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The fetal occiput-spine angle measurement during first stage of labor as a predictor for vaginal delivery, a systematic review and meta-analysis

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Abstract

Objectives: To evaluate the diagnostic utility of the fetal occiput-spine angle (OSA) measured by transabdominal ultrasonography in predicting successful vaginal delivery (VD) during the first stage of labor.

Methods: A systematic search of MEDLINE, Scopus, EMBASE databases, and Google Scholar was conducted from January 15, 2025, to February 1, 2025, following the Preferred Reporting Items for Systematic Reviews and Meta-analyses for diagnostic test accuracy guidelines. Two independent reviewers selected studies according to inclusion criteria, extracted data, and assessed risk of bias assessed by the Quality Assessment of Diagnostic Accuracy Studies-2.

Results: Six studies with 1,129 participants were included. The pooled sensitivity and specificity of OSA for predicting VD were 86 % (95 % confidence interval (CI): 73–93 %) and 80 % (95 % CI: 37–97 %), respectively. The DOR was 23.71 (95 % CI: 2.5–223.36 %). The mean OSA of women with successful VD was 10.44° wider than that of women who underwent cesarean delivery, although not significant (p=0.16). High heterogeneity (I^2>88.2 %) was observed. The risk of bias was low across most domains.

Conclusions: The fetal OSA demonstrated moderate diagnostic value in predicting successful VD. Furthermore, additional high-quality, large-scale studies with standardized cut-offs are necessary to verify its clinical utility.

Keywords: fetal flexion; occiput-spine angle; vaginal delivery; ultrasonography

Introduction

The worldwide incidence of cesarean delivery (CD) has increased significantly across the decades [1]. Although CD can be a life-saving intervention, it also has significant implications for both maternal and neonatal health [2, 3]. Labor dystocia, which is characterized by abnormal or prolonged labor, is a significant criterion for an emergency CD. Failed labor is not attributed only to fetal size, as the birth weights in most cases of cephalic disproportion were within the normal range. Other factors, such as head malposition and malpresentation, may also result in blockage.

In late pregnancy, the fetal head descends into the pelvic inlet and progresses through the mid-pelvis during imminent vaginal delivery (VD) upon cephalic presentation. These processes require the fetal head to adopt a flexed attitude, changing from the occipitofrontal to the suboccipitobregmatic diameter to decrease fetal head diameter [4]. However, fetal malpresentation may occur at any time during labor, affecting 18.5 % of pregnant women undergoing CD. Fetal deflexion is also a cause of failure to progress or cephalopelvic disproportion, resulting in intrapartum CD in 30.5–35.4 % of cases [5, 6].

The major degree of fetal attitude in cephalic presentation can be classified into flexion (i.e., vertex) or deflexion (i.e., sinciput, brow, and face). While digital pelvic examination, currently used in clinical practice, cannot detect small degrees of fetal head deflexion, intrapartum ultrasonographic modalities are more effective in determining fetal position [7]. The angle between the fetal occiput and spine, is called the fetal occiput-spine angle (OSA) via transabdominal ultrasonography, as shown in Figure 1, proved that a narrow fetal OSA has been correlated with operative vaginal delivery (OVD) or CD, with strong intra-observer and moderate inter-observer agreement [8, 9].

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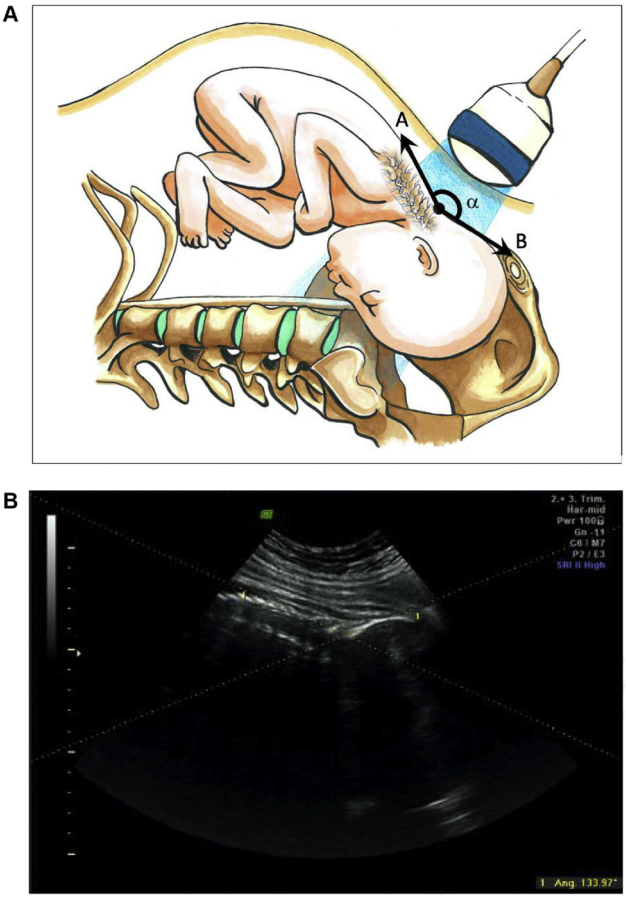

Figure 1: Transabdominal sonographic assessment of the degree of flexion of the fetal head in fetuses in occiput anterior position using the occiput-spine angle (Reproducted from reference [8]).

According to the World Association of Perinatal Medicine and the Perinatal Medicine Foundation guidelines [10], many intrapartum sonographic parameters have been arrived as a predictor of mode of delivery, such as head perineum distance (HPD) or angle of progression (AOP). The performance of these parameters remains inconclusive to use in clinical practice. In other words, numerous studies have reported prenatal OSA as an effective predictor of the mode of delivery only in fetus with occiput anterior position. Concurrent with the previous study, the fetal position is an important parameter that determines the decision-making for delivery and management mode during labor [11]. However, no systematic review has yet analyzed fetal OSA. Therefore, this study conducted a systematic review and meta-analysis to assess the diagnostic utility of fetal OSA measurements during the first stage of labor to predict a successful VD.

Materials and methods

Study design

This systematic review and meta-analysis was performed according to the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) for diagnostic test accuracy extension statement for reporting systematic reviews incorporating meta-analyses [12]. This study was registered in PROSPERO under registration number CRD42025632898.

Search strategy

The systematic search was conducted on the MEDLINE, Scopus, Embase electronic databases, and Google Scholar for articles from January 15, 2025, to February 1, 2025. The search strategy was constructed using the PICOS framework based on population (pregnant women with labor in the first stage of labor), exposure (fetal OSA, with or without cutoff values, measured by transabdominal ultrasonography), no comparator, outcome (mode of delivery), and study design (diagnostic studies). The articles were screened using the title and abstract by two independent reviewers (P.K. and K.N.).

Study selection and criteria

All eligible studies were independently selected by two reviewers (P.K. and K.N.) after reviewing the full articles. The inclusion criteria were studies involving pregnant women experiencing labor pains in the first stage of labor without contraindication for VD, data on fetal OSA measured by transabdominal ultrasonography, and data on the delivery outcome. The exclusion criteria were studies published in a non-English language that was untranslatable and insufficient data for pooling outcomes after three contact attempts with the authors were made every 2 weeks.

Data extraction

Two reviewers (P.K. and K.N.) independently extracted data using a data extraction form (DEF). The DEF consisted of the following items: 1) general data of the article, including author name, year of publication, and country; 2) demographic characteristics of participants, including maternal age, gestational age (GA), body mass index (BMI), parity (nulliparous or multiparous), and estimated fetal weight (EFW); 3) general

information of transabdominal ultrasonography, including the technique of ultrasound measurement (two- (2D) or three-dimensional (3D)) and name of the ultrasound machine; 4) detail of exposure, including the fetal OSA, with or without cutoff values; 5) the outcome was the mode of delivery which defined into two groups: spontaneous VD and successful VD (VD with or without OVD); and 6) data for pooling, which were classified into two groups. The first classification was diagnostic performance, which is the pooled data on fetal OSA with cutoff values for sensitivity, specificity, positive likelihood ratio (LR+), negative LR (LR−), diagnostic odds ratio (DOR), and area under the receiver operating characteristic curve (AUC). The numbers of true positives, false positives, true negatives, and false negatives for each diagnostic test were extracted. The second classification was the frequency data, which pooled data on fetal OSA without cutoff values, expressed as mean and standard deviation (SD). If the original article expressed data as median and range or interquartile range, the results were expressed as mean and SD [13].

Risk assessment

The risk of bias assessment of studies was evaluated independently by two reviewers (P.K. and K.N.) using the Quality Assessment of Diagnostic Accuracy Studies-2 (QUADAS-2) for diagnostic tools or the modified Newcastle Ottawa Scale (NOS) for continuous variables if only a few studies reported data on diagnostic performance. The QUADAS-2 assessment has four domains: patient selection, index test, reference standard test, and flow and timing. Each domain consists of two sections: risk of bias and applicability concerns. The risk of bias has three items: information used to support the risk of bias judgment, signaling questions, and final judgment (low, high or unclear). The two sections under applicability concerns are judged as low, unclear, or high risk [14]. The modified NOS [15] has three domains, namely, selection of the representativeness of the studied subjects, comparability between groups, and the ascertainment of outcome and study factors. Each domain consists of a question with three possible answers, namely, yes, no, or unclear. The possible score ranged from 0 to 9. A score of 7–9 indicated a low risk of bias, 4–6 indicated a high risk of bias, and 0–3 indicated a very high risk of bias. Any disagreements were resolved by a third reviewer (M.S.).

Statistical analysis

The diagnostic performances of VD+ OVD vs. CD (i.e., sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV)), LR+, LR−, and DOR with 95 % confidence interval (CI) were estimated for each study. The data were pooled using a bivariate mixed-effects regression model according to the outcome and type of fetal OSA with or without cutoff values. First, for the results determined by specific cutoff values, data were pooled according to diagnostic performance. The hierarchical summary ROC (HSROC) curve was estimated and plotted in cases where the number of studies was higher than 3. The HSROC curve was classified as low, moderate, or high accuracy if the HSROCs were $0.5<x<0.7$, $0.7\leq x\leq 0.9$, and $0.9<x\leq 1$, respectively [16]. For results not determined by specific cutoff values, data were analyzed by the mean difference (MD) in the OSA between groups of successful VD and CD with 95 % CI. A random-effects model was used to assess heterogeneity, and I^2>50 % was considered to indicate heterogeneity. Potential sources of heterogeneity (i.e., age, GA, BMI, EFW, and parous) were explored by adding variables one by one into the regression model if data were available. If the variables could decrease I^2, a subgroup analysis was performed accordingly. Publication bias was examined using Egger's test and Deeks' funnel plot, and funnel asymmetry was further explored to determine the causes of asymmetry in heterogeneity or publication bias. All analyses were performed using the STATA software package, version 18.0 (Stata Corp, College Station, Texas, USA). A two-sided p-value <0.05 was considered statistically significant, except for the heterogeneity of Egger's tests, where a p-value <0.1 was used.

Results

Study selection

Articles were retrieved from the MEDLINE, Scopus, Embase and Google Scholar electronic bibliographies using comprehensive search terms as part of the PICO framework. In total, 114 studies were retrieved, including three from MEDLINE via PubMed, 106 from Scopus, and five from Embase. Seven duplicate studies were removed, leaving 107 studies for title and abstract screening. Of these, 70 studies were subjected to full-text review, and five met the inclusion criteria. The search via Google Scholar retrieved one study. In total, six studies were included in the analysis. The PRISMA flow diagram summarizing the study selection process is presented in Figure 2.

General information of studies

This systematic review and meta-analysis included six studies [7, 9, 17–20] published between 2016 and 2023 across five countries: the United States, Egypt, Italy, India, and Thailand.

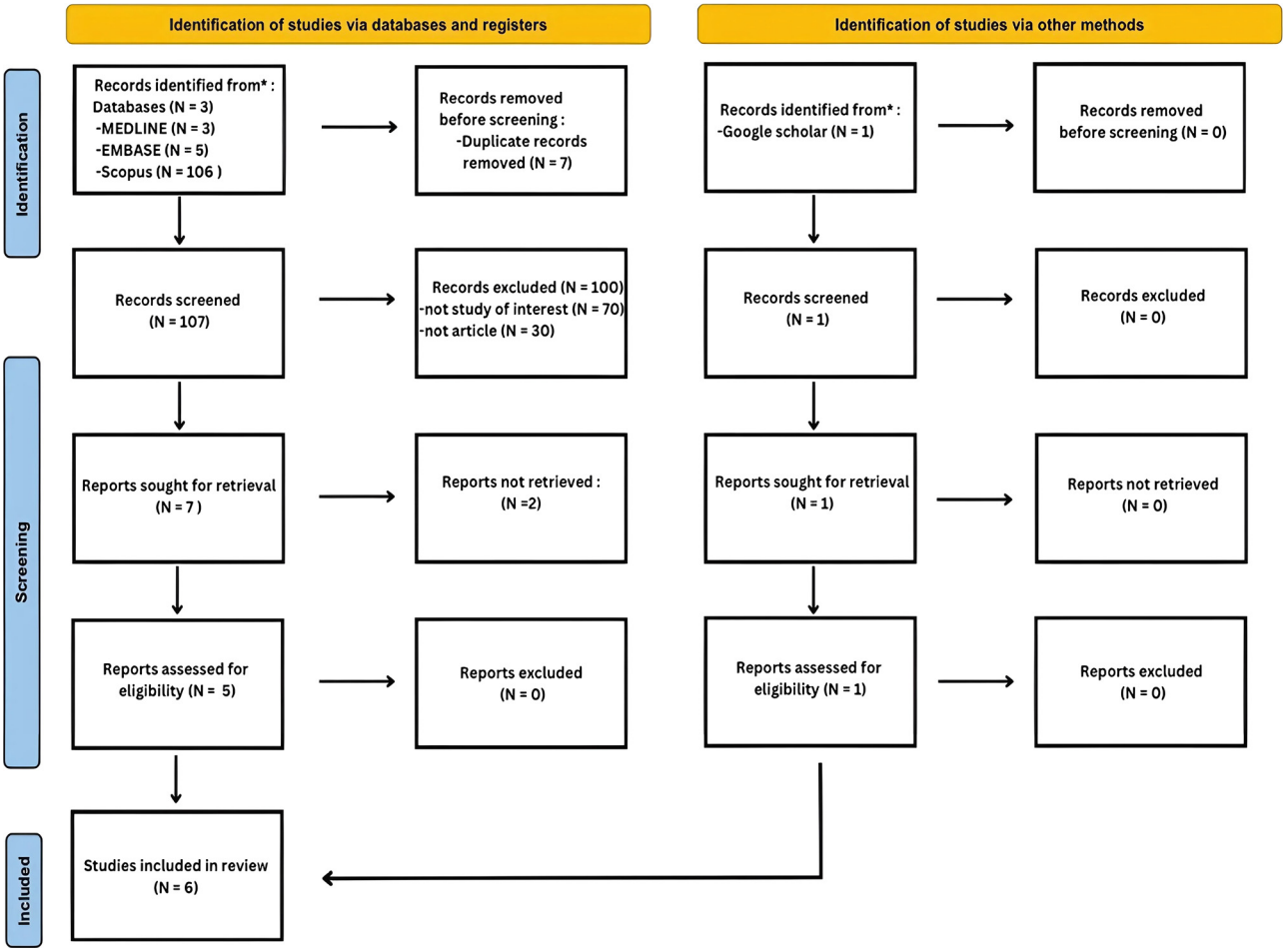

Figure 2: PRISMA flow diagram of systematic review which included searches of databases, registers and other sources.

All studies measured the fetal OSA by 2D transabdominal ultrasonography and reported cutoff values ranged from 100° to 126°. Five studies [7, 17–20] reported the outcomes of successful VD. Only one study [9] reported the outcomes of spontaneous VD. Construction of 2×2 tables was performed to determine the numbers of true positive, false positive, false negative, true negative. Among studies reporting successful VD outcomes, these values ranged from 32 to 314 for true positives, 0 to 34 for false positives, 6 to 47 for false negatives, and 7 to 31 for true negatives. Data for spontaneous VD outcomes were not available. Details are presented in Table 1.

Demographic characteristics of participants

These studies collectively enrolled 1,129 participants, all of whom were pregnant women in the first stage of labor. The demographic characteristics of the study populations varied widely. The median maternal age across the studies ranged from 23.8 to 32.9 years, with a pooled mean of 29.36 years (SD 3.52). The median BMI ranged from 26.0 to 28.1 kg/m^2, with a pooled mean of 27.25 kg/m^2 (SD 0.83). The median GA ranged from 38.4 to 40.0 weeks, with a mean of 39.11 weeks (SD 0.63). The median EFW ranged from 3,072.1 to 3,492 g, with a mean of 3,231.14 g (SD 196.52). Nulliparity ranged from 38 to 95 % across four studies, whereas one study [7] included only multiparous data. As shown in Table 2.

Diagnostic performance of OSA to predict a successful VD

Five studies [7, 17–20] that involved 1,031 participants reported successful VD, which were useful for assessing the diagnostic utility of OSA. The sensitivity was ranged from 56.7 to 95.7 % and the specificity was ranged from 17.1 to 100 %. The likelihood ratio positive was ranged from 1.01 to 24.87 and the likelihood ratio negative was ranged from 0.05 to 0.95, as shown in Table 3. The pooled diagnostic utility of OSA with

Table 1: Data from studies reporting study designs and ultrasonography characteristics, sample sizes, cutoff values, and definitions of outcome between vaginal delivery (VD) with or without operative vaginal delivery (OVD) vs. cesarean delivery (CD).

Study, year, country	Study design	Sample size	Ultrasound type and software	Cut-off value	Definition of outcome	True positive	False positive	False negative	True negative
Ghi et al., 2016, Italy	Prospective	98 (79 vs 19)	2D, NA	125	Spontaneous VD	NA	NA	NA	NA
Maged et al., 2018, Egypt	Prospective	400 (350 vs 50)	2D, Samsung Medison	126	Successful VD	314	19	36	31
Dall'Asta et al., 2021, Italy	Prospective	86 (56 vs 30)	2D, NA	109	Successful VD	32	4	24	26
Mukdee et al., 2021, Thailand	Prospective	330 (289 vs 41)	2D, TOSHIBA SSA-590A or Samsung Sonoace R5	100	Successful VD	242	34	47	7
Salman et al., 2022, Egypt	Prospective	65 (54 vs 11)	2D, Madison Sonoace RS	118	Successful VD	45	1	9	10
Sheshtawey et al. 2023, India	Prospective	150 (138 vs 12)	2D, NA	126	Successful VD	132	0	6	12

Table 2: Demographic characteristics of participants.

Author	Year	Mean age, year	Mean body mass index, kg/m^2	Nulliparous, %	Mean gestational age, weeks	Mean estimated fetal weight, g
Ghi et al.	2016	32.6	26.9	64.3	39.6	3,393.3
Maged et al.	2018	29.9	24	0	38.4	3,098.3
Dall'Asta et al.	2021	32.9	28.1	95.3	40	3,492
Mukdee et al.	2021	26.7	27.4	47.9	39.3	3,072.1
Salman et al.	2022	23.8	26	NA	38.8	NA
Sheshtawey et al.	2023	30.33	NA	38	38.6	3,100

Table 3: Data from studies reporting diagnostic utility with 95 % confidence interval (CI) of occiput-spine angle for predicting successful vaginal delivery.

Author	Year	Sensitivity (%) with 95 % CI	Specificity (%) with 95 % CI	LR+ with 95 % CI	LR− with 95 % CI
Maged et al.	2018	89.7 (86–92)	62 (48–75)	2.36 (1.65–3.37)	0.17 (0.11–0.24)
Dall'Asta et al.	2021	56.7 (43–70)	87.5 (69–96)	4.29 (1.67–10.97)	0.49 (0.35–0.69)
Mukdee et al.	2021	83.7 (79–88)	17.1 (7– 32)	1.01 (0.87–1.17)	0.95 (0.46–1.00)
Salman et al.	2022	83.9 (71–92)	90.9 (58–99)	9.17 (1.41–59.63)	0.18 (0.10–0.34)
Sheshtawey et al.	2023	95.7 (91–98)	100 (74–100)	24.87 (1.64–375.57)	0.05 (0.02–0.10)

varying cutoff values were 86 % (95 % CI: 73–93 %; I^2=93.82 %) and 80 % (95 % CI: 37–97 %; I^2=93 %) for the pooled sensitivity and specificity, respectively, as shown in Figure 3.

The pooled estimate of diagnostic performance for LR+, LR–, and DOR were 4.31 (95 % CI: 0.89–20.99; I^2=96.01 %), 0.18 (95 % CI: 0.08–0.42; I^2=93.83 %), and 23.71 (95 % CI: 2.52–223.36; I^2=100 %), respectively. These diagnostic characteristics all required setting a threshold and trading off sensitivity for specificity or LR+ for LR–; hence, they were analyzed in pairs. Among those studies given a pretest probability VD of 84 %, a positive test (wider OSA) increased the posttest probability to 96 %. In comparison, a negative test (narrower OSA) reduced the posttest probability to 49 %, as shown in Fagan's plot in Figure 4. The pooled HSROC was 0.90 (95 % CI: 0.87–0.92; I^2=96 %), indicating good discrimination. As shown in Figure 5.

For diagnostic performance of OSA to predict a spontaneous VD, only one study [9] was reported the ROC of the OSA was 0.66, indicating fair accuracy in identifying the women who underwent OVD because of labor arrest.

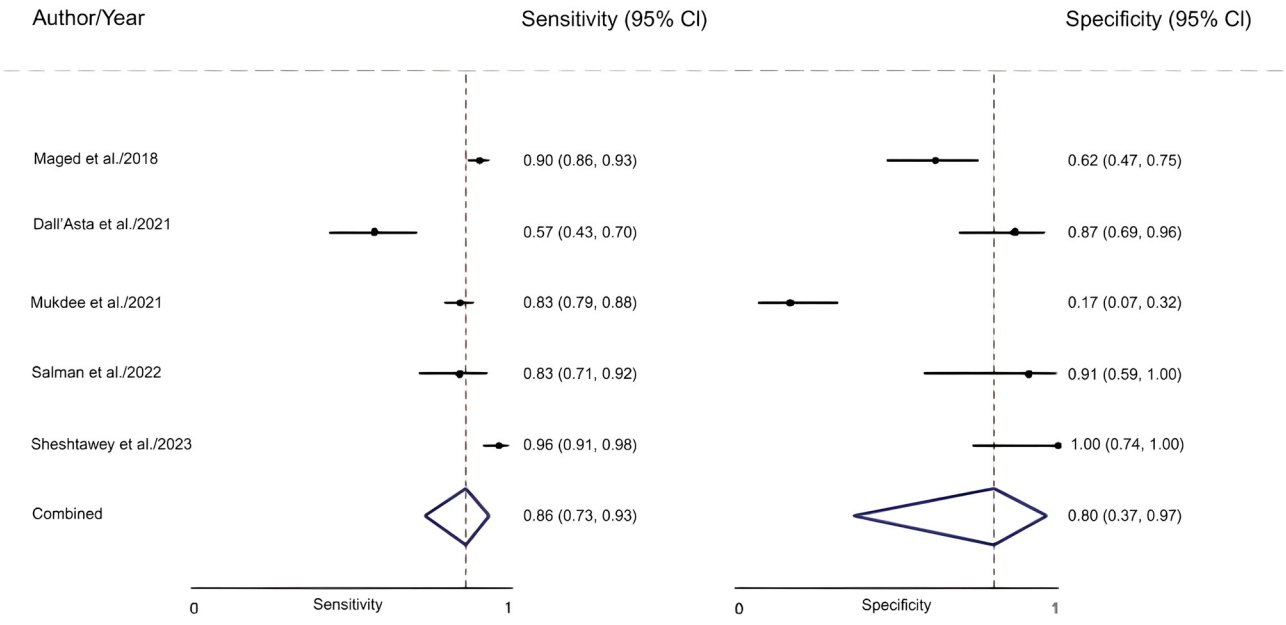

Figure 3: Pooled sensitivity and specificity of wider occiput-spine angle (OSA) compared with narrow OSA with successful vaginal delivery. *Reference line referred to pooled sensitivity or pooled specificity.

Comparison of the mean OSA between successful VD and CD

Three studies [17–19] on OSA involving 481 patients, which defined the outcome as successful VD, were included in the meta-analysis to evaluate the mean OSA between the groups of successful and failed VD, as shown in Table 4. Women who underwent successful VD had a wider mean OSA by 10.44° (95 % CI: −3.98°–24.86°) than those who underwent CD, although the difference was not significant (p=0.16). However, a significantly high level of heterogeneity among the studies was noted (I^2=94.12 %). As shown in Figure 6.

Only one study [9], was defined the outcome as spontaneous VD, revealed that the OSA was significantly narrower in women who underwent obstetric intervention due to labor arrest by 6°, with statistically significant difference (p=0.03).

Risk of bias of the included studies

Risk of bias was evaluated using the QUADAS-2 tool across four domains: subject selection, index test, reference standard, and flow and timing. Most studies had a low risk in subject selection, except for that of one study [18], which was judged as high risk because of population selection issues. For the index test, two studies [7, 20] were judged to have high and unclear risks due to inadequate blinding and unclear protocols, respectively. All analyzed studies showed a low risk in the reference standard domain. Two studies [17, 19] had a high risk in flow and timing because of inconsistent timing and incomplete data. Applicability concerns of the studies analyzed were generally low, except for those by three studies [7, 18, 19], which raised concerns about subject selection and index test applicability. These findings highlight the need for standardized study designs to minimize variability and improve reliability, as shown in Table 5.

Publication bias

Publication bias was assessed using Deeks' funnel plot asymmetry test. The funnel plot appeared relatively symmetrical, and the test result was not statistically significant (p=0.126), indicating no apparent evidence of publication bias among the included studies.

Discussion

Main findings

This systematic review and meta-analysis evaluated fetal OSA as a predictor of successful VD, offering a comparison between successful and failed VD groups. The study enhances our understanding of intrapartum sonographic tools and their potential to minimize adverse pregnancy events. A total of six studies [7, 9, 17–20] that involved 1,129 pregnant women

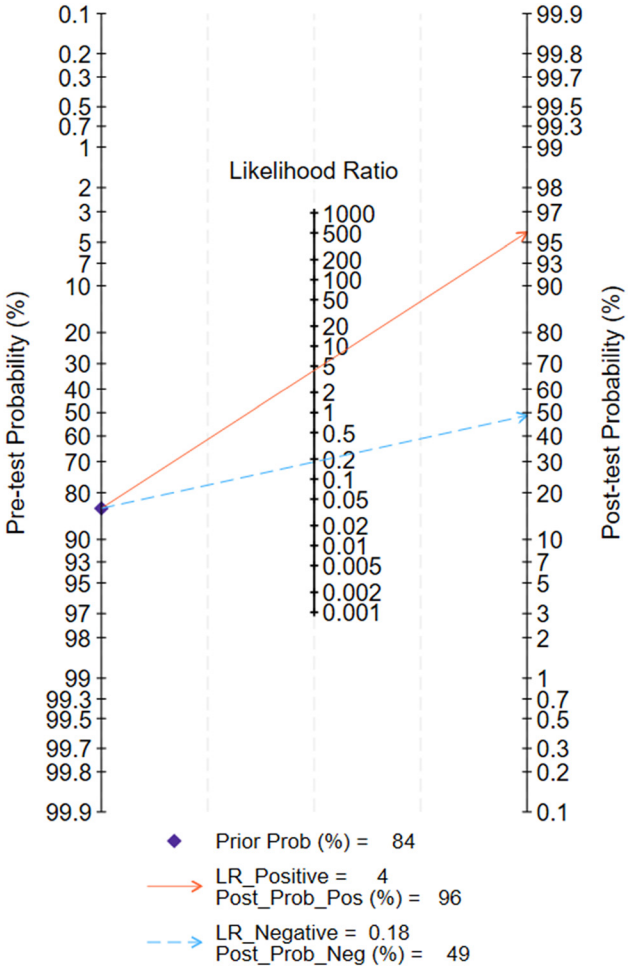

Figure 4: Fagan's plot of wider occiput-spine angle (OSA) and narrow OSA compared with successful vaginal delivery.

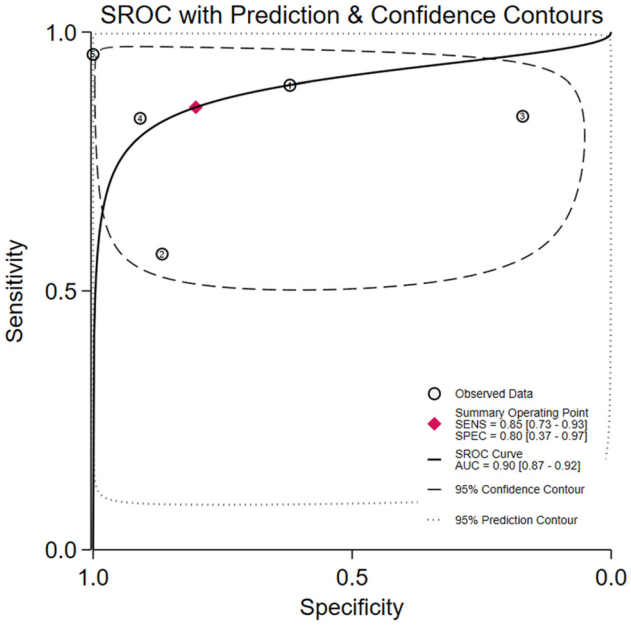

Figure 5: Pooled hierarchical summary receiver operating characteristics curve for prediction of successful vaginal delivery.

Table 4: Mean and standard deviation (SD) of occiput-spine angle between successful vaginal delivery (VD) and cesarean delivery (CD).

Author	Year	Number of successful VD	Mean±SD of successful VD	Number of CD	Mean±SD of CD
Ghi et al.	2016	79	127° ± 9.4°	19	121° ± 10.5°
Dall'Asta et al.	2021	56	126° ± 14°	30	115° ± 24°
Mukdee et al.	2021	289	110° ± 9.1°	41	110.7° ± 11.1°
Salman et al.	2022	54	128.2° ± 11.9°	11	106.3° ± 9°

were analyzed. The pooled diagnostic performance from five studies with the same definition of outcomes was successful VD revealed the good predictive value of fetal OSA. However, a high level of heterogeneity was observed. This study attempted to explore the sources of heterogeneity in term of age, GA, BMI, multiparity, and EFW but did not reduce I^2 by the meta-regression model; in addition, subgroup analysis was not done by the limited number of studies.

The data of five studies [7, 17–20] with no reported cutoff values for OSA were pooled. Data analysis revealed that women who underwent successful VD had a fetal OSA wider than those who underwent CD, but the difference was not significant.

A study with definition of outcomes was spontaneous VD [9] revealed an ROC for OSA by fair accuracy in identifying women requiring OVD because of labor arrest. For continuous variables, the OSA was significantly narrower in women who underwent obstetric intervention.

Results comparison with previous studies

According to the mechanism of labor in occiput-anterior fetuses, the fetal head flexes during VD to pass through the birth canal [1]. Our results are similar to previous systematic review of the fetal OSA [21], indicating that OSA >100°–126° can predict normal VD. In comparison, OSA <126° indicates a significantly longer duration of both the first and second stages of labor, as well as a higher rate of requiring a CD. Furthermore, women who underwent successful VD had a wider fetal OSA than women who underwent CD. For heterogeneity of included studies, we suggested that the sources of heterogeneity might from: The differences cutoff values, where is one study [18] set the cut-off level of 100°, which was

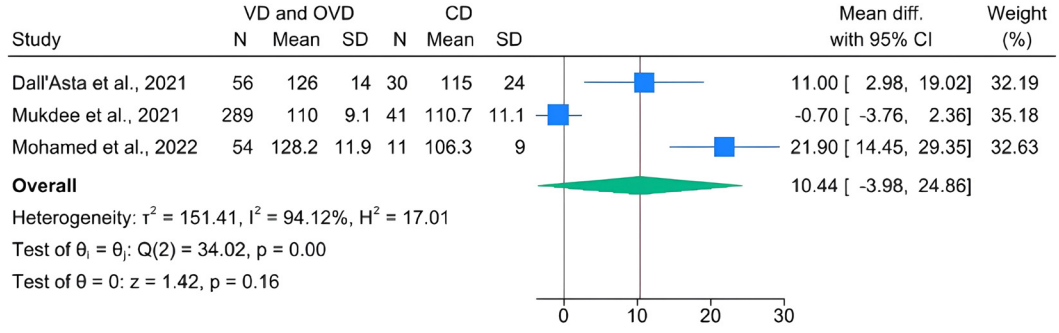

Figure 6: Forest plot of included studies in mean difference (MD) from studies reporting mean±standard deviation (SD) of occiput-spine angle between successful vaginal delivery (VD) and cesarean delivery (CD).

Table 5: Risk of bias assessment based on the quality assessment of diagnostic accuracy studies-2.

Author	Year	Risk of bias				Applicability concerns		
		Subject selection	Index test	Reference standard	Flow and timing	Subject selection	Index test	Reference standard
Ghi et al.	2016	Low	Low	Low	Unclear	Low	Low	Low
Maged et al.	2018	Low	High	Low	Unclear	Low	High	Low
Dall'Asta et al.	2021	Low	Low	Low	High	Low	Low	Low
Mukdee et al.	2021	High	Low	Low	Unclear	High	Low	Low
Salman et al.	2022	Low	Unclear	Low	High	Low	High	Low
Sheshtawey et al.	2023	Low	High	Low	Unclear	Low	High	Low

lower than those in other studies, and reported a high sensitivity and low specificity of 83.7 and 17.1 %, respectively. We suggested that using different cutoff values for OSA might affect diagnostic ability. Furthermore, the incidence of CD varied from 8 to 34.9 %, which one study [17] reported the highest CD rate of 34.9 % and sensitivity and specificity of 56.7 and 87.5 %, respectively, indicating heterogeneity in this systematic review and meta-analysis.

Compared with other intrapartum sonographic parameters, the AOP or HPD during the first stage of labor. A previous systematic review and meta-analysis [21] investigated the diagnostic accuracy of HPD and AOP, reporting DOR of 8.21 and 10.34, respectively. Our study found that OSA had a higher DOR (DOR=23.71) than these parameters (AOP or HPD). Additionally, the HSROC for AOP and HPD were 0.81 and 0.83, respectively, which are lower than that for the fetal OSA (HSROC=0.9). Previous studies on the chin-chest angle (CCA) in fetuses with occiput posterior position during first stage of labor found that the optimal cutoff value for discriminating between VD and CD was 33.0, and the area under the curve related to the mode of delivery was 0.76. These results show that both OSA and CCA, which indicate the fetal attitude, can be useful together as intrapartum ultrasound parameter for predicting of delivery [17, 22]. From these findings, our study suggested that fetal OSA during the first stage of labor is a potential alternative predictor of the route of delivery or the management during labor despite the complexity of ultrasound usage [11].

Strengths and limitations

This systematic review and meta-analysis comprehensively evaluated the diagnostic utility of fetal OSA for predicting spontaneous and successful VD, contributing new knowledge on intrapartum sonographic usage for minimizing adverse events, such as emergency CD during intrapartum labor.

However, this study has some limitations. Only a small number of studies were included, which resulted in the inability to explore sources of heterogeneity and determine the optimal cut-off value for fetal OSA for use in clinical practice. High risk of bias in some studies resulted in poor data quality, heterogeneous study populations that were predominantly Asian, and differences sonographic tools for assessing fetal OSA.

Research implications

This study demonstrated that OSA measured via transabdominal ultrasonography has a good diagnostic utility as a predictor of VD. It could be combined with other sonographic and clinical parameters, such as cervical length and fetal head position, or other intrapartum sonographic parameters, to improve labor and delivery predictions. Moreover, there is a need to standardize fetal OSA measurement techniques across studies to ensure consistency and reliability. Establishing universally accepted cutoff values is also necessary to enhance clinical applicability. Further research involving well-designed, high-quality studies that standardized assessment methods will strengthen the robustness of the evidence.

Conclusions

Fetal OSA is a good diagnostic indicator of spontaneous and successful VD during the first stage of labor. Further studies with larger sample sizes, population differences are needed to validate the current findings. Standardized OSA cutoff values should be established to improve clinical utility. Furthermore, studies need to be conducted on the utility of dynamically changing OSA in assessing labor progression to further explore the applications of fetal OSA in clinical practice.

Supporting information

A copy of the search strategy describing the exact terms pasted into each search engine, as previously mentioned within the methodology section, is available in the supplementary materials.

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Research ethics: The Ethics and Research Standards Division of Srinakhanarinwirot University, Thailand, approved this study. The study was conducted as a systematic review and meta-analysis, adhering to the guidelines outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement for reporting systematic reviews that include meta-analyses. Furthermore, the study was registered in the International Prospective Register of Systematic Reviews (PROSPERO) under the registration number CRD42025632898.

Informed consent: Not applicable.

Author contributions: M.S. designed the research study. P.K. and K.N. searched and extracted data. P.K. and K.N. analyzed the risk of bias. M.S. analyzed data, and P.C. created figures and tables. All authors participated in conceptualizing the contents of this manuscript and were involved in writing the original draft as well as reviewing and editing the contents.

Use of Large Language Models, AI and Machine Learning Tools: None declared.

Conflict of interest: The authors declared there is no conflict of interests.

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Data availability: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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