

ORIGINAL RESEARCH

Maternal and fetal characteristics associated with successful Vaginal Birth After Cesarean (VBAC) in Dr. Soetomo and Universitas Airlangga Hospitals, Surabaya, Indonesia

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Article Info	ABSTRACT
Received Dec 7, 2024 Revised Mar 11, 2025 Accepted Apr 25, 2025 Published Aug 1, 2025 *Corresponding author: Syihab Armawa syihab.armawa.putera-2021@fk.unair.ac.id Keywords: Cervical dilation Cesarean section Maternal health Vaginal birth VBAC	Objective: This study aimed to assess maternal and fetal characteristics associated with successful vaginal birth after cesarean (VBAC) at Dr. Soetomo General Academic Hospital and Universitas Airlangga Hospital in Surabaya, Indonesia. Materials and Methods: A retrospective analytic design was applied using a total sampling method to examine medical records from January 2021 to December 2022. Inclusion criteria were singleton pregnancies with one prior low-segment cesarean section, vertex presentation, and absence of contraindications to vaginal delivery. A total of 46 eligible cases were evaluated after applying exclusion criteria. Results: Among the analyzed parameters, cervical dilation at admission and the 5-minute Apgar score were significantly associated with successful VBAC ($p < 0.05$). All women admitted with cervical dilation >4 cm achieved vaginal delivery, underscoring its strong predictive value. Conversely, those with dilation <4 cm demonstrated a markedly increased likelihood of repeat cesarean section. A higher Apgar score was also positively correlated with VBAC success, reflecting favorable neonatal outcomes in such cases. Maternal BMI showed no statistically significant association with VBAC success ($p > 0.05$), probably due to the predominance of obesity within the cohort. Other variables, including maternal age, parity, birth interval, gestational age, and neonatal birth weight, exhibited no significant relationship with the outcome. Conclusion: Although most maternal and fetal parameters were not significantly related to VBAC success, cervical dilation on admission proved to be a crucial clinical predictor. These findings highlight the value of intrapartum evaluation, particularly cervical assessment, in informing delivery planning for women with previous cesarean sections.

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Highlights:

- 1. High VBAC success rate demonstrated with effective patient selection and intrapartum management.
- 2. Cervical dilation >4 cm at admission identified as a critical predictor of VBAC success.



INTRODUCTION

Cesarean-section (CS) deliveries have experienced a marked global rise, shaping maternal preferences for delivery methods, largely due to anxiety regarding vaginal birth, fear of labor pain, and other determinants influencing the decision to undergo CS. The increasing prevalence is especially pronounced in high- and middle-income nations, where rates of non-medically indicated CS have escalated, often motivated by maternal preference to avoid vaginal delivery and sociocultural influences surrounding childbirth.¹

Worldwide, the CS rate increased from 6.7% in 1990 to 19.1% in 2014, with Asia recording the second-highest rise at 15.1% during this interval.² This growth is linked to advances in surgical safety, including the availability of modern antibiotics, improved transfusion methods, enhanced anesthesia, and supportive medical technologies. Nevertheless, despite these advances, CS is associated with higher risks and complications compared with vaginal birth, such as elevated infection rates, hemorrhage, thromboembolic events, and prolonged recovery.³ Vaginal birth after cesarean (VBAC) represents an important strategy to decrease repeat CS rates, with global success ranging between 60–80%.⁴ In light of the increasing CS prevalence and its associated risks, identifying determinants of successful VBAC is essential to optimize maternal and neonatal outcomes. This study therefore aimed to evaluate maternal and fetal characteristics associated with successful VBAC at Dr. Soetomo General Academic Hospital and Universitas Airlangga Hospital in Surabaya, Indonesia, between 2021 and 2022, to guide clinical decision-making and strengthen patient selection for VBAC attempts.

MATERIALS AND METHODS

A retrospective analytic study design was adopted, employing a total sampling technique to review medical records at Dr. Soetomo General Academic Hospital and Universitas Airlangga Hospital from January 2021 to December 2022. Inclusion criteria consisted of live fetuses, a single prior low-segment transverse cesarean section, singleton gestation, vertex presentation, and the absence of contraindications to vaginal delivery (e.g., placenta previa, active genital herpes, or severe fetal distress). Exclusion criteria comprised incomplete documentation, multiple pregnancies, or non-vertex presentations. Data extracted from both electronic and paper-based records included maternal age, BMI, gravidity, interpregnancy interval, gestational age,

history of vaginal birth, neonatal birth weight, Apgar scores, and cervical dilation on admission. Accuracy of extracted data was confirmed by cross-verification with labor and delivery logs. From 70 records initially identified, 46 fulfilled the inclusion criteria after excluding 24 for incomplete data or ineligibility. Data were summarized in frequency distribution tables and analyzed with the Chi-square test to examine associations between maternal and fetal characteristics and VBAC success. Statistical analysis was conducted using SPSS version 25, with significance set at $p < 0.05$. Ethical approval was secured from the institutional review boards of both hospitals, with confidentiality maintained in compliance with standards for retrospective research, thereby ensuring adherence to accepted principles of medical ethics and patient data protection.

RESULTS AND DISCUSSION

Retrospective Chi-square analysis of medical records from Dr. Soetomo General Academic Hospital and Universitas Airlangga Hospital between January 2021 and December 2022 included 70 women undergoing attempted VBAC, of which 24 records were excluded according to study criteria, leaving 46 cases for analysis through tabulation and graphical representation. The results demonstrated that cervical dilation on admission and 5-minute Apgar scores were significantly associated with successful VBAC ($p < 0.05$), whereas maternal BMI, age, gravidity, and interpregnancy interval were not statistically significant. This analysis underscores the influence of cervical dilation and neonatal condition on VBAC outcomes and provides clinically relevant insights for practice, particularly in facilities with similar resource settings and patient populations.

[Table 1](#) summarizes the data distribution and outcomes of patients undergoing VBAC ($N=46$), demonstrating significant associations for Apgar score and cervical dilation with p -values < 0.05 . The final analysis indicated that selected maternal and fetal characteristics can serve as predictors for evaluating VBAC risk at Dr. Soetomo General Academic Hospital and Universitas Airlangga Hospital. Accordingly, accurate prediction plays a crucial role in clinical decision-making for women with a high likelihood of VBAC success.⁵ In support of these findings, a study from China reported VBAC success rates as high as 84% among post-cesarean women, although elective repeat CS remains the most common delivery mode in this population, reflecting persistent clinical caution and maternal concerns.⁶

Table 1. Data distribution of patients with VBAC procedure

Variables	Margin	Method of delivery		Total percent	p-values
		VBAC	CS		
Maternal age	20-35	31 (86.1%)	5 (13.9%)	36 (78.2%)	0.244
	>35	7 (70%)	3 (30%)	10 (22.8%)	
Maternal BMI	<25 kg/m ²	8 (100%)	-	8 (17.4%)	0.067
	25-30 kg/m ²	14 (87.5%)	2 (12.5%)	16 (34.8%)	
	>30 kg/m ²	16 (72.7%)	6 (27.3%)	22 (47.8%)	
Gravidity	G2	16 (80%)	4 (20%)	20 (43.5%)	0.614
	G3	13 (81.3%)	3 (18.8%)	16 (34.8%)	
	G4	5 (100%)	-	5 (10.8%)	
	>G4	4 (80%)	1 (20%)	5 (10.8%)	
Birth interval	<2 years	8 (88.9%)	1 (11.1%)	9 (19.6%)	0.589
	>2 years	30 (81.1%)	7 (18.9%)	37 (80.4%)	
Gestational weeks	<34 weeks	2 (100%)	-	2 (4.3%)	0.299
	34-37 weeks	5 (62.5%)	3 (37.5%)	8 (17.5%)	
	>37 weeks	31 (86.1%)	5 (13.9%)	36 (78.2%)	
Vaginal birth history	Yes	20 (83.3%)	4 (16.7%)	24 (52.2%)	0.895
	No history	18 (81.8%)	4 (18.2%)	22 (48.8%)	
Baby birth weight	<2 kg	2 (100%)	-	2 (4.3%)	0.842
	2-2.5 kg	5 (71.4%)	2 (28.6%)	7 (15.2%)	
	2.6-2.9 kg	12 (85.7%)	2 (14.3%)	14 (30.4%)	
	3-3.5 kg	19 (86.4%)	3 (13.6%)	22 (47.8%)	
	>3 kg	-	1 (100%)	1 (2.3%)	
APGAR score	0-3	1 (100%)	-	1 (2.2%)	0.023
	4-6	7 (58.3%)	5 (41.7%)	12 (26.1%)	
	7-10	30 (90.0%)	3 (9.1%)	33 (72.7%)	
Cervical dilation	<4 cm	7 (46.7%)	8 (53.3%)	15 (32.6%)	0.000
	>4 cm	31 (100%)	-	31 (68.4%)	

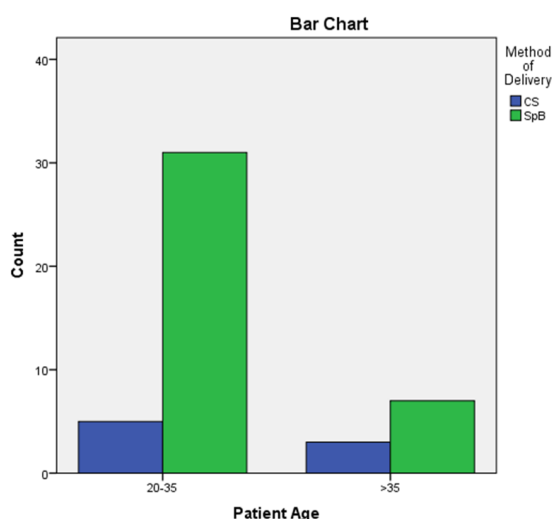


Figure 1. Distribution and frequency of patients based on age.

Figure 1 illustrates that the predominant cohort comprised 36 women (78.2%) aged 20–35 years, with a VBAC success rate of 86.1%, compared with a 70% success rate in patients older than 35 years (N=10, 22.8% of the sample), yielding a p-value of 0.244. Younger patients may benefit from enhanced pelvic

adaptability and fewer comorbidities, thereby facilitating vaginal delivery. Nevertheless, the relatively small number of older participants limited the ability to demonstrate significant differences. Most patients in the 20–35 age group who experienced failed VBAC exhibited obesity, short interpregnancy intervals, or additional maternal conditions that elevated risk, consistent with reports indicating that maternal age below 35 and primiparity are associated with increased likelihood of successful vaginal birth.⁷ Many older women likewise presented with higher BMI or reduced interpregnancy intervals, contributing to greater repeat cesarean rates within this subgroup. This multifactorial interaction highlights the importance of comprehensive risk stratification, suggesting that younger women with normal BMI and a history of vaginal delivery represent ideal VBAC candidates, whereas older women with concomitant risk factors require closer surveillance or consideration of alternative delivery strategies.

Figure 2 presents the distribution and frequency of patients according to BMI, where a p-value of 0.067 indicated a suggestive but non-significant trend toward higher repeat cesarean rates with increasing BMI. The obese group (BMI >30 kg/m²) represented 47.8% of the sample (N=22) and demonstrated a 27.3% cesarean rate, compared with 12.5% in the overweight group (BMI 25–30 kg/m², N=16) and 0% in the normal BMI group

(<25 kg/m², N=8). Cesarean section rates increased progressively from 28% among overweight women to 41.2% among obese women.⁸ VBAC success was most frequently observed in the obese subgroup, which accounted for 47.82% of all cases, whereas the lowest frequency occurred in the normal BMI group at 17.39%. This trend suggests that obesity may adversely influence labor progression, potentially through prolonged labor or heightened uterine rupture risk. The high prevalence of obesity in this population may have reduced statistical power to achieve significance, given that nearly half of participants were obese. These findings underscore the importance of individualized counseling for women with elevated BMI, including preconception weight optimization and nutritional guidance to reduce risks of labor complications and repeat cesarean. Clinicians should incorporate enhanced intrapartum monitoring for obese patients to facilitate timely interventions in the presence of labor challenges.

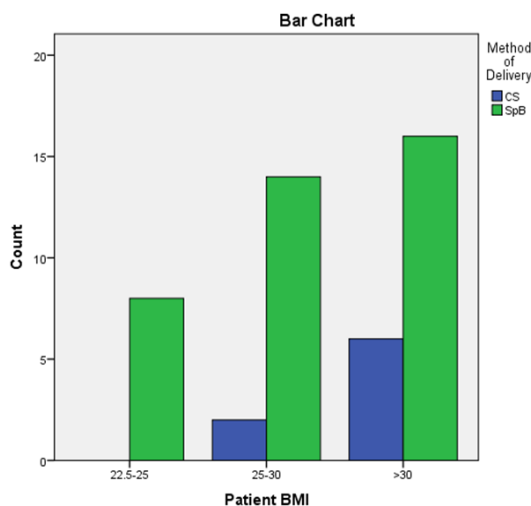


Figure 2. Distribution and frequency of patients based on BMI.

[Figure 3](#) illustrates the subgroup of patients presenting with cervical dilation greater than 4 cm, in which all 31 women (100%) achieved spontaneous vaginal delivery, highlighting the pivotal influence of advanced labor progression upon admission. Conversely, among patients with dilation less than 4 cm, 58.3% required repeat cesarean delivery, with only 7 of 15 achieving vaginal birth. The strong association (correlation coefficient 0.660, p-value <0.02) underscores the necessity for clinicians to evaluate cervical status early during labor as a guide to clinical decision-making. For patients presenting with minimal dilation, early intrapartum interventions, such as augmentation of labor or intensified monitoring, may enhance VBAC outcomes, while concurrent preparation for potential cesarean delivery could optimize maternal and neonatal

safety. The findings also suggest that a history of labor arrest in prior pregnancies affects VBAC success. Women with a history of arrest during the second stage of labor tend to exhibit higher rates of successful VBAC, whereas those with first-stage arrest demonstrate lower success, likely reflecting underlying limitations in labor progression. Supporting evidence from other studies indicates that 90.5% of VBAC attempts with cervical dilation greater than 4 cm culminate in successful vaginal birth, and women admitted with dilation exceeding 1 cm show an increased likelihood of VBAC achievement.^{7,9} Prior maximal cervical dilation likewise represents a prognostic determinant, with second-stage arrest linked to higher VBAC success, while first-stage arrest corresponds to approximately 65% success in subsequent VBAC attempts.^{10,11}

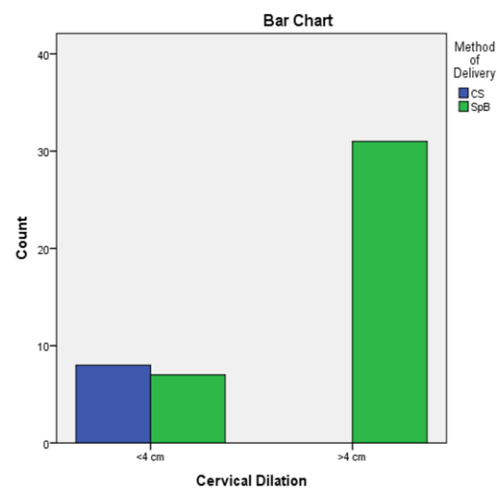


Figure 3. Distribution and frequency of patients based on cervical dilation.

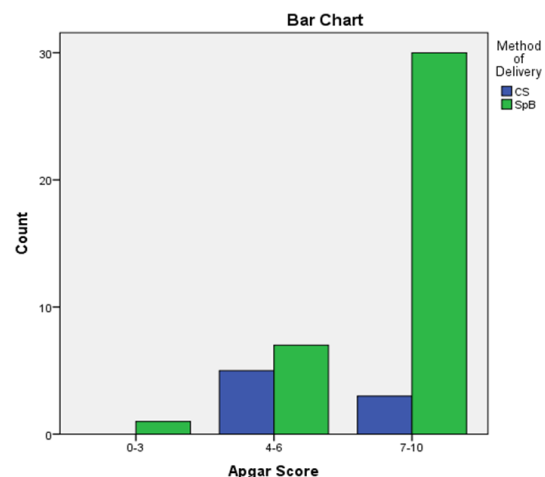


Figure 4. Distribution and frequency of patients based on 5-minute APGAR Score.

[Figure 4](#) illustrates comparable outcomes in neonatal performance, with Apgar scores at 5 minutes post-delivery demonstrating significant prognostic relevance. Specifically, 71.7% of VBAC patients (N=33) achieved Apgar scores of 7–10 within one to five minutes after birth, with 90.9% of this subgroup delivered vaginally, reflecting favorable neonatal outcomes associated with successful VBAC. The mean Apgar score for successful VBAC was higher at 1 minute (7.21) compared with failed trial of labor after cesarean (TOLAC) cases (6.91), and this pattern persisted at 5 minutes.¹² Conversely, those with Apgar scores of 4–6 exhibited a reduced VBAC success rate of 58.3%, implying that fetal distress or intrapartum complications may necessitate cesarean delivery. Within the VBAC cohort, 13 neonates (28.3%) had scores below the 7–10 range, underscoring a notable distinction in Apgar outcomes between successful and unsuccessful VBAC attempts. These findings emphasize the critical importance of vigilant intrapartum surveillance, including continuous electronic fetal monitoring, to promptly identify early compromise that may lower Apgar scores, enabling timely adjustments in delivery mode.¹³ However, the differences in Apgar scores between successful and unsuccessful VBAC attempts were not sufficiently marked to suggest that neonatal outcomes alone dictate delivery success, as maternal characteristics and labor dynamics also substantially influence results.¹⁴

Gravidity and parity ($p=0.614$) revealed no significant association with VBAC outcome, with consistently high success rates across gravidity groups. Patients in the G4 group achieved a 100% success rate (N=5), though the limited sample constrains interpretation. The elevated success rates may reflect stringent selection criteria, particularly inclusion of women with a single prior low-segment cesarean section. Moreover, the presence of women with prior vaginal births (52.2%, N=24) likely enhanced overall success, since previous vaginal delivery is a recognized predictor of VBAC success. Women with such a history, regardless of gravidity, represent promising candidates; however, clinicians should exercise caution with higher-gravidity cases, given cumulative risks from repeated uterine scarring.¹⁵

Birth interval ($p=0.589$) similarly showed no significant effect, with success rates of 88.9% for intervals shorter than 2 years (N=9) and 81.1% for intervals exceeding 2 years (N=37). Although short interpregnancy intervals are typically associated with incomplete uterine healing or increased risk of rupture, the high success rates observed in both groups suggest that judicious patient selection and vigilant monitoring can mitigate such risks. The limited number of women with short intervals, however, reduced the ability to discern subtle differences. Counseling regarding optimal inter-

pregnancy spacing remains advisable to further optimize VBAC safety and outcomes.¹⁶

Gestational age and birth weight, with p -values of 0.299 and 0.842, respectively, also demonstrated no significant correlation with VBAC success. The majority of participants (78.2%, N=36) delivered at term (>37 weeks), achieving an 86.1% success rate, indicating that term gestation favors VBAC through enhanced fetal maturity and readiness for labor. Two preterm deliveries (<34 weeks) achieved 100% success, suggesting that VBAC may be feasible in carefully selected preterm cases. Birth weight similarly showed no consistent trend, with high success rates across most categories, although the single neonate exceeding 3 kg delivered by cesarean highlights potential concerns with macrosomia, underscoring the need for heightened monitoring in such scenarios.

The overall VBAC success rate of 82.6% underscores the effectiveness of stringent patient selection, incorporating factors such as singleton gestation, cephalic presentation, and absence of contraindications to vaginal delivery. Evidence from a Chinese study demonstrated a comparable success rate of 84% among post-cesarean women, although repeat cesarean remains the predominant choice for many with a prior cesarean section.⁶ These observations highlight the necessity of individualized risk stratification and collaborative decision-making in VBAC planning.¹⁵ Cervical dilation and Apgar scores should be emphasized as primary predictors, whereas maternal BMI and age should be integrated into a comprehensive evaluation. This final analysis indicates that specific maternal and fetal characteristics may serve as predictors of VBAC outcomes, making accurate prediction essential for identifying women with a high probability of successful VBAC.⁵

The increased VBAC success rate illustrates the potential of this strategy to reduce repeat cesarean sections, which are associated with increased risks of complications, including infection, hemorrhage, and prolonged recovery relative to vaginal delivery. The pivotal role of cervical dilation, as presented in [Figure 3](#), suggests that intrapartum management protocols should prioritize optimizing cervical progress through timely interventions, such as oxytocin augmentation or artificial rupture of membranes, when clinically appropriate.¹⁷ Clinicians should also apply partograms to systematically monitor labor progression and identify delays at an early stage, particularly among patients admitted with cervical dilation less than 4 cm.¹⁸ The correlation between higher Apgar scores and successful VBAC, as depicted in [Figure 4](#), further reinforces the importance of vigilant fetal monitoring to safeguard

neonatal outcomes, guiding decisions regarding continuation of VBAC attempts or conversion to cesarean delivery.

The non-significant results concerning maternal BMI, as shown in Figure 2, underscore the multifactorial nature of VBAC outcomes, which are determined by the interaction of multiple influences rather than a single variable in isolation. The observed tendency toward increased cesarean rates with rising BMI suggests that obesity-related factors, such as diminished uterine contractility or augmented soft tissue obstruction, may contribute to failed VBAC.¹⁹ This emphasizes the need for a multidisciplinary approach to VBAC counseling, involving obstetricians, nutritionists, and maternal–fetal medicine specialists to address modifiable risks, such as obesity, prior to conception.²⁰ Likewise, the lack of significance for maternal age, as illustrated in Figure 1, may be attributable to confounding variables, including comorbidities or additional maternal conditions, which should be carefully evaluated in prenatal care to optimize candidacy for VBAC.

The high success rate among women with prior vaginal deliveries highlights the importance of incorporating obstetric history into VBAC counseling and management. A history of vaginal birth likely reflects enhanced myometrial adaptability to labor, thereby increasing the likelihood of success. This finding supports the development of predictive models integrating obstetric history alongside clinical factors, such as cervical dilation and fetal well-being.²¹ Such predictive tools could enable stratification of patients into low-, intermediate-, and high-risk categories for VBAC success, facilitating personalized counseling and tailored intrapartum management strategies.

The lack of significant impact from birth interval is particularly relevant for women planning subsequent pregnancies after a cesarean section. While shorter intervals are often considered a risk factor, the high success rate in this study suggests that with appropriate patient selection—such as ensuring a low-segment cesarean scar and no other contraindications—VBAC can be safely attempted even with intervals less than 2 years.²² However, clinicians should remain vigilant for signs of uterine rupture, a rare but serious complication, particularly in women with shorter intervals. Regular ultrasound assessments of the uterine scar during pregnancy could provide additional reassurance in these cases.²³

The findings on gestational age and birth weight further reinforce the importance of fetal maturity and size in VBAC planning. Term deliveries are generally associated with better labor outcomes due to the fetus's

readiness for delivery and the mother's physiological preparedness for labor. The small number of preterm deliveries in this study limits definitive conclusions, but the 100% success rate in this group suggests that preterm VBAC may be a viable option in carefully selected cases, such as those with spontaneous preterm labor and favorable cervical conditions. Conversely, the single case of macrosomia resulting in a cesarean delivery underscores the need for careful monitoring of fetal size, as larger fetuses may increase the risk of labor dystocia or shoulder dystocia, which could complicate VBAC attempts.²⁴

Future research could build on these findings by exploring additional variables that may influence VBAC outcomes, such as the impact of labor induction, the role of maternal comorbidities like diabetes or hypertension, or the effect of different labor management protocols. Larger cohort studies would enhance statistical power to detect differences in non-significant variables like maternal age and birth interval, providing a more comprehensive understanding of VBAC predictors. Additionally, qualitative studies exploring patient preferences and experiences with VBAC could inform strategies to increase its acceptance among women with a prior cesarean section, addressing barriers such as fear of labor or lack of awareness about VBAC benefits.

Strengths and limitations

The study's strengths include its retrospective design, utilizing comprehensive medical records from two major hospitals, ensuring robust data collection, and focusing on key predictors like cervical dilation and Apgar scores, which showed significant associations with VBAC success. The careful patient selection criteria enhanced the reliability of the findings. Limitations include the small sample size (N=46), which reduced statistical power for non-significant variables like maternal BMI and age. The retrospective nature may introduce selection bias, and the lack of data on labor induction or maternal comorbidities limits generalizability. Larger, prospective studies could address these gaps.

CONCLUSION

This study highlights the potential of vaginal birth after cesarean (VBAC) as a viable strategy to reduce repeat cesarean deliveries in multiparous women, provided that rigorous patient selection and thorough risk assessment are prioritized. VBAC represents a safer alternative to repeat cesarean section in the absence of contraindications, such as placenta previa or fetal distress, thereby safeguarding maternal and neonatal outcomes.

These findings enrich the existing scientific evidence and seek to promote greater awareness of the benefits of VBAC. This study demonstrates that VBAC procedures conducted at Dr. Soetomo General Academic Hospital and Universitas Airlangga Hospital, Surabaya, Indonesia, achieved a high probability of success. Greater cervical dilation at the time of admission is a pivotal determinant strongly correlated with successful VBAC. Favorable neonatal outcomes, as reflected by higher Apgar scores, are consistently associated with successful VBAC, underscoring positive indicators of fetal well-being.

DISCLOSURES

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Conflict of interest

No conflict of interest occurred in this study

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Author contribution

All authors have contributed to all processes in this research, including preparation, data gathering and analysis, drafting and approval for publication of this manuscript.

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