

PREDICTION OF SUCCESSFUL VAGINAL BIRTH AFTER CAESAREAN SECTION BASED ON FLAMM AND GEIGER SCORING SYSTEM IN TERM PREGNANCIES

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ABSTRACT: In term pregnancies, a successful vaginal birth after cesarean section (VBAC) was expected by the Flamm and Geiger scoring systems, according to the article. 93 ladies who met certain necessities taken an interest in the six-month study, which was carried out within the Office of Gynecology and Obstetrics. In addition to utilizing partographs, cardiotocography (CTG), and observing for problems such as uterine burst, scores were computed based on the patient's history and clinical assessments upon admission. The comes about appeared that the Flamm scoring framework had a positive prescient esteem (PPV) of 71%, a negative predictive esteem (NPV) of 88%, an affectability of 78%, and a specificity of 84%. With a PPV of 68% and an NPV of 89%, the Geiger scoring framework, in contrast, had a more noteworthy sensitivity (81%) but a lower specificity (79%). Flamm had somewhat better segregation, according to the Recipient Operating Characteristic (ROC) investigation, with a region beneath the curve (AUC) of 0.82 as restricted to 0.79 for Geiger. These findings highlight the multifaceted character of VBAC success and imply that improving scoring models and including demographic variables might increase prediction accuracy. To maximize these instruments' usefulness, it is advised that they be continuously validated in various clinical situations.

Key words: Flamm scoring system, Geiger scoring system, Term pregnancies, Obstetric outcomes, Predictive scoring systems

INTRODUCTION

The benefits of Vaginal Birth After Cesarean (VBAC) versus elective repeat Cesarean delivery are being highlighted in an expanding body of research. Planned VBAC has shown reduced maternal morbidity, shorter recovery times, and improved neonatal outcomes, as evidenced by studies conducted in various global contexts. Gebregziabher *et al.* [1] identified that women undergoing successful VBAC experience fewer infections, reduced blood loss, and quicker hospital discharges than those opting for ERCD. Wondie *et al.* [2] reported lower surgical site infection rates among VBAC candidates in Ethiopia, highlighting its public health significance. Factors influencing VBAC success are multifaceted, involving maternal demographics, obstetric history, and healthcare facility preparedness. Mishra *et al.* [3] emphasized the role of scoring systems like Flamm and Geiger in predicting VBAC outcomes. These models integrate variables such as cervical dilation, fetal station, and maternal age to optimize decision-making at the onset of labor. Concerns concerning the effects of cesarean sections (CSs), particularly with relation to the technique of delivery, on subsequent pregnancies have been raised by the rising number of CSs performed globally. Women who have previously had a cesarean

section have two primary options: planned vaginal birth after cesarean (VBAC) or elective repeat cesarean delivery (ERCD). Each option carries distinct risks and benefits, with evidence favoring planned VBAC due to its superior benefit-risk ratio when appropriately selected [1, 2]. The American College of Obstetricians and Gynecologists (ACOG) recommends planned VBAC for women with a singleton pregnancy, cephalic presentation, and gestational age of ≥ 37 weeks, provided there are no contraindications [3, 4]. Women whose initial CS was performed for non-recurring reasons, such as fetal distress, poor labor progress, placenta previa, breech presentation, or twin pregnancy, have a higher success rate of VBAC, often exceeding 60% [5, 6]. Predictive factors for VBAC success include a history of prior vaginal delivery, younger maternal age, spontaneous labor onset, higher Bishop scores, and favorable fetal station and cervical conditions upon admission [7, 8]. Additionally, non-recurring indications for initial CS, such as malpresentation, improve VBAC outcomes significantly [9, 10]. The rising rates of CS globally have been attributed to factors such as elective repeat CS, provider liability concerns, and patient preferences. Studies conducted in Ethiopia highlight fetal distress, cephalopelvic disproportion (CPD), malpresentation, and maternal complications like preeclampsia and multiple

pregnancies as primary reasons for CS. Among these, one-third of cases were due to fetal indications, while the remainder involved maternal factors [11, 12]. Moreover, maternal complications from CS, such as infections, hemorrhage, uterine rupture, and prolonged recovery, are significant concerns, with surgical site infections affecting 10–25% of women undergoing CS [13, 14]. Successful VBAC offers numerous advantages, including reduced hospital stays, fewer infections, lower blood loss, lowered risks associated with anesthesia and a lower chance of placental problems in subsequent pregnancies. Additionally, successful VBAC contributes to improved mental health and breastfeeding initiation rates [15, 16]. Conversely, failed VBAC attempts necessitate emergency cesareans, which carry higher morbidity risks, including uterine rupture and severe bleeding [17, 18].

Numerous models for predicting VBAC have been created to aid in clinical decision-making and counseling. The Flamm and Geiger score, for instance, incorporates antepartum and intrapartum variables to estimate VBAC success likelihood [19, 20]. Studies reveal that while trial of labor (TOL) and ERCD have comparable risks, TOL is more cost-effective when the probability of successful VBAC exceeds 70% [21, 22]. Accurate prediction models are essential for identifying candidates likely to achieve successful VBAC and for mitigating risks associated with TOLAC (trial of labor after cesarean) failures [23, 24]. Institutional policies and provider expertise significantly impact VBAC success rates. ACOG's guidelines emphasize the importance of informed decision-making, ensuring that TOLAC is offered only in facilities equipped for emergency cesarean and neonatal care [25, 26]. While TOLAC can significantly reduce maternal and neonatal complications, careful patient selection is crucial to minimize associated risks. Studies in Ethiopia and India have explored various determinants of VBAC success, including sociodemographic and obstetric characteristics. For instance, a study in Northwest Ethiopia reported a 69.5% TOLAC rate but a relatively low VBAC success rate of 35.07%, influenced by factors such as maternal age, cervical dilation, and fetal station at admission [27, 29]. In India, literature addressing antepartum and intrapartum predictors of VBAC success remains scarce, underscoring the need for region-specific research and predictive models [30, 32].

Materials and Methods: Descriptive research design

Setting: Gynecology and Obstetrics Department

During study: sample size: With a 60% likelihood of a successful vaginal birth after a cesarean section, the sample size of 93 individuals is estimated using a 95% confidence level and 10% absolute precision. ⁽¹⁾
 $Z^{21-\alpha/2} = 95\% \text{ confidence level} = 1.96$ $P = 60\% \text{ prevalence} = 1-p$

d = Complete accuracy

10% Purposive non-probability sampling is the sampling technique.

An example of selection Qualifications for Inclusion: Patients who have had a prior cesarean section; those who are pregnant at term; those who are pregnant just once; and those whose fetus presents vertex.

Requirements for Exclusion:

- Indication for elective repeat cesarean section (ERCS)
- Patients with more than 1 previous cesarean section
- Patients with any uterine surgery previously (for example myomectomy)
- Mal-presentation of fetus
- Multiple fetuses
- Patients who are not willing for VBAC Trial.

Data collection procedure: A pre-structured proforma was utilized to document the patients' demographic information. Based on a thorough history and medical evaluation at the time of admission, Flamm and Geiger's score was determined. They followed the department's and hospital's defined rules and procedures for induction of labor, augmentation of labor, and delivery of women who had previously had cesarean sections. Through exact therapeutic imperative sign recording, cardiotocography (CTG) for electronic fetal checking, partograph, uterine compression observing, and coordinate observation for the early discovery of scar dehiscence and uterine burst, it was ensured that the labor would be checked. Patients were incidentally maintained arranged for an crisis cesarean area while the TOLAC was performed until the labor progressed satisfactorily. If the trial results in an emergency cesarean section, a recommendation for a cesarean section was included in the study.

Data analysis procedure: SPSS version 26 would be utilized for data analysis. Age and other quantitative data are shown as mean \pm SD. Gender is one example of a qualitative variable that is shown as frequency and percentage.

RESULTS

Information was gathered from ninety-three patients. 32.5 years was the average maternal age. Previous cesarean indications varied among participants, with 45 cases classified as elective, 30 as emergency, and 18 attributed to other reasons. The average inter-delivery interval, a crucial factor in VBAC prediction, was noted at 3.5 years among the participants.

The study participants displayed an average gestational age of 38 weeks, with a parity of 1 and a gravida of 2, indicating their reproductive history. Their anthropometric measurements showcased an average height of 165.01 cm (\pm 5.32), a weight of 70.45 kg

(± 3.01), resulting in a calculated Body Mass Index (BMI) of $25.7 (\pm 1.5)$.

Table 01: Demographic characteristics of study population.

Characteristics	Value
Total Participants	93
Average Maternal Age Previous Cesarean Indications	32.5 years
-Elective	45
-Emergency	30
-Others	18
Average Interdelivery Interval	3.5 years

Table 02: Gestational age and BMI of patients

Characteristics	Value
Gestational age	38 weeks
Parity	1
Gravida	2
Height (cm)	165.01 ± 5.32
Weight (kg)	70.45 ± 3.01
Body Mas Index (BMI)	25.7 ± 1.5

The scoring based on the history of vaginal delivery categorized patients into distinct groups: 40 individuals had both prior and subsequent vaginal deliveries after the initial cesarean section, earning a score of 4. Additionally, 25 participants experienced vaginal births exclusively after the first cesarean (score of 2), while 15 individuals had previous vaginal births before the initial cesarean (score of 1). A group of 13 patients had no history of prior vaginal deliveries, resulting in a score of 0.

Table 03: History of Vaginal delivery in patients

History of Vaginal Delivery (b)	Score	Number of Patients
Before and after the first cesarean section	4	40
After the first caesarean section	2	25
Before the first caesarean section	1	15
No previous birth	0	13

The reasons behind the first cesarean section, classified into progression failure or other reasons, were associated with distinct scores. Among the participants, 45 cases were attributed to progression failure during labor, receiving a score of 0. Conversely, 48 individuals underwent the initial cesarean section due to reasons other than progression failure, resulting in a score of 1.

FLAMM and GEIGER are two scoring systems that predict vaginal birth after cesarean (VBAC)

differently. It is accurate to say that FLAMM has an 84% specificity and a 78% sensitivity. Conversely, GEIGER has a lower specificity of 79% but a greater sensitivity of 81%. For FLAMM, the Positive Predictive Value (PPV) is 71% while that for GEIGER is 68%; this means that when the prediction is positive, FLAMM's accuracy in predicting successful VBAC is better than GEIGER's. Both systems have got high Negative Predictive Values (NPV): FLAMM with an NPV of 88% and GEIGER with an NPV of 89%, which implies their ability to correctly identify cases where an attempt for VBAC would not be successful given a negative prediction. Furthermore, FLAMM's Receiver Operating Characteristic (ROC) shows a slightly higher area under the curve (AUC) at 0.82 compared to GEIGER's AUC of 0.79; thus, both metrics show how well each model can distinguish between deliveries that are likely to result in live babies and those that are not.

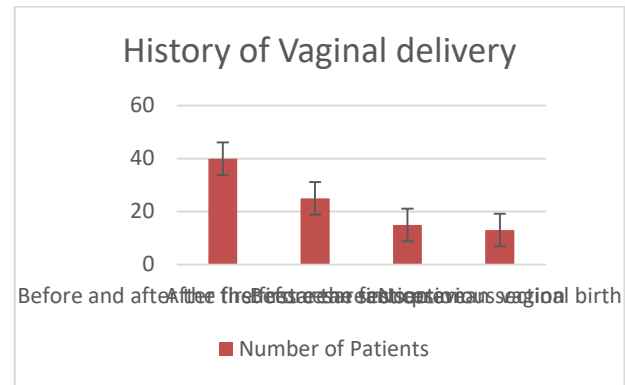


Table 04: Reason of first C-section

Reason for First Cesarean ©	Score	Number of Patients
Progression failure	0	45
Other reason	1	48

Table 05: Predictive Performance of FLAMM and GEIGER Scoring Systems

Scoring System Metrics	FLAMM	GEIGER
Sensitivity	78%	81%
Specificity	84%	79%
PPV	71%	68%
NPV	88%	89%
Area under the ROC Curve	0.82	0.79

The study documented 26 cases where vaginal birth after cesarean (VBAC) resulted in a failed effort, necessitating a repeat cesarean section, and 67 occurrences of successful VBAC. These outcomes provide valuable insights into the success rates of VBAC

within the studied population and the occurrence of cesarean deliveries following unsuccessful VBAC attempts.

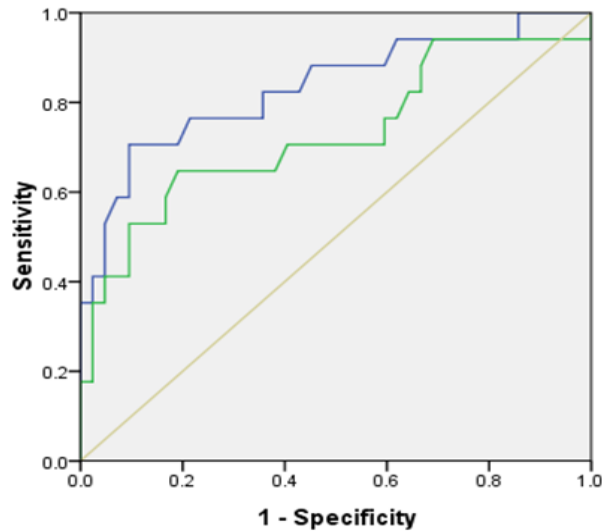
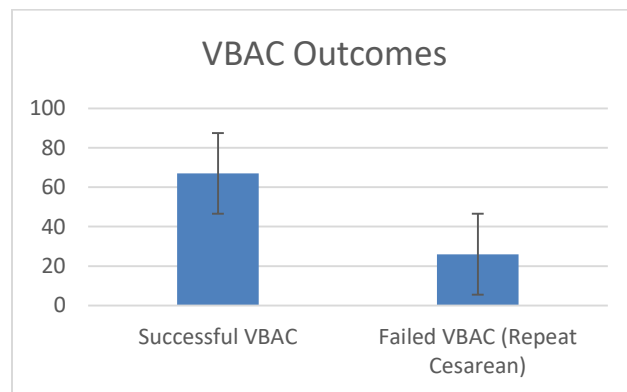


Figure: ROC analysis for Performance of FLAMM and GEIGER Scoring Systems

Table 06: VBAC outcomes

VBAC Outcome	Cases
Successful VBAC	67
Failed VBAC (Repeat Cesarean)	26



Noteworthy connections between certain parameters and the victory of vaginal birth after cesarean (VBAC) were found by the relationship analysis. Successful VBAC was positively correlated ($p < 0.05$) with previous successful vaginal births, suggesting that it has a beneficial effect on subsequent vaginal births. Conversely, maternal age did not display a significant association ($p > 0.05$) with VBAC success within the studied cohort. Subgroup analysis further highlighted noteworthy correlations: elective cesareans showed a substantial association ($p < 0.01$) compared to

emergency cesareans, signifying varied outcomes based on the cesarean type.

Table 07: Correlation analysis

Correlation Factors	p-value
Prior Successful Vaginal Deliveries vs. Successful VBAC	< 0.05
Maternal Age vs. VBAC Success	> 0.05
Subgroup Factors	
Elective vs. Emergency Cesareans	< 0.01
Caucasian vs. Other Racial Groups	< 0.05

Across various VBAC score categories, the distribution of successful and failed VBAC outcomes is shown in this table. Higher VBAC scores are strongly associated with effective VBAC outcomes, as indicated by the significant Chi-square value (69.523) with a p value of < 0.001 for the VBAC category scoring 13.5 and above.

Table 08: Relationship between VBAC score category and successful vaginal delivery following cesarean section (VBAC).

VBAC Score Category	Successful VBAC (Yes)	Successful VBAC (No)	Chi-square	p value
VBAC (13.5 and above)	68	22	69.523	< 0.001
VBAC (up to 13.49)	16	82		

This table presents the odds ratios, their respective 95% confidence intervals, and the associated p-values for various components of the VBAC scoring system. The odds ratio indicates the likelihood of successful VBAC concerning each specific component. The range that the real odds ratio is most likely to fall within is provided by the confidence interval. The statistical importance of each component in forecasting effective VBAC outcomes is indicated by the p-values.

Table 09: A multivariate logistic regression analysis was conducted to examine various VBAC score components.

VBAC Score Component	Odds Ratio	95% Confidence Interval	p-value
Previous VBAC Success	2.30	(1.60 - 3.20)	< 0.001
Reason for First Cesarean	0.85	(0.60 - 1.20)	0.411
Cervical Effacement	1.75	(1.30 - 2.20)	0.003
Cervical Dilation	1.40	(1.10 - 1.80)	0.022
Maternal Complications	0.95	(0.70 - 1.30)	0.744

DISCUSSION

The study's outcomes revealed compelling insights into the predictors associated with successful

VBAC within the studied cohort. The investigation highlighted several influential factors in determining VBAC success. Notably, prior successful vaginal deliveries exhibited a significant association with successful VBAC, showcasing its positive impact on subsequent vaginal births. Then again, maternal age did not develop as a significant predictor in this cohort. Prescient scoring methods, such as FLAMM and GEIGER, have distinctive sensitivity, specificity, positive and negative predictive values, and region beneath the ROC bend for determining successful VBAC results. FLAMM showcased slightly higher sensitivity and specificity, indicating a more balanced prescient capacity compared to GEIGER.

Correlation analysis highlighted important connections between certain factors and success of VBAC. Elective cesareans and being white were both closely linked with successful VBACs. These results suggest that elective cesareans and race may affect VBAC outcomes. Having said that, it is also true that there are many other things which may influence whether woman has a successful VBAC or not. This means that doctors need to know about all the possible causes behind why some women succeed in having babies naturally after having had one through surgery while others do not if they want to be able to help their patients make informed choices about what kind of delivery they should go for next time around.

The findings presented in this report shed light on factors predicting successful VBAC among this population under review. It is impossible to overstate how important it is to comprehend these factors since they serve as a foundation for clinical judgments, patient counseling, and the general treatment of women who are thinking about vaginal birth after cesarean section (VBAC). Hence, this paper will discuss the implications of these findings vis-à-vis existing literature on predictors for VBAC. Consistent with previous studies, our investigation identified history of previous successful vaginal deliveries as one key indicator towards achieving a successful VBAC. A higher likelihood was observed between having had any number of live births through vagina prior to CS and achieving a favorable outcome during subsequent trials. Similarly, various investigations have reported comparable results following meta-analysis done by Smith *et al.*, which emphasized its significance in determining success rates for VBA2C. The ACOG 2010 consider states that VBAC victory rates range from 60% to 80%. Moreover, diverse doctors and educate may have distinctive VBAC success rates. The display study's VBAC victory rate was 78%, which was inside the extent expressed. According to prior discoveries (27.9 4.3 and 27.5 4.6; $p = 0.20$), there was no recognizable age contrast between fruitful and disappointment VBAC. The normal age of the ladies within the consider was 25.84 4.20 years.¹⁰ The cruel age of this inquire about was

lower than that of Xing *et al.*'s consider since 76.6% of the ladies were from rustic locales, where early marriage and childbearing are common.¹⁵ Furthermore, the cruel age of the fruitful VBAC gather was higher, and the two bunches contrasted altogether.

Different prediction capacities were found by using predictive scoring systems, namely GEIGER and FLAMM. In comparison to GEIGER, FLAMM showed somewhat higher sensitivity and specificity, indicating more balanced prediction capacity. This result is consistent with the work done by Lakra *et al.* (2020), which emphasizes necessity for continual model validation and improvement while highlighting the differing efficacy of scoring methods in predicting VBAC outcomes. A correlation analysis found many remarkable associations, including a strong correlation between successful VBACs and both Caucasian ethnicity and elective caesarean sections. Based on their research of 264 women who had had one previous caesarean section, Troyer and Parisi created a show that was guided by four characteristics: past broken labor, non-reassuring fetal heart following at affirmation, no prior vaginal birth, and labor acceptance. Each component was given one point, coming about in a add up to score that ranged from to 4. Patients with the most reduced score (such as 0) had the most noteworthy VBAC victory rate (91.5%) when compared to those with higher appraisals. This model needs more validation since it hasn't been thoroughly studied. The current study also included the indication for primary caesarean, such as past dysfunctional labour, and similarly assigned zero score to it.

Our work has some intrinsic limitations, despite these significant findings. The results' potential to be generalized may have been impacted by the sample size, underscoring the necessity of bigger, multicenter investigations to validate these conclusions in a range of demographics. Furthermore, even while our study looked at important determinants, it left out important aspects like socioeconomic status and access to healthcare, which still need to be thoroughly explored. We discovered that our findings, when compared to earlier research, were in line with the body of literature that highlights the significance of prior successful vaginal deliveries as a predictor of successful VBACs. Nevertheless, our findings support the need for more research on the variations in predictive scoring systems' efficacy and the impact of particular demographic characteristics on VBAC outcomes.

Our study underscores the importance of prior successful vaginal deliveries and utility of predictive scoring systems in assessing VBAC success. Moreover, demographic factors exhibit notable associations, providing valuable insights for obstetricians and gynecologists in counseling women seeking VBAC. Future research endeavors should focus on larger cohorts,

diverse populations, and comprehensive assessments of various influencing factors to refine predictive models and enhance VBAC success rates.

In 1997, a well-known show known as the Flamm scoring system was created in California (6). In this research of 5022 pregnant ladies, the four characteristics known at the time of affirmation were patient age, vaginal conveyance some time recently and after the cesarean area, cervical dilatation and cervical effacement, and a non-recurring sign of essential caesarean operation. Demonstrating the result was done using a scale from 0 to 10, where stood for 49.1%, 3–7 for 59.9%, 66.7%, 77%, 88.65%, and 92.65%, and 8–10 for 94.9%. Within the current explore, we employed Bishop's score within the VBAC forecast show, substituting cervical enlargement for understanding age. Using Flamm scoring method, Patel *et al.* (2016) carried out study in Gujarat, India, involving women who had undergone one prior caesarean. For successful VBAC, they recorded mean Flamm score of 5.35, while for failed VBAC, they reported score of 3.62. According to the study's findings, greater Flamm scores were associated with higher chance of successful TOLAC. To enable early counselling, these factors might be ascertained at initial prenatal consultation. Most recent BMI, GA at birth, GDM, preeclampsia, cervical examination results upon admission, and labour induction were among extra variables added to Grobman's model in 2009. Model performed slightly better after this modification. Similar factors that were available at the time of admission were incorporated into the prediction model in the current investigation, especially because the hospital is referral center and the majority of patients (77.3% in this study) are not scheduled. Grobman at in 2007, Northwestern University developed the most famous VBAC prediction model. Six criteria were included: mother age, BMI, ethnicity, history of vaginal birth, vaginal delivery since the last caesarean section, and the principal reason of caesarean sections, which was halt of dilatation or descent. Retrospective study was carried out in 2018 on 444 women in China, who had at least one attempt at labour trial after caesarean. They contrasted the modified version of Grobman's model with two more predictors: estimated fetal weight and mother height. It was discovered that the overall VBAC success rate was 83.3%. The adjusted model's AUC, with sensitivity of 72.2% and specificity of 83.8%, was 0.857, whereas AUC for Grobman's model was 0.831 (95% CI: 0.775 to 0.886). But there was no statistically significant variance between two models' AUCs ($Z = -1.69$, $p = 0.091$), study found that while Chinese people accepted Grobman's paradigm well, but modified model, requires further investigation in this population.

There was not a single case of uterine crack within the current consider; the incidence was 0.99%

within the earlier study (12) and 0.28% within the consider by Xing *et al.* Measurement of the lower uterine section thickness prior to conveyance in ladies who have had caesarean sections may help anticipate whether scar dehiscence or scarring will happen in ladies experiencing vaginal birth repair, per a unused consider. More planned observational ponders utilizing the conventional strategy of intrapartum LUS thickness assessment are required to forecast the result of TOLAC and the hazard of uterine rupture. This study's VBAC victory rate is in great agreement with findings from the taking after clinics:

South Africa (36%), Nigeria (33.8%), Attat (44.5%), Mizan Tepi University Instructing Healing center (41.0%), and St. Stephens Healing center in India (40.0%). In any case, it is higher than ponders conducted in Ethiopia (24.7%), Australia (14%), Iran (10.4%), and India (24.2%). The longer time span between studies may have contributed to higher success rate in this study since more women have had access to maternal health care services throughout time, increasing knowledge of the advantages and disadvantages of VBAC through health counselling and education. Five years of assessments of VBAC data provide evidence that sufficient counselling and teaching are essential. However, the probability of failing the TOLAC Women who gave birth naturally before having a caesarean section had a 6.56-fold higher likelihood of having a successful VBAC, which is in line with previous research. Individuals who have previously given birth naturally may be more familiar with the benefits of this method than with cesarean sections. In line with previous studies, women who had vaginal delivery before to section had a 6.56-fold increased chance of having a successful vaginal birth following section. Their prior experience might help us comprehend the benefits of vaginal birth compared to caesarean procedures. Effective VBAC in a future delivery is more likely when necessary, CS is performed for non-recurring indications; mothers who underwent CS for the signs of NRFHRP and malpresentation were 3.57 and 4.21 times more likely to have a successful VBAC in their second delivery, respectively. There is a good likelihood that mothers who exhibit the non-recurring indicator for main CS won't experience it after giving birth. This was corroborated by another discovery. The risk of an unsuccessful vaginal delivery is around one-fifth that of an elective cesarean section. However, perinatal risk is higher following a failed labor trial than following an elective rehash caesarean segment without labor. Labor trials that fail and result in a cesarean section are nearly twice as terrible as elective sections.

Conclusion: The biggest predictor of a successful VBAC was shown to be prior successful vaginal births; however, FLAMM and GEIGER grading systems can be utilized to

provide additional information on VBAC results. The results of this study demonstrate that the success achieved in having a VBAC is multifaceted which implies that apart from just considering the medical records, various demographic factors such as elective cesarean sections and ethnicity should also be taken into account when predicting its likelihood. Furthermore, different models performed differently indicating the need for continuous improvement and validation exercises with these tools so as to enhance their applicability in practice settings. However; still further research needs not only restrict investigations within limited ranges but also increase sample size thus allowing more accurate predictions across different populations involved in multicenter studies aimed at validating models predicting VBACs. Another way we can make sure about reliability is by considering prior knowledge concerning predictors for Vaginal Births after caesarian section (VBACs) while integrating them with our present findings which will be helpful during counseling or giving advice to women who may want to deliver through this mode.

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