence of Postnatal SUI

### Univariate Analysis

Differences in age, mode of delivery, perineal tear, protracted or prolonged second stage of labor, fetal macrosomia, and percentage of SUI during pregnancy were significant between the SUI and non-SUI groups ( $P < 0.05$ ) (Table 4).

**Table 2** Assignment Table of Factors Influencing the Occurrence of POP in the Postpartum Period

Variables	Factor	Assignment Description
X <sub>1</sub>	Age (years)	≥35=1, <35=2
X <sub>2</sub>	Mode of delivery	Vaginal delivery = 1, cesarean delivery = 2
X <sub>3</sub>	BMI before delivery (kg/m <sup>2</sup> )	≥25=1, <25=2
X <sub>4</sub>	Perineal tear	Yes=1, No=2
X <sub>5</sub>	Protracted or prolonged second stage of labor	Yes=1, No=2
X <sub>6</sub>	Fetal macrosomia	Yes=1, No=2
Y	POP	Yes=0, No=1

**Table 3** Multifactorial Analysis of Factors Influencing the Occurrence of POP in the Postpartum Period

Associated Factors	B	Standard Error	Wald	P	OR	95% CI
Age ( $\geq 35$ years)	1.468	0.334	19.311	0.000	4.342	2.256–8.359
Mode of delivery (vaginal delivery)	0.043	0.355	33.444	0.000	1.044	0.520–2.094
BMI before delivery ( $\geq 25 \text{ kg/m}^2$ )	0.711	0.324	4.809	0.028	1.456	1.260–1.927
Perineal tear	1.025	0.326	9.883	0.002	2.788	1.471–5.284
Protracted or prolonged second stage of labor	1.323	0.371	12.695	0.000	3.754	1.813–7.772
Fetal macrosomia	1.659	0.357	21.594	0.000	5.254	2.610–10.578

**Table 4** Univariate Analysis of Factors Influencing the Occurrence of SUI in the Postpartum Period (n)

Factor		SUI Group (n=82)	Non-SUI Group (n=218)	$\chi^2$	P
Age (years)	<35	46	179	21.504	0.000
	$\geq 35$	36	39		
Mode of delivery	Vaginal delivery	62	77	38.897	0.000
	Cesarean delivery	20	141		
BMI before delivery ( $\text{kg/m}^2$ )	<25	46	129	0.232	0.630
	$\geq 25$	36	89		
Forceps-assisted delivery	Yes	31	75	0.302	0.583
	No	51	143		
Perineal tear	Yes	42	59	15.568	0.000
	No	40	159		
Persistent occipital transverse position	Yes	13	49	1.594	0.207
	No	69	169		
Stagnation or prolongation of the active period	Yes	10	26	0.004	0.949
	No	72	192		
Protracted or prolonged second stage of labor	Yes	33	11	58.984	0.000
	No	49	207		
Fetal macrosomia	Yes	22	27	9.097	0.003
	No	60	191		
SUI during pregnancy	Yes	31	31	20.215	0.000
	No	51	187		

### Multifactorial Analysis

After assigning the occurrence of SUI as the dependent variable and the factors with significant differences in the univariate analysis as independent variables (Table 5), unconditional multinomial logistic regression analyses were performed, which revealed age  $\geq 35$  years, vaginal delivery, perineal tear, protracted or prolonged second stage of labor, fetal macrosomia, and SUI during pregnancy as possible risk factors for the occurrence of SUI (OR > 1, P < 0.05) (Table 6).

### Discussion

The female pelvic floor is composed of fascia and multiple layers of muscles that close the pelvic outlet. The pelvic floor tissue plays an important role in maintaining the normal position of pelvic organs, such as the rectum, bladder, and uterus. When PFL, fascia, and neuromuscular function are impaired, it can lead to the occurrence of PFD-related diseases such as POP and SUI.<sup>12</sup>

Shao found that obstetric factors such as age, mode of delivery, perineal tear, protracted or prolonged second stage of labor, and fetal macrosomia may increase the risk of early PFD in women,<sup>13</sup> so these risk factors should be correctly identified and treated in a timely manner to prevent the occurrence of PFD. This study revealed that the incidence of POP and SUI at 6–8 weeks after birth was 15.33% and 27.33% in 300 women, respectively; that unconditional logistic regression analysis confirmed that age  $\geq 35$  years, vaginal delivery, BMI before delivery  $\geq 25 \text{ kg/m}^2$ , perineal tear,

**Table 5** Assignment Table of Factors Influencing the Occurrence of SUI in the Postpartum Period

Variables	Factor	Assignment Description
X <sub>1</sub>	Age (years)	≥35=1, <35=2
X <sub>2</sub>	Mode of delivery	Vaginal delivery = 1, cesarean delivery = 2
X <sub>3</sub>	Perineal tear	Yes=1, No=2
X <sub>4</sub>	Protracted or prolonged second stage of labor	Yes=1, No=2
X <sub>5</sub>	Fetal macrosomia	Yes=1, No=2
X <sub>6</sub>	SUI during pregnancy	Yes=1, No=2
Y	SUI	Yes=0, No=1

**Table 6** Multifactor Analysis Affecting the Occurrence of SUI

Associated Factors	B	Standard Error	Wald	P	OR	95% CI
Age (≥35 years)	1.279	0.284	20.250	0.000	3.592	2.058–6.269
Mode of delivery (vaginal delivery)	1.736	0.294	34.973	0.000	5.677	3.193–10.093
Perineal tear	1.040	0.268	15.017	0.000	2.830	1.672–4.789
Protracted or prolonged second stage of labor	2.540	0.383	44.036	0.000	12.673	5.986–26.831
Fetal macrosomia	0.953	0.323	8.702	0.003	2.594	1.377–4.886
SUI during pregnancy	1.299	0.299	18.868	0.000	3.667	2.040–6.590

protracted or prolonged second stage of labor, and fetal macrosomia may be risk factors affecting the occurrence of POP; and that age ≥ 35 years, vaginal delivery, perineal tear, protracted or prolonged second stage of labor, fetal macrosomia, and SUI during pregnancy may be risk factors affecting the occurrence of SUI, which is similar to the findings of Shao. The findings of this study suggested that regardless of whether a parturient has one or more of these conditions (age ≥ 35 years, SUI during pregnancy, vaginal delivery, perineal tear, protracted or prolonged second stage of labor, and fetal macrosomia), she should be informed of the high risk of pelvic floor dysfunction in time, and the pelvic floor rehabilitation training plan should be developed preventively to guide parturient rehabilitation. Possible explanations for the above findings may be described as follows: (1) Age. Progesterone and estrogen levels gradually decrease with age, which tend to affect the structure and function of the urinary tract. Increasing age can lead to atrophy of the urethral mucosa, increasing the incidence of POP and SUI.<sup>14</sup> (2) Vaginal delivery and perineal tears. Previous evidence found that Oxford grading of the pelvic floor muscle strength in the vaginal delivery group 6 weeks after delivery was lower than that in the cesarean section group and that the PFIQ-7 questionnaire score and incidence of SUI and POP were higher than those in the cesarean section group.<sup>15</sup> This suggested that women undergoing vaginal delivery had a higher incidence of SUI and POP, which had a greater impact on their pelvic floor function. This may be because during vaginal delivery, the sudden increase in abdominal pressure and lowering of the bladder neck cause impaired pressure transmission that can lead to damage to the vaginal wall and fascial supporting structures in the pelvic cavity, which can cause direct or indirect damage to the pelvic floor muscles and nerves, inducing SUI and POP in the postpartum period.<sup>16,17</sup> Moreover, ischemia-reperfusion injury during vaginal delivery can lead to fracture and degeneration of elastic fibers and pelvic floor collagen fibers, resulting in damage to the pelvic floor nerves, muscles, and collagen, and cause morphological changes in the anorectal muscle.<sup>17</sup> (3) BMI before delivery. Evidence has confirmed that obesity is one of the main high-risk factors for the occurrence of SUI and POP in women.<sup>18</sup> As BMI increases during pregnancy, fetal weight also increases, which continues to increase the length of muscle fibers being stretched, aggravates the compression of the pelvic floor muscles, and increases the area of the pelvic diaphragm fissure. When the pressure exceeds the threshold, the cervical, bladder neck, and anorectal junction move down, leading to irreversible damage to the pelvic muscles and muscle fiber rupture, thereby increasing the risk of POP.<sup>19,20</sup> (4) Stagnation or prolongation of the second stage of labor. Under pressure, the supporting tissues around the vagina change and fibroblasts undergo metabolic changes and corresponding cytoskeletal changes, often manifested as extreme distortion, expansion,

stretching, and deformation. On the other hand, the abnormal second stage of labor can increase the abdominal pressure and pressure of the fetal head on the pelvic floor tissues, causing pelvic floor muscle fatigue and damage to the pelvic floor muscle fibers when the pressure is excessive.<sup>21</sup> (5) Fetal macrosomia. Excess neonatal weight can have a direct, long-term gravitational effect on maternal soft tissues (eg, fascia, pelvic floor muscles, etc.), causing ischemia or even rupture of connective tissue, pelvic floor muscle fibers, and nerve tissue, resulting in secondary degeneration, necrosis, atrophy, and vascular lesions. Eventually, this leads to a decrease in the number of muscle fibers and loss of connective tissue support, causing damage to the pelvic floor tissues.<sup>22,23</sup>

In order to prevent the occurrence of postpartum PFD, this study proposes the following prevention strategies: (1) strengthen the guidance related to pelvic floor function exercise before and during pregnancy, improve women's knowledge and awareness of pelvic muscles by uptake of enough nutrition while also preventing overnutrition, and develop an exercise program to control pregnancy weight and neonatal weight; (2) fully assess the uncontrollable factors, select the appropriate mode of delivery, closely observe the changes in labor, minimize the duration of the second stage of labor, identify the indications for perineal laterotomy and forceps-assisted delivery, and prevent damage to the muscles and fascia of the pelvic floor; (3) regularly perform postpartum pelvic floor function screening, as well as good contraceptive measures, and receive pelvic floor rehabilitation treatment training to improve women's reproductive health. Lipschuetz et al<sup>24</sup> reported that timely pelvic floor muscle recovery exercises within 10 months after delivery helped to reduce the risk of PFD.

In this study, screening for pelvic floor diseases and analyzing related risk factors was found to be helpful for the early identification of high-risk groups, which is of great significance in preventing the occurrence of PFD in the early postpartum period. However, this study has some limitations. The study had a retrospective and cross-sectional design, and there may be some biases involved with data collection. Further, there was only one source of cases. Few possible factors were included, and the related contents of FI and occurrence of long-term postpartum PFD were not analyzed. In a future study, we will consider the above deficiencies as the focus of the research direction for further analysis. Besides, this study has another deficiency. Due to the retrospective analysis, the pelvic floor functions of all the parturients before delivery were not recorded, leading to the ignorance of the possible influence of prenatal POP on the results. Since only one case in this population developed stage IV POP, relevant medical history was not excluded, resulting in certain data bias. In the next step, we will collect cases from prenatal period and directly track the occurrence of POP from prenatal to postpartum period for data comparison. Furthermore, since it was a preliminary study with insufficient fund and a small number of cases, only two specific pelvic floor dysfunctions with high incidences were selected for comparison. In the next step, we will expand the number of cases and increase the types of related pelvic floor dysfunction to conduct a comprehensive study.

## Conclusions

In conclusion, obstetric factors such as age, mode of delivery, perineal tear, protracted or prolonged second stage of labor, and fetal macrosomia may increase the risk of developing PFD; therefore, these risk factors should be correctly identified and promptly addressed to prevent the development of PFD. In the population with age  $\geq 35$  years, vaginal delivery, perineal tear, protracted or prolonged second stage of labor, fetal macrosomia, SUI during pregnancy with risk factors for PFD, preventive pelvic floor rehabilitation trainings should be carried out after delivery, including the commonly used methods of pelvic floor muscle rehabilitation exercises, low-frequency pulse electrical therapy, and biofeedback therapy, so as to promote the recovery of pelvic floor muscle function as soon as possible.

## Data Sharing Statement

All data generated or analyzed during this study are included in this published article.

## Ethical Statement

This study was approved by the ethics committee of Hubei Provincial Hospital of Traditional Chinese Medicine. Signed written informed consents were obtained from all participants before the study. This study was conducted in accordance with the Declaration of Helsinki.

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## Author Contributions

FY and HL designed the study, FY collected the data, HL analyzed the data, FY and HL prepared the manuscript. All authors read and approved the final manuscript. All authors contributed to data analysis, drafting or revising the article, have agreed on the journal to which the article will be submitted, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.

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## Disclosure

The authors declare that they have no conflicts of interest relevant to this study.

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