

RESEARCH ARTICLE

The Correlation of Ultrasonographic Cervical Length at Term to the Mode of Delivery: A Systematic Review and Meta-Analysis

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Received: 25 September 2025 Accepted: 12 October 2025 Published: 21 October 2025

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Abstract

This study was a systematic review and meta-analysis of observational studies published between 2015 and 2024 that used transvaginal ultrasonography cervical length measurements at term to predict the method of delivery. The review was conducted following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. QUADAS (Quality Assessment of Diagnostic Accuracy Studies) was also used to assess the risk of bias and the quality of the included studies. The assessment criteria and results were reported and justified in a summary table. The studies showed significant heterogeneity ($I^2 = 98\%$, $Q = 235.27$). There was also inadequate statistical evidence to reject the null hypothesis that cervical lengths had no effect on mode of delivery ($p = 0.10$). The ROC analysis revealed relatively modest predictive accuracy ($AUC = 0.722$) with no statistically significant relationship ($p = 0.151$). In conclusion, it was found that ultrasonographic cervical length at term should not be used to make delivery decisions on its own. Additionally, there is still a need to assess numerous clinical aspects and argue for additional research to develop better predictive models.

Keywords: Caesarean Section, Mode of Delivery, Predictive Value, Spontaneous Vaginal Delivery, Ultrasonographic Cervical Length.

1. Introduction

One of the most pressing challenges in modern obstetrics, particularly in developed countries, is the gap between primigravid women's expectations for a natural vaginal birth and the reality of highly medicalized deliveries, which frequently leads to dissatisfaction with the care received¹. Monitoring modest biological changes in pregnant women is critical, as even minor variations can have a large impact on delivery planning. Pregnancy causes profound anatomical and physiological changes to support the developing embryo, influencing all organ systems from conception onward^{2,3}. Within this setting, the cervix plays an important role throughout a woman's reproductive life, particularly

during pregnancy, labor, and delivery. Its dramatic remodeling is critical for the fetus' passage as labor approaches, with a significant decrease in cervical length signaling progress toward birth^{4,5,6,7}.

The most effective and objective approach for examining the cervix's health is transvaginal ultrasonography (TV-US), which measures its length as well as the diameters of the internal and external os^{8,9,10,11}. Antenatal cervical length assessment is extremely important in predicting labor outcomes¹². Studies have stressed the importance of cervical length, coupled with gestational and maternal age, in determining the mode of delivery. Recent research confirms the predicted relationship between cervical length at term and the likelihood of vaginal birth^{13,14}.

Citation: Vernie Kristine Constantino-Albano, Czarina Juliana Lazo-Alcaraz. The Correlation of Ultrasonographic Cervical Length at Term to the Mode of Delivery: A Systematic Review and Meta-Analysis. Open Access Journal of Gynecology and Obstetrics 2025;7(2): 24-33.

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However, disagreements persist, with some studies linking longer cervical lengths to an increased likelihood of cesarean delivery^{15,16,17,18,19,20,21}, while others find no predictive value in cervical length measurements for cesarean delivery at 37 weeks of gestation^{22,23,24,25}. Given these disparities, this study conducted a meta-analysis to understand the correlation between transvaginal ultrasonographic measurements of cervical length at term and mode of delivery, with the goal of providing clarity in an area fraught with conflicting results.

2. Objectives

2.1 General Objective

The general objective of this study is to quantitatively synthesize the included published observational studies (randomized controlled trials, cohort studies, cross-sectional studies, and case controls) from 2015 to 2024, that measures the efficiency of transvaginal ultrasound cervical length measurement at term as a predictor of mode of delivery (i.e., spontaneous vaginal delivery or caesarean section) among patients.

2.2 Specific Objectives

The first specific objective is to review the literature on transvaginal ultrasonographic cervical length measurement at term as a predictor of mode of delivery among patients in terms of spontaneous vaginal delivery and caesarean section. Next is to determine the correlation of transvaginal ultrasonographic measurement of cervical length at term to the mode of delivery.

3. Materials and Methods

3.1 Selection Criteria

3.1.1 Types of Studies

In order to determine the transvaginal ultrasound cervical length measurement at term as a predictor of mode of delivery (i.e., spontaneous vaginal delivery or caesarean section) among patients, this meta-analysis included all published observational studies from 2015 to 2024, including randomized controlled trials, cohort studies, cross-sectional studies, and case controls.

3.1.2 Exclusion Criteria

Case series, reports, editorials, or letters without original data, those whose entire texts could not be obtained, and those lacking statistical analysis of results or appropriate information on the issue were excluded. Studies published in non-English languages or without English translations were also omitted.

3.1.3 Types of Participants

The chosen studies included patients who had comprehensive records of their cervical length at term, as well as their manner of delivery.

3.1.4 Types of Outcomes

The primary outcome measure in this study was the mean transvaginal ultrasonographic cervical length measurement at term reported at each method of birth, spontaneous vaginal delivery or cesarean section, among individuals in the pooled data.

3.2 Search Methods

3.2.1 Electronic Searches

The Cochrane Library, Embase, PubMed, CINAHL, and other significant medical databases were all thoroughly searched. MeSH phrases and free text keywords were used in this search to cover every possible variant on the subject. Boolean operators (AND, OR) were utilized to combine terms like “cervical length,” “ultrasonography,” “pregnancy,” “mode of delivery,” “vaginal delivery,” and “cesarean section” in order to narrow down the search. The methodology was adjusted to take into account specific indexing phrases and search features for every database. Studies published between 2015 and 2024 that were published in English or at least had a complete English translation were filtered out of the computerized search. In order to find any research that might have been missed during the first electronic search, a manual search was also carried out in the reference sections of the recognized articles and reviews. However, this study did not contain any gray literature.

3.2.2 Searching Other Resources

An extensive bibliographic search was conducted solely in the references of the pooled studies. There was no manual inspection of periodicals, particularly those found in libraries and other institutions. When considered appropriate, the data collection method for relevant research was designed to include guidance from other subject matter experts, as well as relevant organizations and groups. However, this consultation session did not take place because data extraction was not difficult, as no statistical approaches were unable to reconcile a significant diversity of data, and the data presented by the screened studies did not look inconsistent.

3.3 Data Collection and Analysis

3.3.1 Selection of Studies

The search terms “cervical length,” “ultrasonography,” “pregnancy,” “mode of delivery,” “vaginal delivery,” and “cesarean section” were combined using the Boolean operators (AND, OR), and studies published in English or with English translation from 2015-2024 were included, with the following criteria: pregnant at term with cervical length and mode of delivery. The included journals were selected independently following the inclusion criteria. The Quality Assessment of Diagnostic Accuracy Studies (QUADAS) general risk-of-bias assessment tool was used in the independent critical appraisal for validity of the included studies, which was performed by VCA and CJA. Studies found to have a high risk of bias were still included in further analysis, but their risk

assessments were explicitly reported in this study, and the findings were presented with caution.

Furthermore, because no published study with full text was available in the public domain, no attempts were made to contact the associated author to obtain a complete copy of the study. Duplicates in the screened studies were deleted based on the research title, author, and year of publication. After the protocol was approved, a flowchart was created using the PRISMA 2020 principles to clearly portray the investigative, evaluative, and final decision-making processes. Figure 1 illustrates a sample flow diagram and depicts the flow of research through the review, with 21 studies screening 2757 women selected from an initial pool of 382 abstracts. Twelve studies were prospective, while nine were retrospective cohort studies, with sample sizes ranging from 14 to 383 women.

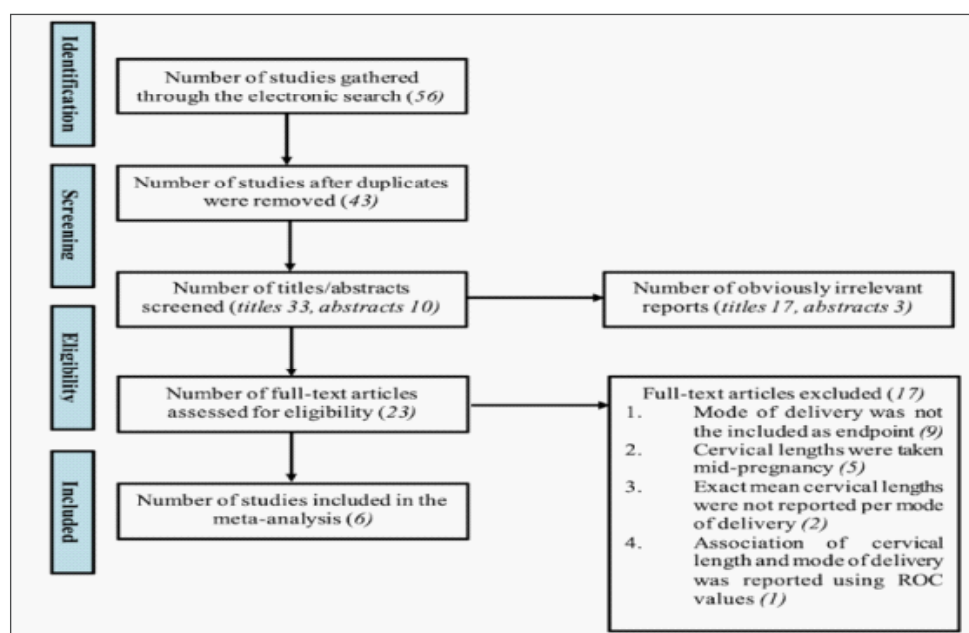


Figure 1. PRISMA flow diagram

3.3.2 Data Extraction and Management

The relevant data from each research sampled was collected using a standardized extraction procedure, namely an encrypted Microsoft Excel file. The principal investigator extracted the data. The following characteristics were gathered from these studies: study design, patient recruitment, inclusion and exclusion criteria, test details (ultrasound), transvaginal cervical length measurement, and reported results/outcome (method of delivery). The gathered data were assured to be precise and consistent through cross-examining the extraction forms—checking and rechecking the data collecting forms by the two authors numerous times to verify that no human errors in data entry or encoding occurred. After data extraction was

completed, the datasets were evaluated. The Statistical Package for the Social Sciences (SPSS), version 29 was utilized to analyze the data for this study.

3.3.3 Assessment of Risk of Bias in Included Studies

The possibility of bias and issues regarding the applicability of the included studies were assessed using the QUADAS (Quality Assessment of Diagnostic Accuracy Studies) criteria. Two reviewers [VKA, CA] assessed the risk of bias, and a dialog was mediated during the evaluation by a third reviewer [EP] to ensure that the evaluation process ran well.

3.3.4 Measure of Treatment Effect

The mean cervical length determined by ultrasonography, as well as the associated standard

deviations reported in each study, was used in this meta-analysis, which was carried out using inverse variance random effects. A p-value of less than 0.05 was considered statistically significant.

3.3.5 Assessment of Heterogeneity

The degree of heterogeneity between study findings was assessed using I² and Cochran's Q. To ensure coherence across research, a measure of heterogeneity was calculated and assessed using I² statistics, which should not have been 0% because this could indicate that the variance in the studies was due to sampling error.

3.3.6 Data Synthesis

The data were processed with SPSS version 29 to generate a forest plot for each component associated to the outcomes investigated in this study. A significance level of 0.05 was determined. The study materials were consolidated using a descriptive evaluation. This study used the input-throughput-output model to investigate the relationship between transvaginal ultrasonographic cervical length measurement at term and mode of delivery among patients. Furthermore, the study offered a full summary of each study's individual qualities and conclusions before presenting the meta-analysis results.

Table 1. Baseline study characteristics

Author, Year	N	Period of Gestation	Cervical Length in mm (SVD)	N (SVD)	Cervical Length in mm (CS)	N (CS)
Sinha et al., 2024	120	39.3 ± 1.1	23.4 ± 3.62	77	31.5 ± 6.64	43
Chandrasekaran et al., 2023	164	38.7±0.53	27.06 ± 7.19	92	27.21±7.64	51
Taha et al., 2020	162	39.5±1.3	42 ± 11.8	30	44.8 ± 5.9	36
Giyahi et al., 2018	126	37	34.08 ± 8.5	85	25.70 ± 8.7	41
Khalifa et al., 2018	100	41	22.31 ± 7.14	78	35.37 ± 5.80	22
Walke et al., 2020	199	37-40	25.8 ± 3.0	154	34.5 ± 1.5	45

Table 2. Summary of included studies

Study	Design	Participants (Eligibility Criteria)	Findings
Sinha et al. (2024)	Prospective observational study	120 antenatal women having a singleton pregnancy with a gestational age of > 37 weeks requiring induction of labor	TVUS cervical length > 26.5 mm more predictive of cesarean section during labor induction compared to Bishop score
Chandrasekaran et al. (2023)	Longitudinal study	164 low-risk singleton pregnancies at 38-40 weeks gestation	Cervical length at end of pregnancy relates to labor onset timing, not labor duration or delivery method
Taha et al. (2020)	Prospective cohort research	162 singleton pregnancies with an uneventful antenatal course between 37-39 weeks of gestation	Cervical length throughout pregnancy predicts method and gestational age at delivery, useful in patient counselling
Giyahi et al. (2018)	Prospective observational study	126 low-risk pregnant women at 37-39 weeks of gestation	Cervical length at 37 weeks predicts onset of spontaneous labor but not delivery method

To consolidate the findings, the study used forest plot analysis. The forest plot depicted the studies included in the analysis, as well as their respective effect sizes (as stated in Hedge's g), 95% confidence intervals, p-values, and effect weights. The forest plot also includes an analysis of the overall effect size to establish the general link between transvaginal ultrasonographic cervical length at term and mode of delivery based on the pooled research.

Furthermore, a ROC curve was used to assess the overall accuracy of transvaginal ultrasonographic cervical length measurement at term in predicting the mode of delivery across all trials included in the meta-analysis.

3.3.7 Sub-Group and Sensitivity Analysis

No subgroup analyses were performed.

4. Results

4.1 Systematic Review of Included Studies

Table 1 describes the features of all included studies and Table 2 provides a summary using a variety of techniques, including prospective observational studies, cohort research, and longitudinal analyses, all aimed at determining the function of cervical length in predicting labor and delivery outcomes. These studies

Khalifa et al. (2018)	Comparative prospective observational study	100 singleton pregnancies with a gestational age of completed 41 weeks	Cervical length accurately predicts labor induction effectiveness, 25mm cutoff most accurate for vaginal delivery prediction
Walke et al. (2020)	Prospective observational study	199 pregnant women at 37-40 weeks gestation	Shorter cervical length correlates with higher likelihood of vaginal birth within 7 days of measurement

emphasize the importance of measuring cervical length using transvaginal ultrasonography (TVUS) in anticipating various delivery-related factors. Sinha et al. (2024)³⁰ underline the importance of cervical length in predicting the need for cesarean sections and the efficacy of labor inductions. Taha et al. (2020)³¹, Khalifa et al. (2018)³², and Walke et al. (2020)³³ present evidences that cervical length is a predictor of labor and mode of delivery linking shorter cervical lengths to an increased likelihood of vaginal birth. On the other hand, Chandrasekaran et al. (2023)³⁴ and Giyahi et al. (2018)³⁵ take a critical approach, arguing that cervical length at term may not correspond with labor duration or mode of delivery, emphasizing the intricate interplay between cervical morphology and labor dynamics. This complexity is evident throughout the research, demonstrating varying prognostic accuracies and contexts for cervical length measurement. Thus,

while cervical length measurement using TVUS has significant potential as a predictor of various delivery outcomes, its use should be addressed within a broader diagnostic framework that includes patient-specific characteristics and full obstetric evaluations. Future research should focus on refining these predictive models, increasing their accuracy, and incorporating them into tailored prenatal care programs.

4.2 Meta-Analysis of the Correlation of Ultrasonographic Cervical Length at Term to the Mode of Delivery

Following a risk-of-bias evaluation (Figure 2), 871 participants’ responses were collected for further study. A funnel plot (Figure 3) revealed an uneven distribution, which suggests publishing bias.

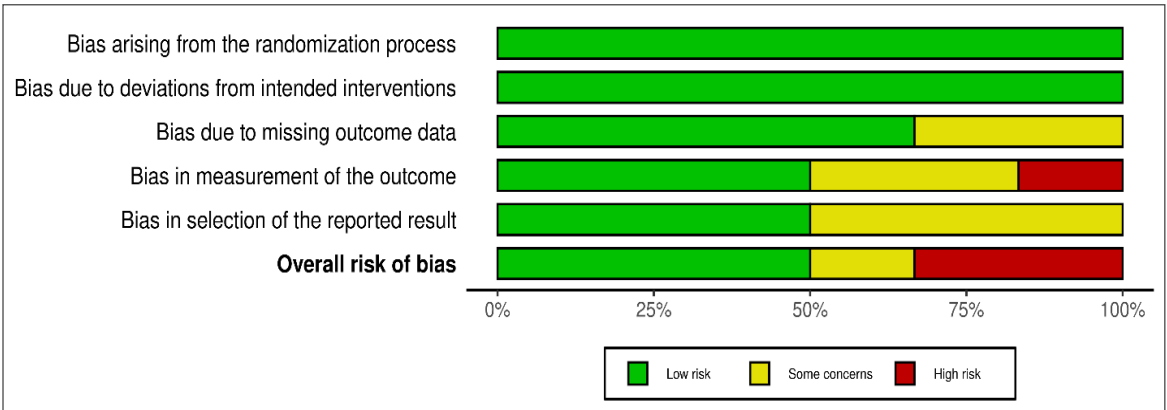


Figure 2. Risk-of-bias assessment results

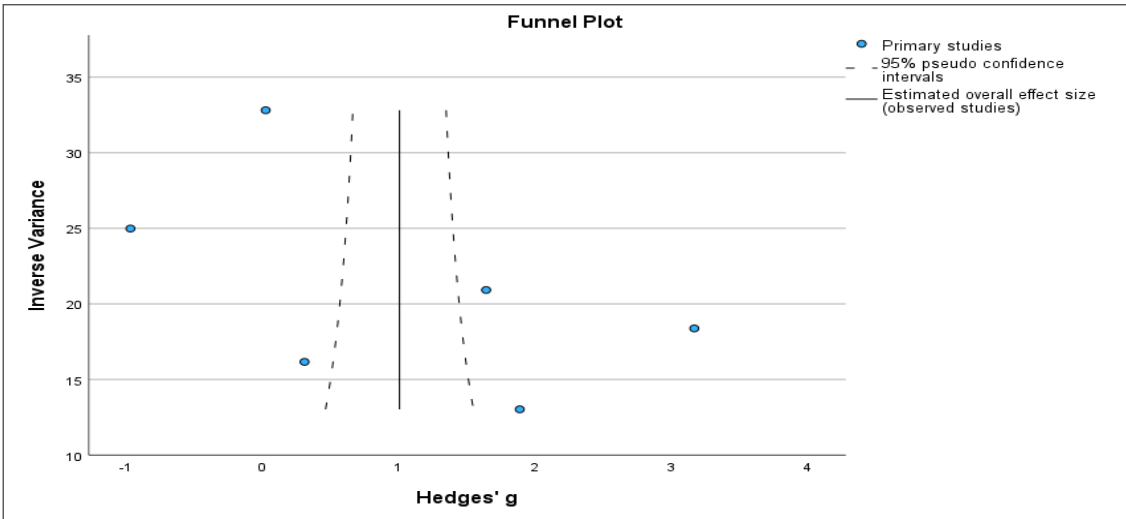


Figure 3. Funnel plot for the included studies

The random effects meta-analysis (Figure 4) revealed high heterogeneity among studies ($I^2 = 98\%$, $Q = 235.27$). However, there was insufficient statistical evidence to reject the null hypothesis that cervical length impacts mode of delivery (SMD = 1.00, 95% CI = -0.20 to 2.20, $p = 0.10$).

Confirmatory receiver operating characteristic (ROC) analysis (Figure 5) was performed to establish whether ultrasonographic cervical length at term predicts mode

of delivery, with Cesarean section as the positive outcome. The ROC curve and area under the curve (AUC = 0.722, $p = 0.151$) demonstrated that cervical length does not predict mode of delivery. These data indicate that, while cervical length assessment with TVUS has potential clinical utility, its role as a single predictor of delivery mode is restricted due to significant variance and low precision in the analyzed samples.

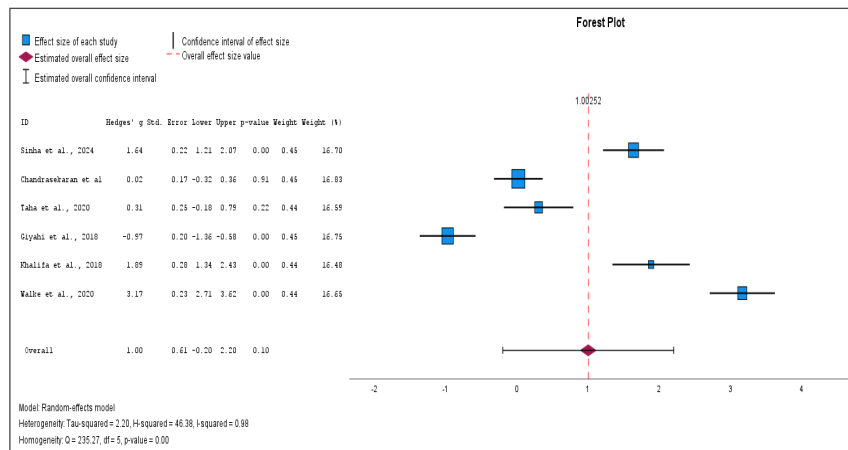


Figure 4. Meta-analysis of ultrasonographic cervical length and mode of delivery

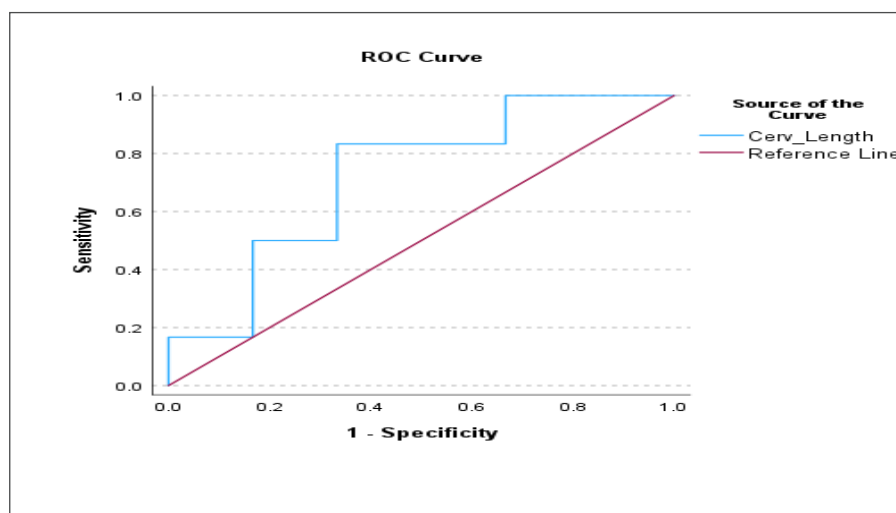


Figure 5. ROC analysis on the ultrasonographic cervical length and mode of delivery

5. Discussion

This study's findings provided significant insights while also stressing the limitations of using ultrasonographic cervical length alone as a predictor of method of delivery.

There was significant heterogeneity among the included studies, indicating that factors such as varying methodology and demographic characteristics may influence the results^{26,27}. While the study found a possible significant impact of cervical length on the method of delivery, the accuracy of this assessment was low. The inconsistency calls into question the reliability of using cervical length as the sole predictor

for deciding whether to have a cesarean section or vaginal delivery.

Furthermore, the ROC analysis demonstrated the limitations of cervical length as a predictor. The ROC curve's inability to reach the crucial area, as well as the resulting area under the curve, suggest only modest efficacy in distinguishing between the need for a cesarean section and vaginal delivery. The current level of precision is insufficient for cervical length to be solely relied upon in clinical decision-making.

These data suggest that it is not clinically sound to base the method of delivery solely on ultrasonography measurements of cervical length at term²⁸. Healthcare providers should consider a broader range of factors,

including the mother's and fetus's health, the mother's obstetric history, and the duration of labor, when making decisions related to delivery²⁹. Because of the moderate predictive capacity of cervical length and the notable variability observed in the included studies, further research is necessary. In order to increase accuracy, future studies should endeavor to preserve methodological consistency and investigate the addition of additional predictive factors.

Given these findings, it may be appropriate to alter clinical guidelines to lessen the emphasis on cervical length as a single predictor and instead advocate a more holistic approach to determining delivery options.

6. Conclusion

The ultrasonographic measurement of cervical length at term was not a dependable sole indicator for determining the method of delivery. The cervical lengths between vaginal and cesarean deliveries could not be reliably differentiated due to the large variability and lack of statistical data.

6.1 Limitation

This study's primary focus on cervical length as a predictor without quantitatively incorporating other possibly important variables is one of its limitations. The result's generalizability and practical usefulness may be restricted by the omission of more comprehensive clinical parameters and established prognostic algorithms. To improve the precision and dependability of delivery outcome forecasts, future studies should adopt a multifactorial approach and make use of standardized methodology.

6.2 Recommendations

Although cervical length could be a factor in a more comprehensive evaluation, it should not be relied upon solely to determine the method of delivery. Hence, in order to protect the health of the mother and the fetus, medical professionals must take into account a number of considerations while deciding which technique of delivery to use for a pregnant patient. Evidence-based procedures should guide this decision-making process, which should include a number of factors including the mother's general health, her obstetric history, and the fetus's current condition. Furthermore, to improve the accuracy of predictions, it is recommended to do additional studies using standardized procedures and additional predictive indications.

6.3 Acknowledgements

My profound appreciation goes out to everyone who helped me during this research. I also want to express my gratitude to my consultant and colleagues for their advice and insightful comments. I would especially like to thank my family for their constant encouragement and support. Lastly, I would want to express my gratitude to everyone who provided assistance in any form throughout this study.

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Appendix

A. Included Studies

Sinha P, Gupta M, Meena S. Comparing Transvaginal Ultrasound measurements of cervical length to Bishop score in Predicting Cesarean Section following induction of labor: a prospective observational study. *Cureus.* 2024 Feb 16;16(2).

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B. Excluded Studies

Reason for Exclusion- Mode of delivery was not included as endpoint

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cervical length in prolonged pregnancy: prediction of spontaneous onset of labor and successful vaginal delivery. *Ultrasound in Obstetrics and Gynecology: The Official Journal of the International Society of Ultrasound in Obstetrics and Gynecology.* 2008 Mar;31(3):328-31.

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