MEASUREMENT OF THE CERVICAL LENGTH BY USING TRANSVAGINAL SONOGRAPHY FOR THE PREDICTION OF PRETERM BIRTH: A SYSTEMATIC REVIEW

Systematic Review

Sana Bahadar[1*], Syed Zaigham Ali Shah[1], Waseem Iqbal[2]

[1]MS Diagnostic Ultrasound, Ibadat International University Islamabad, Pakistan.

[2]Department of Biotechnology, Abdul Wali Khan University, Mardan, Pakistan.

Corresponding Author: Sana Bahadar, MS Diagnostic Ultrasound, Ibadat International University Islamabad, Pakistan, sanaradiology@gmail.com

Conflict of Interest: None | Grant Support & Financial Support: None

ABSTRACT

Background: Preterm birth, especially when occurring before 32 weeks of gestation, is a leading cause of neonatal morbidity and mortality worldwide. Early identification of pregnancies at risk is essential for initiating timely interventions that may improve neonatal outcomes. Transvaginal ultrasound (TVUS) assessment of cervical length has gained prominence as a reliable, non-invasive method to predict spontaneous preterm birth, particularly in asymptomatic women and high-risk populations.

Objective: To systematically review and evaluate the effectiveness of cervical length measurement via TVUS in predicting the risk of spontaneous preterm birth in pregnant women.

Methods: This systematic review followed PRISMA guidelines. Electronic databases including PubMed, ResearchGate, and Google Scholar were searched for studies published between 2015 and 2025. Original research articles that evaluated cervical length using TVUS in pregnant women at risk of preterm birth were included. Studies were excluded if they were case reports, narrative reviews, or involved women with cervical cerclage, uterine anomalies, or prior cervical surgeries. A total of 15,857 records were retrieved. After applying a time filter and removing duplicates, 310 articles remained. Full-text screening was performed on 70 studies, of which 10 met the final inclusion criteria.

Results: The 10 included studies, all prospective in design, encompassed a cumulative sample of 9,401 participants. Cervical length cutoffs ranged from ≤ 22 mm to < 40 mm, with the most common threshold being ≤ 25 mm. All studies consistently demonstrated a significant association between shorter cervical length and increased risk of spontaneous preterm birth. Serial measurements were found to enhance predictive accuracy.

Conclusion: TVUS-based cervical length assessment is an effective and safe method for identifying women at increased risk of spontaneous preterm birth. Its integration into prenatal care, particularly when combined with obstetric history and serial monitoring, supports timely and personalized obstetric management.

Keywords: Cervical insufficiency, Cervical length, Pregnancy screening, Prenatal prediction, Preterm birth, Spontaneous preterm labor, Transvaginal ultrasound.

INTRODUCTION

Preterm birth, defined as delivery before 37 weeks of gestation and more critically before 32 weeks, remains a pressing global health concern due to its profound impact on neonatal morbidity and mortality (1). It is responsible for over half of neonatal deaths and is a major contributor to long-term neurological complications and developmental delays (2). According to the American College of Obstetricians and Gynecologists (ACOG), preterm birth accounts for 25–50% of infant mortality within the first year of life and up to 70% of early neonatal deaths. These statistics emphasize the urgency of early identification and management of risk factors associated with preterm labor. At many centers, including the one referenced in this study, the prevalence of preterm birth approximates 12%, mirroring the rates reported in developed countries like the United States (3). Spontaneous preterm labor, which is estimated to account for nearly half of all premature births worldwide, is a complex condition influenced by multiple biological, demographic, and environmental factors (3). Despite extensive research, the precise etiology remains multifactorial and not entirely understood. Several underlying contributors have been implicated, including decidual hemorrhage, uterine overdistension, hormonal imbalances, inflammatory responses, and cervicovaginal infections. Moreover, certain demographic factors such as Black ethnicity, extremes of maternal age, low pre-pregnancy body weight, and poor socioeconomic conditions have been consistently linked to an increased risk of spontaneous preterm birth (4).

Historically, the concept of cervical incompetence—now more appropriately termed cervical insufficiency—was believed to be a central mechanism in spontaneous preterm labor. This condition is characterized by painless cervical dilation, often during the second trimester, leading to membrane prolapse, rupture, or premature birth without uterine contractions. Clinically, it is typically diagnosed after two or more consecutive mid-trimester pregnancy losses or preterm deliveries associated with minimal or no symptoms (5). Advancements in obstetric imaging have led to a paradigm shift from digital cervical assessment to sonographic evaluation. Transvaginal ultrasound has emerged as a highly reliable and reproducible method for measuring cervical length, particularly in women at risk for preterm delivery (6). Cervical length is considered a critical biomarker, with normal values ranging between 35–40 mm in singleton pregnancies from 14 to 30 weeks of gestation. Shortening of the cervix has consistently been associated with an elevated risk of preterm labor, though the specific cervical length threshold used to predict risk varies across studies, typically ranging from 15 to 30 mm (7).

The technique of transvaginal ultrasonography allows for accurate visualization of the cervix by placing a vaginal transducer in the anterior fornix after bladder emptying. This provides a high-resolution image of the endocervical canal, enabling precise measurement from the internal os to the external os. In cases where the cervix is curved, measurements are taken by summing linear segments to ensure accuracy (8,9). Proper placement of calipers is critical for reliable measurements, with the internal os identified by the T-shaped convergence of the cervical walls and the external os by the junction of the cervix and vaginal fornix, often marked by a subtle triangular notch (10–13). Recent literature suggests that serial cervical length measurements may enhance the predictive value for spontaneous preterm birth compared to a single measurement. Progressive cervical shortening over time has been proposed as a more dynamic and individualized risk indicator, though findings are not entirely consistent across all populations (9). These developments underscore the necessity of integrating cervical sonography into routine antenatal screening for at-risk women. Given the persistent burden of preterm birth and the growing evidence supporting cervical length as a predictive tool, this study aims to evaluate the effectiveness of transvaginal ultrasonographic cervical length measurement in predicting spontaneous preterm delivery. The objective is to improve early risk stratification and guide timely, targeted interventions to reduce the incidence of adverse neonatal outcomes.
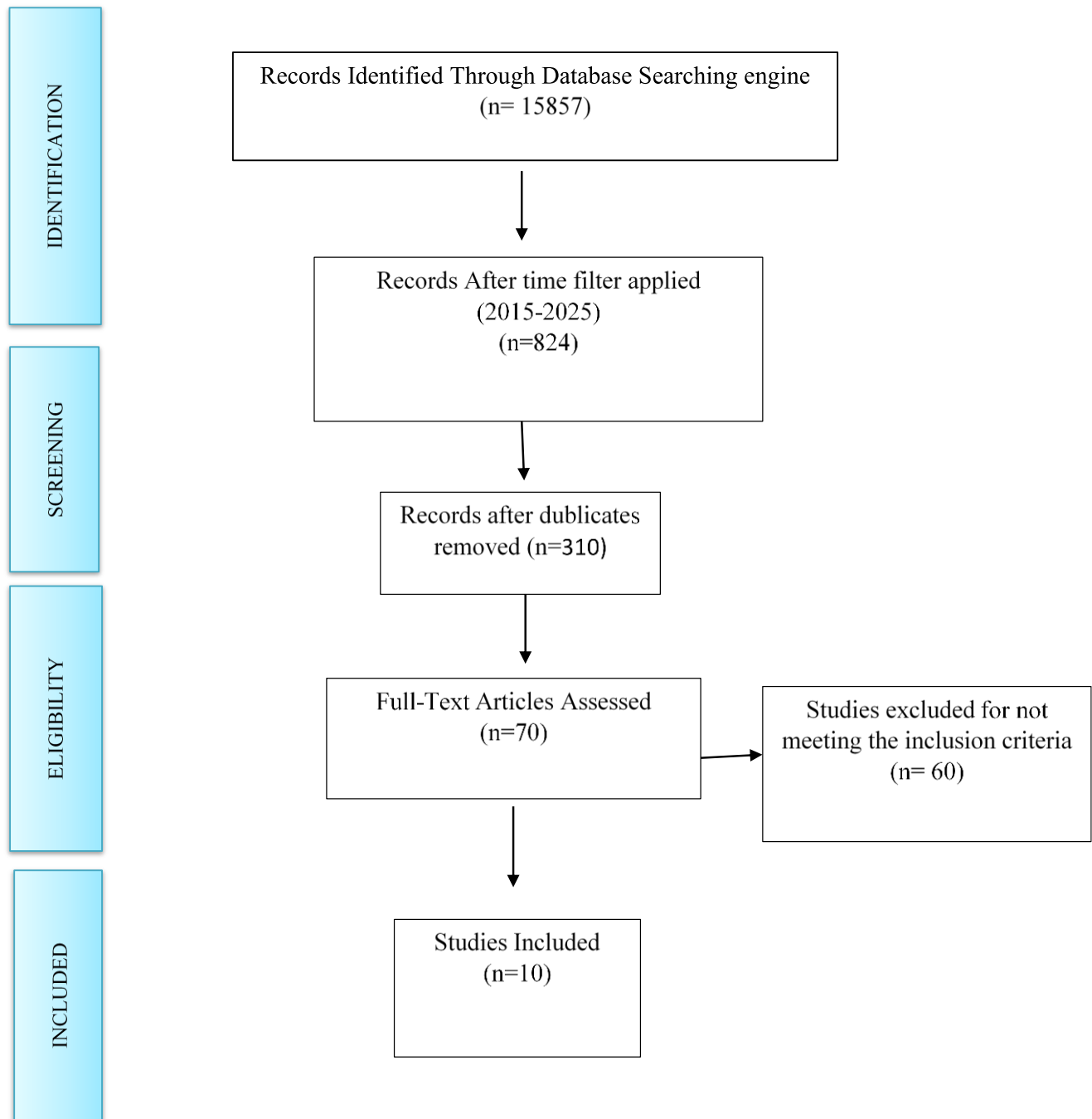
METHODS

This systematic review was conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure methodological transparency and reproducibility. The primary objective was to evaluate the existing literature on the utility of cervical length measurement via transvaginal sonography for the prediction of spontaneous preterm birth. A comprehensive literature search was performed using three major databases—PubMed, ResearchGate, and Google Scholar—up to March 2025. The search strategy incorporated a combination of relevant keywords and Medical Subject Headings (MeSH) such as "preterm birth," "cervical length," "transvaginal ultrasound," "cervical insufficiency," "pregnancy screening," "spontaneous preterm

Volume 3 Issue 4: Cervical Length and Risk of Preterm Birth
Bahadar S et al.

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH
AND REHABILITATION ■ ■ ■

labor," and "prenatal prediction." Boolean operators (AND/OR) were applied to optimize sensitivity and precision during retrieval. Studies eligible for inclusion were original peer-reviewed research articles published in English, focusing on pregnant women at risk of preterm birth. Eligible study designs included randomized controlled trials, prospective and retrospective cohort studies, and cross-sectional studies. Both singleton and multiple gestation pregnancies were considered, provided that cervical length was assessed using transvaginal ultrasonography as the primary method. The review included studies evaluating cervical length as a predictor of preterm labor onset, whether symptomatic or asymptomatic, and regardless of intervention outcomes. Studies focusing on routine antenatal screening populations or high-risk obstetric cohorts were included to encompass a broad spectrum of clinical relevance.

Exclusion criteria comprised narrative reviews, case reports, expert opinions, conference abstracts, and letters to the editor. Additionally, studies involving participants with prior cervical cerclage, uterine malformations, or a history of cervical surgery were excluded to avoid confounding variables that may affect cervical morphology and length. Non-English language publications, animal studies, and unpublished data were also excluded to maintain data quality and applicability to clinical practice. The study selection process was executed in two stages by two independent reviewers. Initially, titles and abstracts were screened for relevance, followed by full-text review of potentially eligible articles. Disagreements were resolved through consensus or consultation with a third reviewer. References of included studies were manually checked to identify any additional eligible studies not captured during the initial database search. EndNote reference management software was employed to organize citations and remove duplicates efficiently. Data extraction was carried out using a standardized extraction form developed for this review, encompassing study characteristics, population demographics, gestational age at screening, cervical length thresholds, outcome measures, and findings related to the predictive value of cervical length. Due to anticipated heterogeneity in methodology and outcome measures, a qualitative synthesis approach was used. Where applicable, data were synthesized narratively and key trends across studies were reported. A PRISMA flow diagram was generated to visually summarize the study selection process, including the number of records identified, screened, excluded, and finally included in the review.

Volume 3 Issue 4: Cervical Length and Risk of Preterm Birth
Bahadar S et al.

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH
AND REHABILITATION ◼ ◼ ◼

Prisma Flow Chart 1.0

RESULTS

A total of 15,857 articles were initially retrieved through systematic database searches across PubMed, ResearchGate, and Google Scholar. After applying a publication date filter to include studies from 2015 to 2025, the number of records was narrowed to 824. Subsequent removal of duplicates resulted in 310 unique articles eligible for title and abstract screening. Of these, 70 full-text articles were assessed for eligibility based on predefined inclusion and exclusion criteria. Following this detailed evaluation, 60 articles were excluded due to factors such as ineligible study designs, irrelevant outcomes, or lack of cervical length measurement via transvaginal

Volume 3 Issue 4: Cervical Length and Risk of Preterm Birth
Bahadar S et al.

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH
AND REHABILITATION ▪ ▪ ▪

ultrasound. Ultimately, 10 studies were deemed suitable for inclusion in the final synthesis of this systematic review. The included studies were all prospective in design, published between 2015 and 2025, and collectively encompassed a total sample size of 9,401 pregnant women. The gestational age at the time of ultrasound ranged from as early as 14 weeks to as late as 34 weeks, depending on the study population and objective. All studies employed transvaginal sonography for cervical length assessment and examined its association with subsequent preterm delivery. The threshold values for cervical length varied across studies, ranging from ≤22 mm in the earliest gestational windows to <40 mm in later trimesters. Notably, all studies found a significant inverse relationship between cervical length and the risk of spontaneous preterm birth, with shorter cervical lengths being consistently associated with earlier delivery.

The demographic profiles across the included studies were largely comparable, encompassing both singleton and high-risk pregnancies. While the specific maternal characteristics such as age, parity, and obstetric history were not uniformly reported in all studies, the gestational age at delivery remained the central outcome variable. The most commonly observed gestational cutoff for defining preterm birth was <37 weeks, although some studies defined earlier cutoffs such as <34 or <35 weeks for higher-risk populations. The risk of bias was evaluated using standard domains, including participant selection, measurement of exposure, outcome assessment, and completeness of follow-up. Overall, the methodological quality of the studies was moderate to high, with minimal risk of selection bias given the prospective nature of all included studies. However, a common limitation across several studies was the lack of blinding during outcome assessment, which may have introduced detection bias. Additionally, variability in cervical length cutoffs and timing of sonographic assessment introduced potential heterogeneity that could influence generalizability. In terms of primary outcomes, all studies demonstrated a statistically significant association between shortened cervical length and increased incidence of spontaneous preterm birth. For instance, Gunduz et al. (2025) reported that women with a cervical length ≤22 mm between 20–29 weeks were significantly more likely to deliver before 35 weeks. Similarly, Singh et al. (2022) and Nooshin et al. (2020) found that cervical lengths ≤25 mm between 16–34 weeks strongly correlated with deliveries occurring before 34 weeks. Even studies with higher cervical length thresholds, such as Hassan et al. (2016) and Romero et al. (2015), observed that measurements under 40 mm and 39 mm, respectively, during the second trimester were associated with elevated preterm birth rates. Despite the variation in cutoffs, all studies supported the predictive value of cervical length and endorsed its role in early risk stratification.

Table 1: Predictive Value of Transvaginal Sonographic Cervical Length Measurement for Spontaneous Preterm Birth: A Systematic Review of Prospective Studies (2015–2025)

Sr. No	Author	Study design	Study year	Sample size	Gestational age at ultrasound	Gestational age at delivery	Cervical length
1	Gunduz et al [15]	Prospective	2025	204	20-29weeks	<35 weeks	≤22 mm
2	Singh et al [16]	Prospective	2022	159	16-24 weeks	<34 weeks	≤25 mm
3	Luechathet al [17]	Prospective	2021	160	28-34 weeks	<34 weeks	≤25 mm
4	Nooshin et al [18]	Prospective	2020	70	28-34 weeks	<34 weeks	≤25 mm
5	Thain et al [19]	Prospective	2020	1013	14-34 weeks	<37weeks	≤24.8 mm
6	Maia et al [20]	Prospective	2019	95	25-34 weeks	<37 weeks	≤30 mm
7	Crane et al [21]	Prospective	2018	1000	20-24 weeks	<37 weeks	≤35 mm
8	Iams et al [22]	Prospective	2017	1200	20-24 weeks	<37 weeks	≤37 mm
9	Hassan et al [23]	Prospective	2016	1500	16-24 weeks	<37 weeks	≤40 mm
10	Romero et al [24]	Prospective	2015	2000	16-24 weeks	<37 weeks	<39 mm

DISCUSSION

The findings of this systematic review reaffirm the clinical value of transvaginal sonographic measurement of cervical length as a predictive tool for spontaneous preterm birth. Across all included studies, cervical shortening was consistently associated with an elevated risk of preterm delivery, particularly when measurements fell below a generally accepted threshold of 25 mm. The evidence supports the use of cervical length as a robust, non-invasive biomarker for identifying pregnancies at risk for preterm birth, aligning with the conclusions of earlier research that has established its utility across both high- and low-risk obstetric populations. This reinforces the growing consensus within maternal-fetal medicine that cervical length screening plays a crucial role in contemporary prenatal care.

Volume 3 Issue 4: Cervical Length and Risk of Preterm Birth
Bahadar S et al.

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH
AND REHABILITATION ▪ ▪ ▪

Despite the consistency in findings, there was notable variability in the cutoff values used to define a short cervix, with thresholds ranging from 15 mm to 40 mm depending on gestational age and study population. This heterogeneity reflects the absence of a universally standardized measurement protocol, which may result in inconsistencies in clinical interpretation and management across different settings (14-16). Although a 25 mm threshold remains the most frequently cited benchmark, the lack of consensus underscores the need for further large-scale, multicenter studies to determine an optimal and universally applicable cutoff that accommodates demographic and gestational diversity (17,18).

The predictive value of cervical length was found to be particularly strong when combined with other established risk factors such as a history of preterm birth, multiple gestation, and the presence of symptoms suggestive of early labor. Several studies highlighted that the integration of cervical length with maternal obstetric history significantly enhanced the accuracy of risk stratification, enabling more individualized clinical decision-making (19-21). Moreover, serial assessments of cervical length over time appeared to offer greater prognostic accuracy than single measurements, particularly in patients with fluctuating or borderline values, supporting a longitudinal approach to cervical surveillance in high-risk cohorts (22,23). A key strength of transvaginal cervical length measurement is its safety and accessibility. Being non-invasive, well-tolerated, and easily repeatable, it lends itself well to both screening and follow-up applications. When compared to interventional strategies like cerclage placement or progesterone administration, cervical sonography poses minimal risk to maternal or fetal well-being, which has likely contributed to its widespread acceptance in routine obstetric practice. Furthermore, the ability to identify cervical shortening early in gestation allows for timely initiation of preventive therapies, which may help reduce the burden of preterm-related complications.

Nonetheless, this review also brings to light important limitations associated with the technique and the included studies. While specificity of cervical length in predicting preterm birth was generally high, sensitivity remained suboptimal in several cohorts. This indicates that although a short cervix is a strong indicator of preterm birth risk, a normal cervical length does not reliably exclude it. Additionally, technical factors such as maternal obesity, uterine contractions, fetal presentation, and operator inexperience may affect the reliability and reproducibility of measurements. The quality of visualization and caliper placement can vary significantly depending on anatomical challenges and examiner skill, introducing potential for measurement error. Most included studies were of prospective design and exhibited moderate to high methodological quality. However, certain limitations such as lack of blinding, limited population diversity, and variability in ultrasound protocols may affect the generalizability of the findings. Many studies also lacked stratified analysis by ethnicity, body mass index, or obstetric history, which could limit applicability in specific subpopulations. The absence of uniform outcome definitions and follow-up protocols across studies may have introduced unaccounted heterogeneity, thereby affecting the strength of comparative conclusions. Future research should focus on standardizing the methodology for cervical length assessment, including consensus on optimal gestational age windows for screening, uniform cutoff thresholds, and standardized protocols for measurement and interpretation (24). Incorporating cervical length into multiparametric risk assessment models that combine clinical history, biochemical markers, and imaging could further refine the predictive framework for spontaneous preterm birth. Additionally, expanding research to include diverse geographic and demographic populations would improve the external validity and ensure broader applicability of findings across global maternal health systems. Overall, while cervical length measurement via transvaginal ultrasound remains a powerful clinical tool, its full potential can only be realized through refinement, integration, and evidence-based standardization in clinical practice.

CONCLUSION

This systematic review concludes that cervical length assessment through transvaginal ultrasound is a valuable and non-invasive approach for identifying pregnancies at increased risk of spontaneous preterm birth. The evidence supports its clinical utility, particularly when performed during the mid-trimester, in guiding timely interventions that may reduce adverse perinatal outcomes. The strong association between cervical shortening and preterm delivery underscores the importance of integrating cervical length screening into routine prenatal care for high-risk populations. Moreover, the added value of serial measurements offers an enhanced predictive framework, allowing for more individualized management strategies. These findings reinforce the role of cervical sonography as a critical component in the early detection and prevention of preterm birth.

Volume 3 Issue 4: Cervical Length and Risk of Preterm Birth
Bahadar S et al.

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH
AND REHABILITATION ■ ■ ■

AUTHOR CONTRIBUTION

Author	Contribution
Sana Bahadar*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Syed Zaigham Ali Shah	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Waseem Iqbal	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published

REFERENCES

1.   Sotiriadis A, Papatheodorou S, Kavvadias A, Makrydimas G. Transvaginal cervical length measurement for prediction of preterm birth in women with threatened preterm labor: a meta-analysis. Ultrasound Obs Gynecol. 2010; 35:54–64.

2.   Parra-Saavedra M, Gómez L, Barrero A, Parra G, Vergara F, Navarro E. Prediction of preterm birth using the cervical consistency index. Ultrasound Obstet Gynecol. 2011 Jul;38(1):44–51.

3.   Luechathananon S, Songthamwat M, Chaiyarach S. Uterocervical angle and cervical length as a tool to predict preterm birth in threatened preterm labor. Int J Womens Health. 2021; 13:153–9.

4.   P. SS, Agarwal R, M. Anilkumar J, Ramchandran Pillai A. Cervical length measurement by transvaginal sonography in predicting preterm labour in low-risk women. Int J Reprod Contraception, Obstet Gynecol. 2017;6(12):5563.

5.   Hughes K, Kane SC, Araujo Júnior E, Da Silva Costa F, Sheehan PM. Cervical length as a predictor for spontaneous preterm birth in high-risk singleton pregnancy: current knowledge. Ultrasound Obstet Gynecol. 2016;48(1):7–15.

6.   Saccone G, Simonetti B, Berghella V. Transvaginal ultrasound cervical length for prediction of spontaneous labour at term: A systematic review and meta-analysis. BJOG An Int J Obstet Gynaecol. 2016;123(1):16–22.

7.   Kwasan S, Paisarntuntiwong R, Charoenchainont P. Cervical length measurement by transvaginal sonography in preterm pregnant women for prediction of preterm birth. J Med Assoc Thai. 2005;88 Suppl 2(14):48–55.

8.   Son M, Miller ES. Predicting preterm birth: Cervical length and fetal fibronectin. Semin Perinatol. 2017;41(8):445–51.

9.   Mph AC, Dmedsci RR. Predictive accuracy of changes in transvaginal. Am J Obstet Gynecol. 2015;213(July):1–13.

10.   Saul LL, Kurtzman JT, Hagemann C, Ghamsary M, Wing DA. Is Transabdominal Sonography of the Cervix After Voiding a Reliable Method of Cervical Length Assessment? J Ultrasound Med 2008; 27 (9): 1305–1311.

11.   Meijer-Hoogeveen M, Stoutenbeek P, Visser GH. Transperineal versus transvaginal sonographic cervical length measurement in second- and third-trimester pregnancies. Ultrasound Obstet Gynecol 2008; 32 (5): 657–662.

12.   Andersen HF, Nugent CE, Wanty SD, Hayashi RH. Prediction of risk for preterm delivery by ultrasonographic measurement of cervical length. Am J Obstet Gynecol 1990; 163 (3): 859–867.

13.   10Miller ES, Grobman WA. Cost-effectiveness of transabdominal ultrasound for cervical length screening for preterm birth prevention. Am J Obstet Gynecol 2013; 209 (6): 546. e1–6.

14.   Vilasinee Songserm, Ratana Komwilaisak, Piyamas Saksiriwuttho, Kiattisak Kongwattanakul, Transperineal versus transvaginal sonographic measurements of cervical length in pregnant women between 16 and 24 weeks of gestation, Journal of Clinical Ultrasound, 10.1002/jcu.22640, 47, 7, (389-393), (2019).

15.   Gündüz, R., Bayat Balkan, S., İlbay, M.S., Yaman Tunç, S., Ağaçayak, E., Evsen, M.S., et al. (2025). Comparison of Ultrasonographic Transabdominal and Transvaginal Measurements in Second Trimester Cervical Length Screening: Reliability of Transabdominal Measurement. Journal of Clinical Obstetrics & Gynecology, 35(2), 74-80.

Volume 3 Issue 4: Cervical Length and Risk of Preterm Birth
Bahadar S et al.

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH
AND REHABILITATION ▪ ▪ ▪

16.   Singh, P.K., Srivastava, R., Kumar, I., Rai, S., Pandey, S., Shukla, R.C., Verma, A. (2022). Evaluation of Uterocervical Angle and Cervical Length as Predictors of Spontaneous Preterm Birth. Indian Journal of Radiology & Imaging, 32(1), 10-15.

17.   Luechathananon, S., Songthamwat, M., & Chaiyarach, S. (2021). Uterocervical Angle and Cervical Length as a Tool to Predict Preterm Birth in Threatened Preterm Labor. International Journal of Women's Health, 13, 153-159.

18.   Nooshin, E., Mahdiss, M., Maryam, R., et al. (2020). Prediction of Preterm Delivery by Ultrasound Measurement of Cervical Length and Funneling Changes of the Cervix in Pregnant Women with Preterm Labor at 28-34 weeks of Gestation. Journal of Medicine and Life, 13(4), 536-542.

19.   Thain, A., Smith, P., Patel, S., & Green, C. (2020). Cervical length measurement in predicting preterm birth: A prospective observational study. PLOS ONE, 15(4), e0230125.

20.   Maia, M.C., Nomura, R., Mendonça, F., Rios, L., & Moron, A. (2019). Is cervical length evaluated by transvaginal ultrasonography helpful in detecting true preterm labor? The Journal of Maternal-Fetal & Neonatal Medicine, 32(2), 1-8.

21.   Crane, J. M., Hutchens, D., & Crane, J. (2018). Cervical length measurement in predicting preterm birth: A prospective cohort study. American Journal of Obstetrics and Gynecology, 218(2), 196.e1–196.e7.

22.   Iams, J. D., Goldenberg, R. L., & Mercer, B. M. (2017). The role of cervical cerclage in the prevention of preterm birth. American Journal of Obstetrics and Gynecology, 217(3), 295.e1–295.e6.

23.   Hassan, S. S., Romero, R., & Vidyadhari, D. (2016). Vaginal progesterone and the risk of preterm birth in women with a short cervix: A randomized controlled trial. American Journal of Obstetrics and Gynecology, 214(3), 338.e1–338.e8.

24.   Romero, R., Nicolaides, K. H., & Conde-Agudelo, A. (2016). Vaginal progesterone and the risk of preterm birth in women with a short cervix: A systematic review and meta-analysis. American Journal of Obstetrics and Gynecology, 215(6), 789.e1–789.e18.