



Original Article

Effectiveness of the doula program in Northern Taiwan

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ABSTRACT

Objective: The cesarean section rate in Taiwan is 32%–34%, exceeding the rate that the World Health Organization considers reasonable. A doula is a trained woman who provides physical, emotional, and informational support to pregnant women before, during, and after delivery. This study investigated the effectiveness of a new doula program in Northern Taiwan. **Materials and Methods:** A quasi-experimental research design was employed. Two hundred and twenty women, divided into an experimental group with doula services and a no-doula control group receiving routine hospital care, participated in the present study. Participants' basic information was collected; the study tools were the State-Trait Anxiety Inventory, Edinburgh Postnatal Depression Scale, labor pain visual analog scale, a labor timetable, and Mother's Level of Childbirth Satisfaction Rating Scale, which were distributed to participants during the postpartum hospitalization period. **Results:** The highest level of satisfaction was with the spouse in the control group and the doula in the experimental group. The results indicated that the childbirth process involved considerable anxiety in both groups. After delivery, the doula group exhibited a greater reduction in anxiety than the control group, but the reduction was not significant; however, a statistically significant difference was identified in the cesarean section (C/S) rate (13.0% vs. 43.2%) and normal spontaneous delivery (NSD) rate (87.0% vs. 56.8%) between the doula and control groups after controlling for the factor of primara. **Conclusion:** Providing continuous doula program to pregnant women requiring labor support may reduce the C/S rate and increase the NSD rate. The regression model showed that the factors including high prenatal anxiety, total time needed for doula accompaniment, and epidural and analgesics use were associated with labor women receiving C/S. The factors of continuous doula support and oxytocin use were associated with receiving NSD.

KEYWORDS: Cesarean rate, Doula, Effectiveness, Labor support, Postpartum anxiety

INTRODUCTION

In Taiwan, the cesarean birth rate was approximately 33.1%–37.2% from 2004 to 2018 [1-4]. In 2016, the rate was 35.5%, which was significantly higher than the rate, 10%–15%, that the World Health Organization (WHO) considers reasonable [5]. A survey regarding the demand for doula services in Taiwan indicated that as many as 65.3% of pregnant women expected to receive continuous labor support services during the entire childbirth process [6]. A doula is a woman who is trained and experienced in providing physical, emotional, and informational support to pregnant women before, during, and after childbirth [7-11]. Typically, qualified and trained birth doulas must receive 7 to 12 h of childbirth education and 16 h of birth doula training, and they must attend two to five births. Campero *et al.* studied the effectiveness of doulas and indicated that women in their doula group had significantly more positive childbirth experiences [12]. Continuous labor support

by a doula provides numerous benefits: decreased cesarean birth rate, need for pain relief medication, use of local analgesia, childbirth time, rate of low 5-min Apgar scores, negative childbirth experiences, and others [9,13]; increased vaginal birth rate, childbirth satisfaction, sense of self-efficacy, and willingness to breastfeed; and improved neonatal health conditions [14,15]. By reducing anxiety, unhappiness, and stress and increasing self-esteem and self-efficacy among pregnant mothers, doulas provide social support that improves maternal emotional well-being, and such support may constitute the mechanism of doulas' effectiveness. Doulas also help mothers to feel more knowledgeable and capable, alleviating potential distress during the labor process [16]. Although the

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effectiveness of doulas in Western countries has already been proven, whether doulas have the same effect in Asian countries, where an entirely different childbirth environment exists, remains to be explored; this is especially the case in Taiwan, where the cesarean birth rate has always been relatively high. This study investigated the effectiveness of the doula program after its initial introduction in Taiwan.

MATERIALS AND METHODS

We studied the following physical and psychological effects before and after childbirth: anxiety, depression, and pain level. Finally, we studied the mother's level of satisfaction. Levels of prenatal and postpartum anxiety were measured using the State-Trait Anxiety Inventory (STAI) [17,18], which comprises 20 statements for state anxiety evaluation. Prenatal and postpartum depression scores were measured using the Edinburgh Postnatal Depression Scale (EPDS) [19], which has satisfactory sensitivity and specificity and is also sensitive to change in the severity of depression over time. Prenatal and postpartum pain scores were measured using the visual analog scale (VAS) for pain. In this study, the VAS, which is a straight line with a length of 0–100 on which a mother can draw a short vertical line to represent the subjective feeling of the degree of pain, was used to evaluate the degree of pain [20-25]. The Mother's Level of Childbirth Satisfaction Rating Scale was measured using a modification of the Mackey Childbirth Satisfaction Rating Scale [26-28]. The score included feelings associated with labor and childbirth, including a mother's level of satisfaction with the overall childbirth process, childbirth support, herself, her spouse, the newborn, the nursing staff, the doctors, and the doula. All the outcome indicators were selected after a review of the Cochrane Database [29]. The validity of the measurement tools was satisfied. The psychometric properties of the STAI, EPDS, and VAS for pain showed that the coefficient alpha estimates of reliability for the scales were acceptable, individually. The Cronbach's alpha coefficient for the Mackey Childbirth Satisfaction Rating Scale was 0.94 for the total scale and ranged from 0.72 to 0.96 for the subscales.

This study was approved by the institutional review board of the medical center. A quasi-experimental research design was used. Participants were recruited from among clinical obstetric outpatients at a medical center in Taiwan. Written informed consent was obtained in accordance with the Declaration of Helsinki and was approved by the ethics committee of the institute (Number: 098-05-281). Written informed consent was obtained from all patients before their enrollment in this study. The participants were divided into two groups: the experimental group (doula group), in which the participants received doula services during labor and childbirth, and the control group (no-doula group), in which the participants were provided with routine hospital care. The inclusion criteria were as follows: (1) no pregnancy complications, (2) able to communicate in Chinese or Taiwanese, and (3) consent to participate in this study. The exclusion criteria were as follows: (1) premature childbirth (<38 weeks of pregnancy) and (2) fetal/neonatal death.

Research steps

Six trained doulas were invited to provide doula services before, during, and after the labor process. The principal investigator and a doula introduced the program and invited pregnant women to participate in the research. Because this doula program was provided free of charge, the participants were recruited according to their needs and regardless of their financial situation. All participants met the doula for the first time at the obstetrics clinic. During prenatal consultation, women who met the inclusion criteria were approached by the principal investigator who explained the study aims. If a pregnant woman who was recruited to participate in the study, but no doula services were recruited as the control group. The control group was offered routine hospital care in the labor and delivery room. The Birth Doula Program [30] was run by the first author, a DONA-certified doula trainer, and the six trained doulas. In the program, each participant was treated according to their needs during labor. The researcher provided both continuous psychological support and comfort measures to the women in the experimental group and their family and simultaneously assisted them in obtaining information and the best advocacy. The doula program was terminated after the baby was born and the postlabor questionnaire was completed. The women from both groups filled out their demographic data forms and questionnaires (i.e., the STAI, EPDS, and labor pain VAS) [20-25], and they also completed a questionnaire concerning their satisfaction with childbirth support (i.e., Mother's Level of Childbirth Satisfaction Rating Scale) [26-28]. Data on childbirth-related physiological effects were obtained from their medical records. All forms were anonymous, and the participants placed the completed forms in a sealed box at the nursing station.

Statistics

Statistics were used to examine group differences in clinical and demographic characteristics. All analyses were performed using the Statistical Package for SPSS, Version 19 (Armonk, NY, USA: IBM Corp). Analyses were considered statistically significant if *P* was less than or equal to 0.05 (two-tailed). To address the hypothesis (i.e., the assistance of a doula improved the satisfaction of birthing mothers), we conducted the Chi-square test and independent *t*-test to compare the variables for the two groups, including the physical and psychological effects and the mother's level of satisfaction for each of the individual categorical and continuous variables. All the possible confounding factors were selected for control after a review of the Cochrane Database [29]. Logistic regression was performed to ascertain the effects of "accompanying doula," "parity," and "spouse companionship in labor" techniques as well as drugs used to alleviate labor pain or facilitate labor, including "oxytocin use," "epidural use," or "analgesics," on the probability of pregnant women "receiving cesarean section (C/S)." We also controlled the confounding factors affecting the outcome of receiving C/S, including "prenatal anxiety, depression, and pain."

RESULTS

In total, 220 participants (125 in the experimental doula group and 95 in the control group) were recruited, and 185

participants completed the questionnaire, yielding a response rate of 84.1%. A comparison of demographic data between the experimental and control groups indicated no significant difference in educational level, family income, and occupation [Table 1]. A comparison of pregnancy-related data indicated no significant difference in pregnancy complications, labor confidence in pregnancy, and whether the pregnancy was planned between the two groups. However, most of the participants in the experimental doula group were first-time gravida (77.6%) compared with only 57.9% in the control group. Participants in the experimental group exhibited a significantly higher need for a doula support than those in the control group [Table 2].

The level of satisfaction with the childbirth experience among the mothers was compared between the experimental and control groups, and the mean level of all the eight subitems was higher in the experimental group individually [Figure 1], but no significant difference was observed. When we ordered the mean scores of each subitem for assessing the mothers' levels of satisfaction on a scale from 0 to 10, we observed that the highest level of satisfaction was with spouses, followed by doctors, nursing staff, newborns, and finally themselves. In the experimental doula group, the mothers' level of satisfaction with childbirth support provided by a doula (9.12 ± 1.48) was the highest and was even higher than the level of satisfaction with their spouses (8.80 ± 1.74). Moreover, the mean satisfaction scores for the total scores of mothers' level of satisfaction with childbirth support (8.15 ± 1.16 vs. 7.87 ± 1.25) and mothers' level of satisfaction with the overall childbirth process (7.77 ± 1.61 vs. 7.71 ± 1.64) were higher in the

experimental doula group than in the control group, although not significant [Figure 1].

A comparison of the changes in feelings of anxiety, depression, and pain before and after childbirth between the experimental and control groups revealed that doula intervention reduced the levels of anxiety, but no significant difference was observed (-14.61% vs. -8.92%). The doula group experienced higher levels of pain after childbirth than before childbirth, but no significant difference was observed (22.96% vs. 12.88%).

A comparison of the induction medication and labor time between the experimental and control groups revealed a significant difference in oxytocin use (66.7% vs. 33.3% , $P < 0.001$), the natural childbirth rate (87.0% vs. 56.8%) and cesarean birth rate (13.0% vs. 43.2%) between the experimental and control groups after controlling for the factor of primipara [Table 3]. There was also a significant difference observed in total labor time (795.76 min vs. 517.86 min, $P < 0.001$), and duration of the first stage of labor (755.50 min vs. 482.48 min, $P < 0.001$) after controlling for the factor of primipara. However, no significant difference was observed in the duration of the second and third stages of labor. In addition, no significant difference was observed in 1 min and 5 min Apgar scores; use of epidural anesthesia and analgesia; application of vacuum extraction, obstetric forceps; normal childbirth status; and the occurrence of asphyxia, meconium staining, injury during childbirth, breech childbirth, and congenital malformation between the experimental and control groups [Table 4].

Table 1: Comparison of demographic variables between the experimental (have doula) and control (no doula) groups

	No doula (n=95; 100%), n (%)	Have doula (n=125; 100%), n (%)	Chi-square test	P
Education level				
Junior high school	0 (0.0)	4 (3.8)	9.06	NS
Senior high school	9 (12.3)	21 (19.8)		
College	22 (30.6)	21 (19.8)		
Bachelor	26 (36.1)	42 (39.6)		
Master	16 (22.2)	17 (16.0)		
PhD	0 (0.0)	1 (0.9)		
Family income				
30,000 or less	4 (6.0)	4 (3.8)	5.74	NS
30,000-50,000	13 (19.1)	31 (29.8)		
50,000-70,000	13 (19.4)	24 (22.9)		
70,000-90,000	15 (22.4)	23 (21.9)		
90,000-110,000	14 (20.9)	16 (15.4)		
110,000 or >110,000	9 (13.4)	6 (5.8)		
Occupation				
Unemployed	22 (30.1)	33 (32.0)	7.30	NS
Armed forces occupations	7 (9.7)	13 (12.6)		
legislators, senior officials and managers	2 (2.8)	4 (3.8)		
Professionals	15 (20.8)	11 (10.7)		
Technicians and associate professionals	4 (5.6)	6 (5.8)		
Clerical support workers	9 (12.5)	10 (9.6)		
Service and sales workers	5 (6.9)	9 (8.7)		
Plant and machine operators, and assemblers	0 (.0)	1 (1.0)		
Elementary labourers	1 (1.4)	0 (0.0)		
Not elsewhere classified	8 (11.1)	16 (15.5)		

NS: Not significant

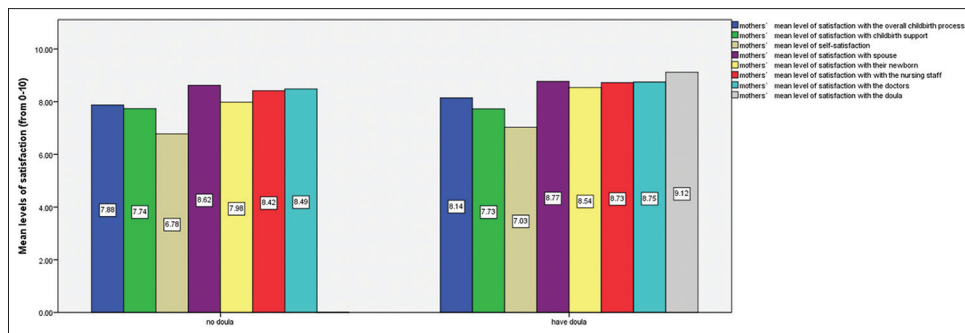


Figure 1: The level of satisfaction with the childbirth experience among the mothers in the experimental and control groups

Table 2: Comparison of pregnancy-related data between the experimental (have doula) and control (no doula) groups

	Groups		Fisher's exact test	
	No doula (n=95; 100%), n (%)	Have doula (n=125; 100%), n (%)	Pearson Chi-square	Significant (two-sided)
Gravida				
1	55 (57.9)	97 (77.6)	12.09	<0.01
2	29 (30.5)	21 (16.8)		
3	8 (8.3)	5 (4.0)		
≥4	4 (4.2)	1 (0.8)		
Labor confidence				
Extremely have confidence	7 (10.3)	12 (11.3)	0.644	NS
Have confidence	29 (42.6)	39 (37.1)		
Moderate	29 (42.6)	46 (43.8)		
No confidence	4 (5.9)	8 (7.6)		
Birth plan				
Planned pregnancy	50 (72.5)	76 (71.0)	0.043	NS
Unplanned pregnancy	19 (27.9)	31 (29.0)		
Need doula support				
Not applicable	1 (1.4)	0 (0.0)	22.294	<0.01
Not needed	14 (19.7)	4 (3.8)		
Ordinary needed	27 (38.0)	27 (25.7)		
Needed	19 (26.8)	59 (56.2)		
Very needed	10 (14.1)	15 (14.3)		

NS: Not significant

We controlled for the confounding factors affecting the outcome regarding whether or not mothers received C/S, including “accompanying doula,” “parity,” and “accompanying husband,” “total time accompanied by doula,” “oxytocin use,” “epidural anesthesia,” and “analgesic use”. The logistic regression model demonstrated statistical significance, $\chi^2 (8) = 87.758, P < 0.0001$. The model explained 66.8% (Nagelkerke R^2) of the variance in receipt of C/S and correctly classified 92.9% of cases. “Epidural anesthesia use” and “analgesic use” were associated with 8.89 and 24.05 times greater probabilities, respectively, of receiving C/S than normal spontaneous delivery (NSD). The doula group and “oxytocin use” group were 0.24 and 0.05 times more likely, respectively, to receive C/S than NSD and were associated with a reduction in the likelihood of C/S being received. No significant correlation was observed between parity or accompaniment by a spouse and C/S [Table 5]. Logistic regression was performed to ascertain the effects of prenatal anxiety, depression, pain visual score, and total time of doula accompaniment required on the likelihood that pregnant women received C/S. The logistic regression model demonstrated statistical significance, $\chi^2 (4) = 9.876, P < 0.05$. The model explained 25.7% (Nagelkerke

R^2) of the variance in receipt of C/S and correctly classified 91.5% of cases. Increasing prenatal anxiety score and the total time of doula accompaniment required were associated with an increased likelihood of C/S being received [Table 6].

DISCUSSION

The results demonstrated a significant difference in the natural childbirth rate (87.0% vs. 56.8%) and cesarean birth rate (13.0% vs. 43.2%) between the doula and control groups. This is reasonable and in line with the WHO-recommended C/S rate of around 10%–15%. The finding is also compatible with the prior Cochrane review, which suggested that continuous support was most effective at reducing cesarean birth rate and greater spontaneous vaginal birth rate. Doula may help laboring women lower their risk of a cesarean by helping them think through their choice of provider and birth location, supporting them in considering the benefits and risk of induction, lowering the need for pain medication during labor, helping them find their voice to advocate for the best care [31].

Our results showed oxytocin use to be significantly greater in the doula group than in the control group and greater in

Table 3: Comparison of the labor process between the experimental (have doula) and control (no doula) groups in primipara

	No doula (n=55), n (%)	Have doula (n=97), n (%)	Chi-square test	
			Pearson Chi-square	Significant (two-sided)
Use oxytocin				
No	24 (66.7)	30 (32.6)	12.30	<0.001
Yes	12 (33.3)	66 (67.4)		
Spinal anesthesia				
No	12 (33.3)	40 (43.5)	1.10	NS
Yes	24 (66.7)	52 (56.5)		
Analgesics				
No	13 (38.2)	46 (51.7)	1.78	NS
Yes	21 (61.8)	43 (48.3)		
NSD				
No	16 (43.2)	12 (13.0)	14.16	<0.001
Yes	21 (56.8)	80 (87.0)		
Vacuum aspiration				
No	36 (100.0)	83 (91.2)	3.37	NS
Yes	0 (0.0)	8 (8.8)		
Forceps				
No	36 (100.0)	91 (100.0)	-	NS
Yes	0 (0.0)	0 (0.0)		
C/S				
No	21 (56.8)	80 (87.0)	20.687	<0.001
Yes	16 (43.2)	12 (13.0)		
Normal delivery status				
No	0 (0.0)	2 (2.2)	0.39	NS
Yes	36 (100.0)	89 (97.8)		
Meconium staining				
No	36 (100.0)	90 (98.9)	0.39	NS
Yes	0 (0.0)	1 (100.0)		

NSD: Normal spontaneous delivery, NS: Not significant, C/S: Cesarean section

Table 4: Comparison of the emotional state and labor time before and after delivery between the experimental (have doula) and control (no doula) groups in primipara

	Mean±SD		t-test	
	No doula (n=55)	Have doula (n=97)	T	Significance
Pre-AS	42.90±9.87	42.08±9.90	0.38	NS
Pre-DS	7.40±4.36	7.63±4.10	-0.25	NS
Pre-Pain	7.82±2.46	7.98±2.57	-0.29	NS
Post-AS	35.64±9.96	34.58±7.79	0.62	NS
Post-DS	7.83±5.99	7.21±3.81	0.70	NS
Post-Pain	8.06±3.10	8.81±2.25	-1.47	NS
Gestational days	275.16±8.80	277.06±7.27	-1.24	NS
1 st LT (min)	482.48±317.96	755.50±420.99	-2.76	<0.01
2 nd LT (min)	31.48±28.24	46.04±61.43	-1.05	NS
3 rd LT (min)	3.90±3.52	12.68±68.72	-0.58	NS
Total LT (min)	517.86±333.70	795.76±432.03	-2.73	<0.01
1-min Apgar	7.94±0.24	7.80±0.80	1.00	NS
5-min Apgar	8.88±0.48	8.93±0.33	-0.70	NS

Pre-AS: Prenatal anxiety score, Pre-DS: Prenatal depression score, Pre-Pain: Prenatal pain score (0-10), Post-AS: Postnatal anxiety score, Post-DS: Postnatal depression score, Post-Pain: Postnatal pain score (0-10), 1st LT: First stage of labor time, 2nd LT: Second stage of labor time, 3rd LT: Third stage of labor time, Total LT: Total labor time, SD: Standard deviation

the NSD group than in the C/S group. This phenomenon might reflect the status of Taiwan’s medical-based fertility

environment. Oxytocin is an often-used option for NSD. In the doula group, the proportion of NSD was significantly higher than that in the nondoula group. Therefore, the proportion of oxytocin use was relatively high. In the logistic regression model, the doula group and “oxytocin use” group were also associated with lower C/S rate. In the experimental group, doula may help the pregnant women think through their choice of delivery method (NSD or C/S), helping them to advocate for the best care, creating an environment that increase comfort of birth and had the highest satisfaction level to doula by laboring women. The control group mothers who reject doulas service could be due to their preference for C/S or may choose a way to relieve laboring pain as soon as possible, such as a cesarean section and therefore had a relatively short labor time and less oxytocin use for induction.

Although no difference in prenatal anxiety was exhibited between the doula and control groups, a significant difference was observed in prenatal anxiety scores for participants receiving C/S or NSD [Table 6]. The regression model showed the association between high C/S ratio and “prenatal anxiety state.” The mechanism of the high NSD ratio could be linked to the presence of continuous doula accompaniment and the high satisfaction level with continuous doula accompaniment and offering labor support during the whole labor process.

Studies have investigated the effects of doula services on postpartum depression [32,33]. In one study, participants were

Table 5: Regression Model for the prediction of labor woman receiving cesarean section in accompanying doula, use of oxytocin, use of epidural, use of analgesia, and parity

	B	SE	Wald	P	Exp(B)	95% Exp(B) CI	
						Lower	Upper
Doula group	-1.42	0.66	4.68	0.03	0.24	0.07	0.87
Oxytocin use	-2.97	0.70	17.91	0.00	0.05	0.01	0.20
Epidural use	2.19	0.92	5.69	0.02	8.89	1.48	53.53
Analgesics use	3.18	1.18	7.22	0.01	24.05	2.36	244.82
Parity			0.21	NS			
1 st parity	0.26	0.85	0.10	NS	1.30	0.25	6.88
2 nd parity	0.11	1.44	0.01	NS	1.12	0.07	18.71
3 rd parity	-15.79	27,435.36	0.00	NS	0.00	0.00	
4 th parity	1.45	4.04	0.13	NS	4.26	0.00	11,723.72
Constant	-3.42	1.16	8.71	NS	0.03		

Variables: Doula group, oxytocin use, epidural use, analgesics use, parity.
SE: Standard error, CI: Confidence interval

Table 6: Regression model for the prediction of labor woman receiving cesarean section in prenatal anxiety, depression, pain and total time of doula accompaniment required

	B	SE	Wald	P	Exp(B)	95% Exp(B) CI	
						Lower	Upper
Prenatal STAI	0.09	0.04	3.99	0.05	1.09	1.00	1.19
Prenatal EPDS	-0.18	0.12	2.23	NS	0.83	0.66	1.06
Prenatal pain VAS	0.22	0.21	1.06	NS	1.24	0.82	1.88
TTDAR	0.00	0.00	4.60	0.03	1.00	1.00	1.00
Constant	-7.37	2.69	7.48	0.01	0.00		

Variables: Prenatal STAI, Prenatal EPDS, Prenatal pain VAS, TTDAR.
TTDAR: Total time of doula accompaniment required, SE: Standard error, CI: Confidence interval, STAI: State-Trait Anxiety Inventory, EPDS: Edinburgh Postnatal Depression Scale, VAS: Visual analog scale

divided into an experimental group that received doula services and a control group that received traditional childbirth services. The results indicated that 6 weeks after childbirth, the incidence of postpartum depression was lower in the experimental group than in the control group, which suggests that the accompaniment of a doula during childbirth can effectively reduce the incidence of postpartum depression. In the present study, no significant difference was observed in the total scores for postpartum depression between the two groups; however, because the depressive assessment only on the day after birth and thus cannot assert whether a longer follow up period would affect this result. In the past, experts believed that a key cause of postpartum depression was the temporary but dramatic changes in neurotransmitter and hormone activity in the brain during the short period from conception to postpartum. Other possible influencing factors are physical and psychological changes during pregnancy, prenatal personality traits, a history of depression, and psychological and social support during pregnancy.

Our results demonstrated that postpartum anxiety significantly decreased after childbirth, indicating that the childbirth process is indeed a challenge that involves anxiety for women. Before childbirth, women in both the experimental and control groups had above-moderate anxiety (anxiety score >40). For most women, pregnancy is a special experience; however,

because they experience tremendous physical changes and must simultaneously cope with psychological and social role changes, pregnancy is also a period characterized by a feeling of conflict between negative emotions such as anxiety, fear, unexpected surprise, and depression and positive emotions such as joy, expectation, happiness, and pride. After childbirth, the level of anxiety among pregnant women in the doula group decreased considerably; however, no statistically significant difference was observed. From this result, we hypothesized that a strong correlation exists between the state of anxiety and the childbirth process. After birth, the feeling of anxiety significantly diminishes among mothers. The level of labor pain felt by pregnant women after childbirth was higher than that felt before childbirth, even though they had received doula services. We assessed labor pain immediately after childbirth in the study, and pain assessment results in women with cesarean birth were explored before the anesthetic effect has subsided. In addition, the results of the mothers' satisfaction questionnaire revealed relatively high levels of satisfaction in both groups; however, the level of mothers' self-satisfaction was the lowest, whereas the level of satisfaction with the doula was the highest. Although the duration of the first stage of labor and total labor time were longer and more labor induction medication was used in the experimental group than in the control group, the natural birth rate was significantly higher (87.0% vs. 56.8%) and the cesarean birth rate was significantly lower (13.0% vs. 43.2%) in the doula group than in the control group, yielding a significant difference. These results are consistent with those reported by Thomassen *et al.* [34]. Moreover, the cesarean birth rate in the control group was comparable to the domestic cesarean birth rate (approximately 37%); although the duration of the first stage of labor and the total labor time were longer for the women in the experimental group, they had a higher natural birth rate and lower cesarean birth rate than the control group, with both rates reaching a statistically significant difference. Therefore, providing continuous labor support in the form of doula services results in higher natural childbirth and lower cesarean birth rates.

CONCLUSION

Providing continuous labor support before, during, and after childbirth to pregnant women requiring labor support may reduce the C/S rate and increase the NSD rate, but the relevant mechanism between the two remains to be clarified in the future. The regression model showed that the factors associated with labor woman receiving C/S included high prenatal anxiety, total time need for doula accompaniment, epidural use and analgesics use. The factors of continuous doula support and oxytocin use were associated with receiving NSD.

This study had some limitations. We investigated the first doula program introduced in a medical center in Taiwan, but because of task force and time constraints, this medical center in Taipei was the only one selected. Thus, the results cannot be transferred or generalized to the maternity units of all types of healthcare institutions. The study limitations must be addressed, especially concerning selection bias. The doula service is aimed at women with low-risk pregnancies

who require doulas. The limitations also include the main bias for control mothers. The control group mothers who reject doulas service could be due to their preference for C/S. Nevertheless, our model may provide a reference for step-by-step planning.

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Conflicts of interest

There are no conflicts of interest.

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