ORIGINAL RESEARCH

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

Syihab Armawa[1]*, Agus Sulistyono[2], Muhammad Ilham Aldika Akbar[3], Risa Etika[4]
[1]Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia.
[2]Department of Obstetrics and Gynecology, Dr. Soetomo General Academic Hospital, Surabaya, Indonesia.
[3]Universitas Airlangga General Academic Hospital, Surabaya, Indonesia.
[4]Department of Pediatrics, Dr. Soetomo General Academic Hospital, Surabaya, Indonesia.

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***Corresponding author:**
Syihab Armawa
syihab.armawa.putera-2021@fk.unair.ac.id

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ABSTRACT

Objective: This study aims to evaluate the 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 study was conducted using a total sampling method to review medical records from January 2021 to December 2022. Inclusion criteria encompassed singleton pregnancies with a previous one-time low-segment cesarean section, vertex presentation, and no contraindications to vaginal delivery. A total of 46 eligible cases were analyzed following exclusion criteria.

Results: Among the studied variables, cervical dilation at admission and the 5-minute Apgar score were significantly associated with successful VBAC ($p < 0.05$). All patients presenting with cervical dilation >4 cm delivered vaginally, indicating a strong predictive value. In contrast, those with dilation <4 cm had a markedly higher rate of cesarean delivery. A higher Apgar score also correlated positively with VBAC success, suggesting favorable neonatal outcomes in these cases. Maternal BMI did not show a statistically significant association with VBAC success ($p > 0.05$), likely influenced by the predominance of obesity in the cohort. Other factors, including maternal age, parity, birth interval, gestational age, and neonatal birth weight, were not significantly associated with the outcome.

Conclusion: While most maternal and fetal variables did not significantly impact the likelihood of successful VBAC, cervical dilation on admission emerged as a critical clinical predictor. These findings emphasize the importance of intrapartum evaluation, particularly cervical assessment, in guiding delivery planning for women with prior cesarean sections.

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Highlights:

1. VBAC at Dr. Soetomo General Academic Hospital and Universitas Airlangga Hospital demonstrated a high success rate, reflecting effective patient selection and clinical management in achieving favorable outcomes for multiparous women with a prior cesarean section.
2. Cervical dilation, particularly greater than 4 cm at admission, is a significant predictor of VBAC success, highlighting its critical role in guiding labor management and decision-making for optimal delivery outcomes.

INTRODUCTION

Cesarean-section (CS) deliveries have seen a significant global increase, influencing pregnant women's preferences for delivery methods, primarily due to anxiety surrounding vaginal birth, fear of pain, and other factors contributing to the choice of CS. The rising trend is particularly notable in high- to middle-income countries, where non-medically indicated CS rates have surged, often driven by self-preference to avoid vaginal birth.[1]

Globally, the CS rate rose from 6.7% in 1990 to 19.1% in 2014, with Asia recording the second-highest increase at 15.1% over the same period.[2] This escalation is attributed to advancements in surgical safety, including improved antibiotics, blood transfusion techniques, and supportive medical technologies. However, despite these improvements, CS carries higher risks and complications compared to vaginal delivery, including increased chances of infection, hemorrhage, and longer recovery times.[3] Vaginal birth after cesarean (VBAC) offers a potential strategy to reduce repeat CS rates, with global success rates for VBAC attempts ranging from 60–80%.[4] Given the rising CS rates and their associated risks, identifying factors that contribute to successful VBAC is critical for optimizing maternal and fetal outcomes. The aim of this study is to investigate 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 inform clinical decision-making and enhance patient selection for VBAC attempts.

MATERIALS AND METHODS

This study employed a retrospective analytic design, utilizing a total sampling method to analyze medical records from Dr. Soetomo General Academic Hospital and Universitas Airlangga Hospital between January 2021 and December 2022. Patient records were filtered based on inclusion criteria: live fetuses, one prior cesarean section with a low-segment transverse incision, singleton pregnancy, vertex presentation, and no contraindications for vaginal delivery (e.g., placenta previa, active genital herpes, or severe fetal distress). Exclusion criteria included incomplete records, multiple gestations, or non-vertex presentations. Data were extracted from electronic and paper-based records, including maternal age, BMI, gravidity, birth interval, gestational age, vaginal birth history, baby birth weight, Apgar scores, and cervical dilation at admission. Data were verified for accuracy by cross-referencing with labor and delivery logs. A total of 70 records were initially retrieved, with 46 meeting inclusion criteria after excluding 24 due to missing data or failure to meet criteria. Data were compiled into a frequency distribution table and analyzed using the Chi-square test to assess associations between maternal and fetal characteristics and VBAC success. Statistical analysis was performed using SPSS version 25, with a significance threshold of $p<0.05$. Ethical approval was obtained from the institutional review boards of both hospitals, ensuring confidentiality and compliance with ethical standards for retrospective studies.

RESULTS AND DISCUSSION

Based on a retrospective analysis using the Chi-square test from Dr. Soetomo General Academic Hospital and Universitas Airlangga Hospital medical records spanning from January 2021 to December 2022, a cohort of 70 patients underwent vaginal birth after cesarean (VBAC), with 24 records excluded based on specific criteria, resulting in 46 medical records analyzed into distribution tables and graphs. The study's findings highlight cervical dilation and Apgar scores as significant predictors of VBAC success, with p-values less than 0.05, while factors such as maternal BMI, age, gravidity, and birth interval showed no statistically significant impact. This comprehensive analysis provides valuable insights into maternal and fetal characteristics that influence VBAC outcomes and explores their clinical implications to guide practice.

Table 1 shows the data distribution and outcome of patients with the VBAC procedure (N=46), some significant values from this study are APGAR score and cervical dilation with p-value <0.05. This final research analysis discovered that some maternal and fetal characteristics could provide some prediction in evaluating the risk factors of the VBAC procedure in Dr. Soetomo General Academic Hospital and Universitas Airlangga Hospital. Hence, a proper prediction is crucial to take action for pregnant women who have a high chance of a successful VBAC.[5] According to a study conducted in China, the success of VBAC in postCesarean women was up to 84% although the most preferred mode of delivery for women with a previous history of CS is still repeat CS.[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%)	

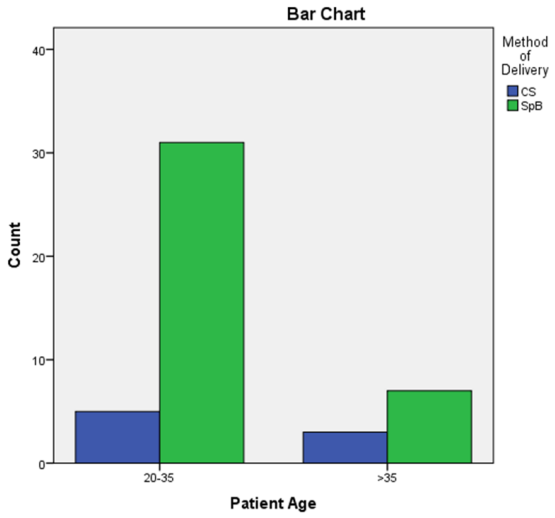

Figure 1. Distribution and frequency of patients based on age.

Figure 1 describes a predominant population of 36 individuals, constituting 78.2% of patients aged 20–35 years, with a VBAC success rate of 86.1%, compared to a 70% success rate in those over 35 years (N=10, 22.8% of the cohort), with a p-value of 0.244. Younger women may benefit from greater pelvic flexibility and fewer comorbidities, facilitating vaginal delivery. However, the small number of older patients limited the ability to detect significant differences. The majority of patients who failed VBAC in the 20–35 age group exhibited obesity, challenging birth intervals, or other maternal conditions that heightened risks, aligning with findings that maternal age under 35 and primiparity enhance the likelihood of successful vaginal delivery.[7] Many older patients also presented with higher BMI or shorter birth intervals, contributing to the increased cesarean rate in this group. This interplay of factors emphasizes the need for a comprehensive risk assessment, with younger women with normal BMI and a history of vaginal delivery being ideal VBAC candidates, while older women with additional risk factors may require closer monitoring or alternative delivery planning.

Figure 2 shows the distribution and frequency of patients based on BMI, with a p-value of 0.067 indicating a notable but non-significant trend where the rate of repeat cesarean sections increased with higher BMI. The obese group (BMI >30 kg/m²) comprised 47.8% of the cohort (N=22) and had a 27.3% cesarean rate, compared to 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). The rate of cesarean sections increased from 28% in the overweight group to 41.2% in the obese group.[8] The success of VBAC was highly

remarked by the predominance of the obese group, which constituted 47.82% of all patients, while the lowest frequency was in the normal BMI group at 17.39%. This trend suggests that obesity may complicate labor, potentially due to prolonged labor durations or increased risk of uterine rupture. The high prevalence of obesity in the sample may have reduced statistical power to detect significance, as nearly half of the patients were obese. This observation underscores the need for tailored counseling for women with higher BMI, including preconception weight management and nutritional guidance to mitigate risks such as labor complications or repeat cesarean sections. Clinicians should consider additional monitoring for obese patients during labor to address potential challenges early.

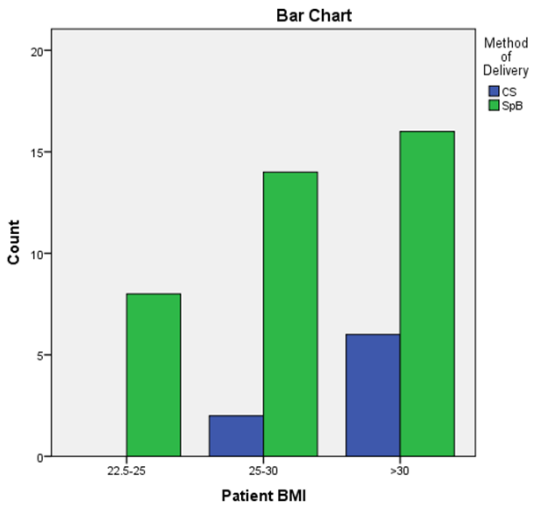

Figure 2. Distribution and frequency of patients based on BMI.

Figure 3 describes the patient group with a cervical opening of more than 4 cm, where all 31 patients (100%) delivered spontaneously, underscoring the critical role of advanced labor progression at admission. In contrast, patients with cervical dilation less than 4 cm had a 58.3% chance of requiring a repeat cesarean section, with only 7 out of 15 patients in this group delivering vaginally. The strong correlation (coefficient 0.660, p-value < 0.02) emphasizes the need for clinicians to assess cervical status early in labor to guide decision-making. For patients with minimal dilation, early interventions such as labor augmentation or closer monitoring may improve VBAC outcomes, while preparing for a potential cesarean delivery could enhance maternal and fetal safety. The data also suggests that a history of labor arrest in previous pregnancies influences VBAC success. Women with a history of arrest in the second stage of labor may have a higher likelihood of successful VBAC, while those with first-stage arrest face a lower success rate, potentially due to underlying issues with labor progression. Other studies have reported that 90.5% of VBAC cases with cervical dilation greater than 4 cm result in successful vaginal delivery, and women admitted with dilation exceeding 1 cm have an increased chance of VBAC success.[7,9] Prior maximal cervical dilation is also a prognostic factor, with second-stage arrest associated with higher VBAC success rates, while first-stage arrest correlates with a 65% success rate in subsequent VBAC attempts.[10,11]

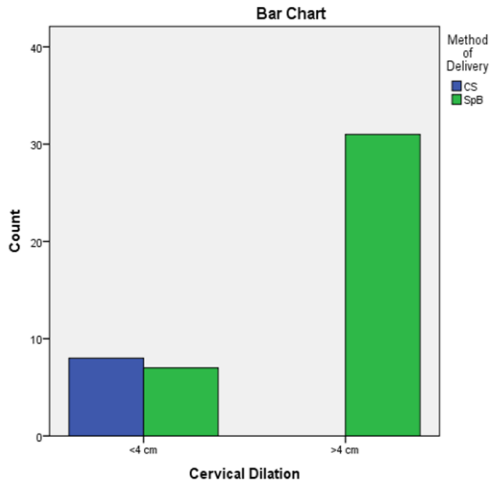

Figure 3. Distribution and frequency of patients based on cervical dilation.

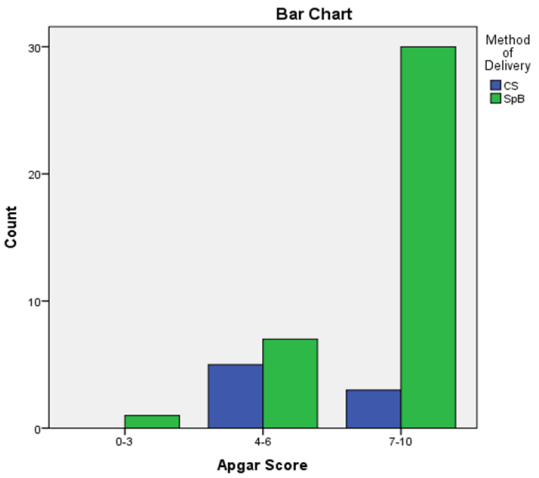

Figure 4. Distribution and frequency of patients based on 5-minute APGAR Score.

Figure 4 shows similar outcomes in neonatal performance, with Apgar scores at 5 minutes post-birth demonstrating significant predictive value. Notably, 71.7% of VBAC patients (N=33) recorded Apgar scores

of 7–10 within the first one to five minutes post-birth, with 90.9% of this group delivered vaginally, indicating favorable neonatal outcomes linked to successful VBAC. The mean Apgar score for successful VBAC cases was higher at 1 minute (7.21) compared to failed trial of labor after cesarean (TOLAC) (6.91), with the trend continuing at 5 minutes.[12] In contrast, the 4–6 Apgar score group had a lower VBAC success rate of 58.3%, suggesting that fetal distress or labor complications may necessitate cesarean delivery. Within the VBAC cohort, 13 patients (28.3%) scored below the 7–10 range on the Apgar scale, underscoring a notable pattern in Apgar score outcomes between successful and failed VBAC attempts. These findings highlight the importance of robust fetal monitoring, such as continuous electronic fetal monitoring, to detect early signs of compromise that might lead to lower Apgar scores, enabling timely decisions about delivery mode.[13] However, the difference in Apgar scores between successful and failed VBAC attempts was not substantial enough to suggest that neonatal outcomes alone drive delivery outcomes, as maternal and labor-related factors also play a significant role.[14]

Gravidity and parity (p-value 0.614) showed no significant impact on VBAC outcomes, with high success rates across all gravidity groups. G4 patients achieved 100% VBAC success (N=5), though the small sample size limits conclusions. The high success rate may reflect careful patient selection, including those with a single prior low-segment cesarean section. The inclusion of patients with a history of vaginal birth (52.2%, N=24) likely contributed to the overall high success rate, as prior vaginal delivery is known to enhance VBAC likelihood. Women with a history of successful vaginal births, regardless of gravidity, may be strong VBAC candidates, though clinicians should remain cautious with higher-gravidity patients due to potential risks from cumulative uterine scarring.[15]

Birth interval (p-value 0.589) showed no significant effect, with success rates of 88.9% for intervals less than 2 years (N=9) and 81.1% for intervals greater than 2 years (N=37). Shorter intervals are often associated with risks such as incomplete uterine healing or uterine rupture, but the high success rate in both groups suggests that careful patient selection and monitoring can mitigate these risks. The small number of patients with short intervals limited the ability to detect differences. Counseling on optimal birth spacing could further enhance VBAC safety and success.[16]

Gestational age and birth weight, with p-values of 0.299 and 0.842, respectively, showed no significant association with VBAC success. Most patients (78.2%, N=36) delivered at term (>37 weeks), with an 86.1% success rate, indicating that term deliveries are favorable for VBAC due to fetal maturity and labor readiness. The small number of preterm deliveries (<34 weeks, N=2) achieved 100% success, suggesting preterm VBAC may be feasible in select cases. Birth weight showed no clear trend, with high success rates across most categories, though the single case of a neonate weighing over 3 kg resulting in a cesarean delivery highlights potential challenges with macrosomia, warranting additional monitoring.

The overall VBAC success rate of 82.6% reflects the effectiveness of careful patient selection, including criteria such as singleton pregnancy, vertex presentation, and no contraindications for vaginal delivery. According to a study in China, VBAC success in post-cesarean women reached 84%, though repeat cesarean remains the preferred mode for many with a prior cesarean section.[6] These findings emphasize the importance of individualized risk assessment and shared decision-making in VBAC planning.[15] Cervical dilation and Apgar scores should be prioritized as key predictors, while maternal BMI and age should be considered in a holistic evaluation. This final analysis indicates that some maternal and fetal characteristics can predict VBAC risk factors, making proper prediction crucial for identifying women with a high chance of successful VBAC.[5]

The high VBAC success rate underscores the potential of this approach to reduce repeat cesarean sections, which carry higher risks of complications such as infection, bleeding, and longer recovery times compared to vaginal delivery. The significant role of cervical dilation, as shown in Figure 3, suggests that labor management protocols should focus on optimizing cervical progression through timely interventions, such as oxytocin augmentation or artificial rupture of membranes, when appropriate.[17] Clinicians should also use partograms to track labor progress and identify potential delays early, particularly in patients with cervical dilation less than 4 cm at admission.[18] The association between higher Apgar scores and successful VBAC, as depicted in Figure 4, further supports the need for vigilant fetal monitoring to ensure neonatal well-being, which can guide decisions about continuing with a VBAC attempt or transitioning to a cesarean delivery.

The non-significant findings for maternal BMI, as illustrated in Figure 2, highlight the complexity of VBAC outcomes, which are influenced by a combination of factors rather than any single variable in isolation. The trend of increased cesarean rates with higher BMI suggests that obesity-related complications, such as reduced uterine contractility or increased soft

tissue obstruction, may contribute to VBAC failure.[19] This necessitates a multidisciplinary approach to VBAC counseling, incorporating obstetricians, dietitians, and maternal-fetal medicine specialists to address modifiable risk factors like obesity before pregnancy.[20] Similarly, the lack of significance for maternal age, as shown in Figure 1, may be due to the confounding effects of comorbidities or other maternal conditions, which should be thoroughly evaluated during prenatal care to optimize VBAC candidacy.

The high success rate among patients with a history of vaginal birth highlights the importance of considering obstetric history in VBAC planning. Women with prior vaginal deliveries may have a more favorable myometrial response to labor, increasing the likelihood of successful VBAC. This finding supports the development of predictive models that incorporate obstetric history alongside clinical factors like cervical dilation and fetal well-being.[21] Such models could help stratify patients into low-, moderate-, and high-risk categories for VBAC success, enabling personalized counseling and management plans.

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 underscores the potential of vaginal birth after cesarean (VBAC) as an effective approach to reduce repeat cesarean sections in multiparous women, provided meticulous patient selection and risk assessment are prioritized. VBAC serves as a safer alternative to repeat cesarean delivery when no contraindications, such as placenta previa or fetal distress, are present, ensuring both maternal and fetal safety. These findings contribute to the scientific literature and aim to enhance awareness of VBAC's benefits. This study shows that VBAC procedures at Dr. Soetomo General Academic Hospital and Universitas Airlangga Hospital, Surabaya, Indonesia, demonstrated a high likelihood of success. Advanced cervical dilation at admission is a critical factor strongly associated with successful VBAC Favorable neonatal outcomes, indicated by robust Apgar scores, are closely linked to successful VBAC, reflecting positive fetal well-being.

DISCLOSURES

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Conflict of interest

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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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