

Research Article

Impact of Interpregnancy Interval on Success of Vaginal Birth after Cesarean Section

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ABSTRACT

Introduction: The inter-pregnancy interval may play a role in the success of VBAC due to its effect on the healing of the uterine scar, the mother's recovery, and the outcome of the second labor. The safety and success of TOL may then be enhanced with appropriate birth spacing.

Objective: To assess the effect of IPI on VBAC following a previous cesarean delivery.

Materials and Methods: This was a prospective cohort study carried out at Benazir Bhutto Shaheed Teaching Hospital, Women and Children Hospital, Abbottabad, from November 2025 to April 2026. There were 240 eligible women who had had one cesarean section who were included in the study. The outcomes of delivery were compared among the participants according to the interpregnancy interval.

Results: Of all the women who attempted VBAC, 72.5% were successful. The success rates were 55.0%, 72.5% and 83.0% for women with intervals of <18 months, 18-23 months and ≥24 months, respectively. The length of interpregnancy interval was significantly associated with successful VBAC.

Conclusions: The longer the time between pregnancies, the higher the likelihood of having a successful VBAC. Birth spacing should be taken into account when counselling and selecting for TOLAC.

Keywords: Interpregnancy Interval, VBAC, Cesarean Section, TOLAC, Birth Spacing, Vaginal Delivery.

INTRODUCTION

Caesarean section is a surgical procedure used in obstetrics that is among the most frequently performed procedures in the world and is an important procedure when medically indicated to reduce maternal and neonatal morbidity and mortality. However, the continuing rise in cesarean delivery rates has resulted in an increasing number of women presenting in subsequent pregnancies with a uterine scar. Vaginal birth after cesarean section (VBAC) is an option for women who are appropriate for it, and can minimize cumulative surgical risks of multiple cesarean sections. However, there are a number of maternal, fetal, and obstetric features that are important for successful VBAC. The interpregnancy or inter-delivery interval has become a significant factor that could be associated with successful VBAC, especially

since the time between pregnancies may impact healing of the uterine scar, maternal physiological recovery, and performance during labor. Inter-delivery interval has recently been shown to be associated with VBAC success in population-based studies, indicating that birth spacing should be part of individualized assessment for women who are considering a trial of labor after cesarean section (TOLAC) (1). The time interval between a previous delivery and the conception of the next pregnancy is called the interpregnancy interval, and the time interval between two consecutive births is called the inter-delivery interval. Both measures are clinically relevant following cesarean section, as insufficient recovery time could affect the integrity of the previous scar on the uterus. Women with previous cesarean delivery who had short IPIs were found to have poor

maternal and neonatal outcomes, suggesting that pregnancy spacing may have consequences beyond the mode of subsequent delivery (2). Studies have also highlighted the differences between short and long inter-delivery intervals, suggesting that birth interval might have an impact on the risk of VBAC and should be taken into account when counseling women about their birth options following a previous cesarean section (3). However, women's choices about the timing of subsequent pregnancies following cesarean delivery are shaped by a host of personal, reproductive, social, and clinical factors, and there is some evidence that counseling on optimal interpregnancy intervals is not uniform (4).

A brief post-cesarean period has been focused upon as it takes time to achieve complete healing and remodeling of the uterine incision. If a woman conceives soon after a cesarean section, scar maturation may be less complete, which theoretically could make a scar more likely to cause complications during labor, and could affect clinicians' decision to recommend TOLAC. Previous evidence in Pakistan has shown that a short inter-delivery interval is clinically significant in women with one previous cesarean section and its association with subsequent mode of delivery, highlighting its relevance in local obstetric practice (5). But too-long gaps can also have negative consequences. The inter-delivery interval between women who have had TOLAC has been compared to other intervals to find that both very short and very long intervals are related to higher rates of complications for the mother or baby, while an intermediate interval may be associated with better outcomes (6).

Safe VBAC practice continues to be dependent on the selection of candidates. VBAC is a viable and viable alternative to cesarean section delivery for many women with a prior low transverse cesarean incision, when adequate facilities for monitoring and emergency intervention are available, according to international recommendations. Previous vaginal delivery, indication for previous cesarean, maternal body mass index, spontaneous onset of labor, fetal characteristics, and the interval between births may affect the likelihood of a successful vaginal delivery (7). Uterine rupture is one of the most serious problems encountered during TOLAC, but is not particularly common. The association of interpregnancy interval with uterine rupture for women who have had one previous cesarean

section has been studied in large population-based research studies, which further emphasize the need to consider pregnancy spacing as part of a thorough risk assessment (8).

Birth spacing also could have a role in post-cesarean delivery outcomes like low birth weight, placental issues, maternal bleeding, preterm delivery, and other pregnancy complications. Research evaluating pregnancy outcomes based on the time interval after cesarean delivery shows that interpregnancy spacing is an important aspect of reproductive planning and subsequent obstetric care (9). Simultaneously, VBAC success is a multifaceted phenomenon and cannot be identified by one characteristic. More modern prediction models that combine many maternal and obstetric factors have included interpregnancy interval as a potential predictor of successful VBAC, and it is included in this model as well as other clinical predictors (10).

Due to the differences in the obstetric services provided, the reported success of VBAC has been found to vary significantly by institution and population, as candidate selection, maternal characteristics, previous obstetric history, labor management, and availability of emergency obstetric services differ across institutions. A series of studies have been carried out in tertiary maternity hospitals to identify factors independently associated with successful VBAC to enhance counselling and clinical decision-making (11). Interpregnancy interval may be even more significant for women who have other risk factors, such as advanced maternal age, where the effects of reproductive ageing and birth spacing may combine to affect maternal and perinatal outcomes (12). Investigations specifically examining birth spacing after cesarean section among multiparous women of advanced maternal age also highlight the importance of assessing birth spacing in the context of the overall clinical situation, rather than as an isolated exposure (13).

Interpregnancy interval is also a factor in the mode of delivery of subsequent births, particularly in relation to previous cesarean delivery and obstetric complications, which is why it is pertinent to interventions aimed at reducing potentially avoidable repeat cesarean sections (14). Existing research protocols involving large linked population data sets continue to show uncertainty over the exact time frame of best outcomes following cesarean section and highlight the need for additional

data in a variety of populations (15). This is especially relevant in low-resource health care environments where the factors associated with successful VBAC may be different due to restricted antenatal counselling, intrapartum surveillance, access to specialties, and access to immediate operative delivery (16).

Recognizing factors associated with uterine rupture is also important for safety during TOLAC. Previous vaginal birth, labor characteristics, induction, cervical progress, and augmentation are factors that have been shown to affect rupture risk and should be taken into account when assessing candidates for VBAC in conjunction with other obstetric factors (17). Likewise, maternal factors like BMI, gestational weight gain, previous successful VBAC, and labor augmentation can influence TOLAC outcomes and further demonstrate the complex factors involved in successful VBAC (18). Therefore, it is clinically relevant to understand the effects of IPI on successful VBAC for evidence-based counselling, selection of candidates, and to decrease unnecessary repeat cesarean deliveries. Such assessment in the local population may offer valuable information to obstetricians in Pakistan and aid in the process of informed, individual decision-making on TOL after cesarean section.

Objective: To assess the effect of interpregnancy interval on the success of vaginal birth after cesarean section (VBAC) for women who had undergone one cesarean section.

MATERIALS AND METHODS

Study Design: Prospective cohort study.

Study Setting: Department of Obstetrics and Gynecology, Benazir Bhutto Shaheed Teaching Hospital, Women and Children Hospital, Abbottabad, Pakistan.

Study Duration: November 2025 to April 2026.

Inclusion Criteria: Women aged 18-40 years, singleton, cephalic, term pregnancy (37-41 completed weeks) and who had had one previous lower-segment cesarean section and were willing to attempt a trial of labour after cesarean section were included. Women with a documented interpregnancy interval who had spontaneous or induced labor were eligible.

Exclusion Criteria: Women who had two or more cesarean sections, a previous classical cesarean incision, a previous uterine rupture, multiple pregnancy, placenta previa, malpresentation, major fetal anomaly, intrauterine fetal death, or any contraindication to vaginal delivery were excluded.

Informed consent was obtained, and eligible women who met the inclusion criteria were enrolled. A structured proforma was used to collect baseline data on maternal age, parity, body mass index, gestational age, indication for previous cesarean section, history of vaginal delivery, and interpregnancy interval. The interval between deliveries was determined as the time interval between the date of the last delivery and the estimated date of conception of the current delivery, and was divided into pre-established interval groups. Continuous maternal and fetal monitoring was done as per departmental protocol for all participants in the trial of labor. Progress of labor, cervical dilatation, fetal heart rate, induction or augmentation of labor, and intrapartum complications were recorded. Vaginal birth after cesarean section (VBAC) was defined as vaginal delivery after a trial of labor, and the emergency repeat cesarean section (ERCS) was defined as unsuccessful VBAC. Post-delivery maternal and neonatal outcomes were recorded. Data were analyzed to determine the relationship between interpregnancy interval and successful VBAC.

RESULTS

A total of 240 women with one previous cesarean section who underwent trial of labor after cesarean section were included in the study. The average maternal age was 28.7 years (SD 4.2), and gestational age at delivery was 38.6 weeks (SD 1.1). The participants were divided into three groups: <18 months, 18–23 months, and ≥24 months. Sixty (25.0%) women had an interpregnancy interval of <18 months, 80 (33.3%) had an interval of 18–23 months, and 100 (41.7%) had an interval of ≥24 months. The baseline maternal and obstetric parameters are shown in Table 1.

Table 1. Baseline characteristics of study participants (n=240).

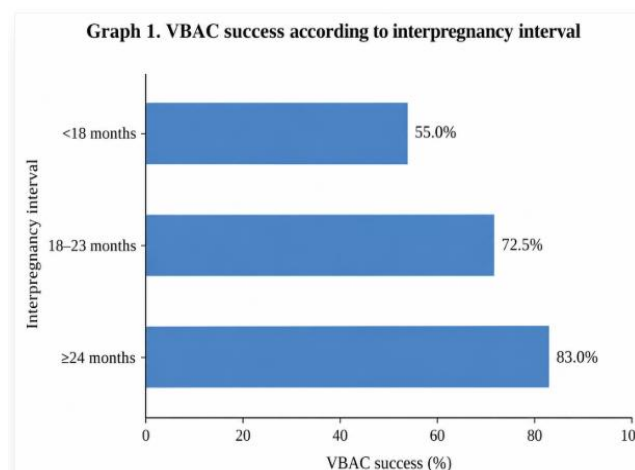
Table 1. Baseline Characteristics of Study Participants (N=240)

Characteristic	<18 months (n=60)	18–23 months (n=80)	≥24 months (n=100)
Mean maternal age, years	27.9 ± 4.1	28.6 ± 4.3	29.3 ± 4.2
Mean gestational age, weeks	38.5 ± 1.2	38.6 ± 1.1	38.7 ± 1.0

Previous vaginal delivery	12 (20.0%)	21 (26.3%)	32 (32.0%)
Spontaneous onset of labor	41 (68.3%)	60 (75.0%)	80 (80.0%)

Overall, successful VBAC occurred in 174 (72.5%) women, and 66 (27.5%) women had to undergo an emergency repeat cesarean delivery. Successful VBAC rates increased gradually with increasing interpregnancy

interval. The proportion of women who had a successful vaginal delivery was 33 (55.0%) for interval <18 months, 58 (72.5%) for interval 18–23 months, and 83 (83.0%) for interval ≥24 months.



Graph 1. VBAC Success According to Interpregnancy Interval

The association between interpregnancy interval and mode of delivery was statistically significant ($p < 0.001$). Women who had an

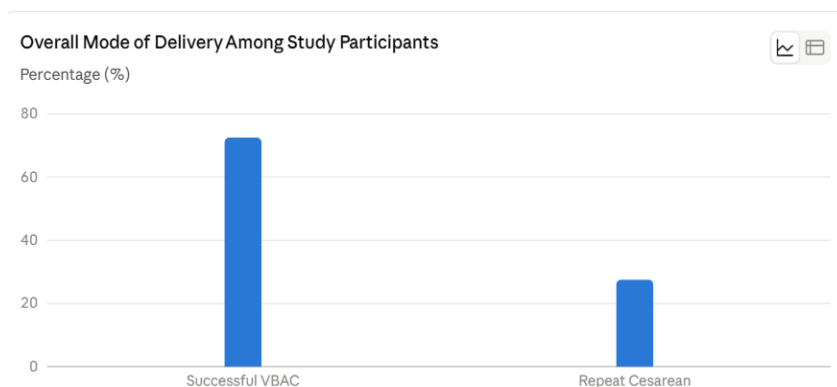
interpregnancy interval of ≥24 months had the highest VBAC success rate and lowest emergency repeat cesarean delivery rate.

Table 2. Association between Interpregnancy Interval and Mode Of Delivery

Interpregnancy interval	Successful VBAC	Failed VBAC/Repeat CS	Total	P-value
<18 months	33 (55.0%)	27 (45.0%)	60	
18–23 months	58 (72.5%)	22 (27.5%)	80	
≥24 months	83 (83.0%)	17 (17.0%)	100	<0.001
Total	174 (72.5%)	66 (27.5%)	240	

The most frequent reasons for emergency cesarean section in the 66 women who had an unsuccessful TOLAC were non-progress of labor, fetal distress, and suspected complications of

the scar. A higher percentage of failed TOLAC was observed among women with shorter interpregnancy interval.



Graph 2. Overall Mode of Delivery among Study Participants

Multivariable logistic regression was used to determine independent predictors of successful VBAC. An interpregnancy interval of ≥ 24 months was still significantly associated with greater odds of successful VBAC when

compared with an interpregnancy interval of <18 months after adjusting for maternal age, previous vaginal delivery, gestational age and onset of labor.

Table 3. Multivariable Logistic Regression for Predictors of Successful VBAC

Predictor	Adjusted OR	95% CI	p-value
Interpregnancy interval 18–23 months	1.86	1.01–3.45	0.047
Interpregnancy interval ≥ 24 months	3.21	1.69–6.10	<0.001
Previous vaginal delivery	2.47	1.31–4.66	0.005
Spontaneous onset of labor	1.92	1.03–3.58	0.040
Maternal age ≥ 35 years	0.71	0.38–1.34	0.291

These results showed a significant positive correlation between the length of the interpregnancy interval and successful VBAC, with the greatest likelihood of successful VBAC seen in women who had a subsequent pregnancy at least 24 months after their previous cesarean delivery.

DISCUSSION

This study aimed to assess the effect of IPI on VBAC for women with prior cesarean delivery who were having a trial of labor. Overall, the findings showed that 72.5% of women had a successful VBAC and 27.5% had an emergency repeat cesarean section. There was a clear relationship between increasing IP and successful vaginal delivery. Women with an interpregnancy interval less than 18 months had the lowest VBAC success rate of 55.0%, followed by women with an interpregnancy interval of 18-23 months, who had a VBAC success rate of 72.5%, and women with an interpregnancy interval of 24 months or more, who had a VBAC success rate of 83.0%. This association persisted when other factors associated with the mother and the obstetric history were taken into account. The results of this study align with more recent population-based data that showed the timing between pregnancies or deliveries could significantly affect the odds of VBAC (1).

The lower success rate among women with shorter interpregnancy interval may be due to incomplete physiological recovery and/or remodeling of the uterus after cesarean section. Myometrial incision healing is a process that takes place over the course of several months after delivery and involves tissue repair, collagen remodeling, and recovery of tensile strength. If a woman becomes pregnant before she has fully recovered from the surgery, it can have a negative impact on the integrity of the scar and on the safety and course of the next

pregnancy. Dong et al. found that a short interpregnancy interval (IPI) after cesarean section (CS) was linked to higher risks of several adverse maternal and neonatal outcomes, highlighting the significance of proper birth spacing after CS (2). Likewise, Putera et al. showed that birth spacing affects VBAC outcomes, which implies that birth spacing should be taken into account when counselling women about TOL after cesarean (3).

The results also have implications for preconception counselling and postpartum family planning. There is often conflicting information from doctors for women on how long to wait before trying to conceive again after a cesarean section. Canty et al. noted the lack of consistency in interpregnancy interval counselling and planning following cesarean section and proposed more consistent and evidence-based recommendations (4). Structured postpartum counselling and contraceptive availability differ significantly in Pakistan and may be particularly important for appropriate birth spacing. In a study in Pakistan, Mazhar et al. found that short inter-delivery intervals were associated with an increased rate of repeat cesarean section (5). The results of the current study agree with the results of these studies, which found that women with an interval of less than 18 months had the highest percentage of failed VBAC.

While a longer interval seemed to be beneficial in the present analysis, the association between birth spacing and TOLAC outcomes may not be strictly linear. Rao et al. found that the ideal time interval between deliveries in women who had TOLAC was 24 months, and they concluded that very short and very long intervals may have negative effects (6). Therefore, it is not possible to conclude from the results that longer time spans always lead to better results. Instead, adequate recovery following cesarean

section seems to be important, and a pregnancy scheduled at an appropriate interval may help to facilitate a more successful trial of labor. Counselling for VBAC is also recommended to be individualized according to the recommendations of FIGO, and the previous obstetric history, characteristics of uterine scar, maternal factors, and available health care facilities are identified as factors associated with safe TOLAC (7).

One of the biggest issues to consider when considering VBAC is uterine rupture. Although uncommon, it can have serious consequences for both the mother and fetus. Adily et al. showed that the risk of uterine rupture was related to the length of the interpregnancy interval, among women who had undergone TOLAC after 1 previous cesarean delivery and no previous vaginal delivery (8). This association offers a potential clinical explanation for the lower VBAC success rates seen with shorter intervals between pregnancies because when abnormal fetal heart rate patterns, scar tenderness, or poor labor progress occur, obstetricians may have a lower threshold for emergency cesarean delivery. Other research comparing birth spacing following cesarean delivery has also found links between birth spacing and adverse outcomes of pregnancy, further supporting the value of birth spacing as an antenatal risk factor (9).

But there are several factors involved in successful VBAC, not just the interpregnancy interval. Today, prediction models include maternal age, BMI, previous vaginal delivery, reason for the previous cesarean section, cervical examination, gestational age, fetal characteristics, and labor-related factors (10). In the present study, previous vaginal delivery and spontaneous onset of labor were independently associated with greater odds of successful VBAC. These results are similar to those of studies that have found that previous vaginal delivery, especially a successful one, significantly increases the likelihood of a vaginal delivery in future pregnancies (11). Therefore, it is important to view inter-pregnancy interval as part of a larger, personalized prediction model for eligibility for TOLAC, and not as a stand-alone indicator.

The association between pregnancy spacing and subsequent outcomes may be further adjusted by maternal age. Both reproductive age and birth spacing should be taken into account when counselling multiparous women of advanced maternal age, as research has

shown that the interpregnancy interval following a cesarean section may affect perinatal outcomes (12,13). While maternal age greater than 35 years did not independently predict successful VBAC in the present model, older women may have other obstetric and medical risk factors that impact mode of delivery decision-making. Likewise, Irawati et al. found that interpregnancy interval, previous cesarean section, and obstetric complications were determinants associated with cesarean delivery, reflecting the complex association between maternal history and pregnancy-related factors (14).

The ongoing evolution of large population-based studies and linked-data studies highlights that uncertainty still exists about the exact optimal birth interval for cesarean delivery (15). This is especially important in low-resource communities where a successful VBAC may offer significant benefits, including avoiding repeat abdominal surgery, shorter hospital stay, decreased costs, and fewer complications associated with multiple cesarean sections. The success of VBAC is heavily dependent on proper patient selection, institutional readiness, and proper intrapartum management, as evidenced in low-resource healthcare settings (16).

The present results should also be considered in the context of other known risk factors for unsuccessful TOLAC and uterine rupture. Several labor-related and obstetric factors were associated with complete uterine rupture in women who attempted vaginal delivery following cesarean section, as determined by Didier-Mathon et al. (17). Additionally, maternal factors such as gestational weight gain can influence delivery outcome in women with TOLAC, highlighting that other factors that can be modified can influence the chances of vaginal delivery (18). The results of the present study indicate that a longer interpregnancy interval is associated with greater success of a VBAC than a shorter interval. Therefore, providing interpregnancy spacing information during postpartum counseling and during antenatal evaluation could help with patient selection, informed shared decision-making, and help with reducing unnecessary repeat cesarean deliveries, which could lead to safer practices.

CONCLUSION

The present study shows that the interpregnancy interval is a significant factor in VBAC. Women with an interpregnancy interval of 24 months or longer had the highest VBAC

success rate, while women with an interpregnancy interval of less than 18 months had a relatively higher incidence of trial of labor failure and emergency repeat cesarean delivery. Other factors that were found to increase the likelihood of successful VBAC were previous vaginal delivery and spontaneous onset of labor. The results indicate that birth spacing following CS could be beneficial for the mother and should be taken into account when counselling and assessing the mother during the postpartum period. The IPI should not be the only factor considered to identify candidates for TOLAC; it should be considered in conjunction with maternal, fetal, and obstetric risk factors. Proper counseling, patient selection, and intrapartum surveillance can enhance the success rate of VBAC and avoid unnecessary repeat cesarean section.

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