

Transabdominal cervical length measurement as primary screening method for short cervix in the mid-trimester: A prospective observational cohort diagnostic accuracy study

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ABSTRACT

Introduction: Preterm birth (PTB) is a leading cause of neonatal morbidity and mortality, with cervical insufficiency being a major contributor. While transvaginal ultrasound is the gold standard, concerns over invasiveness, resource requirements, and acceptability limit its universal use. Transabdominal cervical length measurement may offer a pragmatic alternative, particularly in conservative populations. We aim to compare transabdominal versus transvaginal cervical length measurement for screening of short cervix during the mid-trimester, and to determine the feasibility and clinical utility of using transabdominal ultrasound as a primary screening tool, especially in populations with reservations about undergoing transvaginal scans.

Materials and Methods: This was a prospective observational cohort diagnostic accuracy study involving pregnant women undergoing routine mid-trimester anomaly scans. Cervical length was measured using transabdominal and transvaginal ultrasound by experienced sonographers. Statistical analysis: correlation assessed with Spearman's coefficient. Agreement evaluated with intraclass correlation and Bland-Altman plots. Diagnostic accuracy metrics (sensitivity, specificity, PPV and NPV) were calculated for transabdominal thresholds. Confounding factors, including bladder filling, maternal body mass index (BMI), and prior caesarean delivery on visualisation, were also evaluated.

Results: Of the 266 women eligible to participate in the study, 6.0% were excluded as they declined a transvaginal scan. Postvoid transabdominal (TA) measurements demonstrated better agreement with transvaginal (TV) values but were associated with higher rate of non-visualization (10.0%). Bland-Altman plots showed good agreement without systematic bias. The mean prevoid TA cervical length and postvoid TA cervical length were 35.7 mm and 35.6 mm respectively, compared to 39.3 mm on TV measurement. Non-visualization occurred more often postvoid (10%) than prevoid (6.4%), while postvoid TA measurements showed stronger agreement with TV (ICC=0.818). Agreement of measurements was higher among Maternal-Fetal Medicine (MFM) consultants than among MFM fellows. Body mass index (BMI) and prior

caesarean section scars did not significantly affected visualization or measurement accuracy.

Conclusion: TA cervical length measurement is a reliable initial screening approach for identifying women at risk of short cervix during mid-trimester when performed by experienced operators. It serves as a pragmatic alternative in settings where TV scans are declined or not feasible, facilitating timely referral for TV confirmation and early initiation of preventive interventions such as progesterone therapy or cerclage. However, its application may be limited in untrained hands.

KEYWORDS:

Cervical length; transabdominal ultrasound; transvaginal ultrasound; mid-trimester screening; short cervix; conservative populations; diagnostic accuracy

INTRODUCTION

The World Health Organization (WHO) reported that approximately 15 million babies were born too soon annually, with Malaysia contributing more than 34,000 of these preterm births.^{1,2} The majority of preterm births (PTB) were spontaneous (as opposed to medically-indicated), resulting from preterm labour (40 to 50 percent) or preterm prelabour rupture of membranes (20 to 30%); with cervical insufficiency recognised as one of the significant contributors.³ In fact, the International Federation of Gynaecology and Obstetrics (FIGO) Working Group for Preterm Birth identified cervical insufficiency as one of the "low-hanging fruits" and issued recommendations on its intervention.⁴

For an intervention to be implemented, cervical length screening must first take place. Most studies on cervical length in the prediction of PTB were performed via transvaginal (TV) ultrasound, which has also been shown to be reproducible and less prone to technical issues.^{5,6} However, introducing routine TV ultrasound in a centre at the outset may add considerable assessment time and clinicians may be reluctant to comply, in the absence of data supporting a clinical advantage.⁶ From a resource perspective, allocation of an additional chaperone during the TV scan and,

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Table 1: Demographic and Socioeconomic Characteristics of Participants

Characteristic		Value
Age (year)		33.4 ± 6.6
Race	Bidayuh	26 (10.4)
	Chinese	28 (11.2)
	Iban	55 (22.0)
	Malay	133 (53.2)
	None of the above	8 (3.2)
Gestational age (weeks)		21.3 ± 1.3
Parity	Nulliparous	62 (24.8)
	Multiparous	188 (75.2)
Booking BMI (kg/m ²)	<18.5	18 (7.2)
	18.5-24.9	66 (26.4)
	25.0-29.9	77 (30.8)
	30.0-34.9	55 (22.0)
	35.0-39.9	19 (7.6)
	≥40	1 (0.4)
	Not available	14 (5.6)
Previous cesarean section		54 (21.6)
Previous preterm birth		25 (10)
History of cervical conization/ loop excision		0 (0)
Household income	Top 20	7 (2.8)
	Middle 40	43 (17.2)
	Bottom 40	173 (69.2)
	Not available	27 (10.8)

Data represent mean (Standard deviation) or n (%) unless stated

disassembly and disinfectant of an additional transducer can be prohibitive. TV ultrasound is invasive and some women find the procedure distressing.⁷ Furthermore, in some culturally-conservative societies such as the authors', TV ultrasound is regarded as a highly intimate examination, with some women compelled to request for their partner's approval.⁸ Studies among Asian patients reported 7.7 to 22.9% of women declining TV ultrasound.⁹⁻¹⁰ Lastly, performing an intimate examination on mostly young women in a vulnerable position with dim lighting, subjects the clinician to threats of litigation if workplace protocols are not strictly adhered to.¹⁰

Technically, the sonographic assessment of cervical length can also be performed using a transabdominal (TA) or transperineal approach. TA ultrasound is associated with reduced scanning time, use of resources and discomfort for the patients. However, whether TA is sufficiently accurate as a surrogate for TV in screening of women with shortened cervical length remains in equipoise, based on existing studies.^{4,5,11} We sought to (1) compare TA and TV measurements of cervical length to assess the efficacy of an initial TA assessment in defining a group of women that should have further TV evaluation; (2) assess inter-observer variation of both TA and TV measurement; (3) investigate if bladder filling or body mass index (BMI) affected the ability to visualize the cervix using TA ultrasound.

MATERIALS AND METHODS

We conducted a prospective observational cohort diagnostic accuracy study, evaluating pregnant women who underwent mid-trimester fetal anomaly screening in the Maternal-Fetal Medicine (MFM) unit of Sarawak General Hospital, Malaysia.

Women ≥18 years of age with singleton pregnancies between 18+0 and 23+6 weeks of gestation were eligible. Exclusion criteria included symptoms of threatened preterm labour, uterine anomalies, pre-existing cerclage in-situ, or progesterone therapy. Women declining TV scans and their reasons were documented. Written informed consent was obtained. A bilingual patient information leaflet was also made available and women who did not understand English or Bahasa Malaysia were counselled in the presence of an interpreter.

TA cervical length was measured pre- and post-void. Visualization was defined by the identification of both internal and external os. Three TA measurements were obtained; the shortest was used for analysis. TV measurements were performed as per Fetal Medicine Foundation guidelines.¹² To reduce measurement bias, TV and TA scans were performed independently by different operators, who were blinded to the other's findings. Inter-observer reliability was assessed. Bladder volume was estimated using a standard formula previously described.^{13,14} Sample size was determined using Bujang & Adnan (2016), requiring 264 participants to achieve 90% sensitivity with 85% power for TV cervical length of 25 mm, based on a target significance level of 0.05.¹⁵ A cut-off of 25 mm measured transvaginal was used as the reference standard as cervical length below this cut-off is associated with increased risks of preterm deliveries.¹⁶ Data collected were analysed with SPSS version 26.0 (SPSS Inc, Chicago, IL). Statistical analysis: correlation assessed with Spearman's coefficient. Agreement evaluated with intraclass correlation and Bland-Altman plots. Diagnostic accuracy metrics (sensitivity, specificity, PPV and NPV) were calculated for transabdominal thresholds. Regression models explored effects of BMI and prior

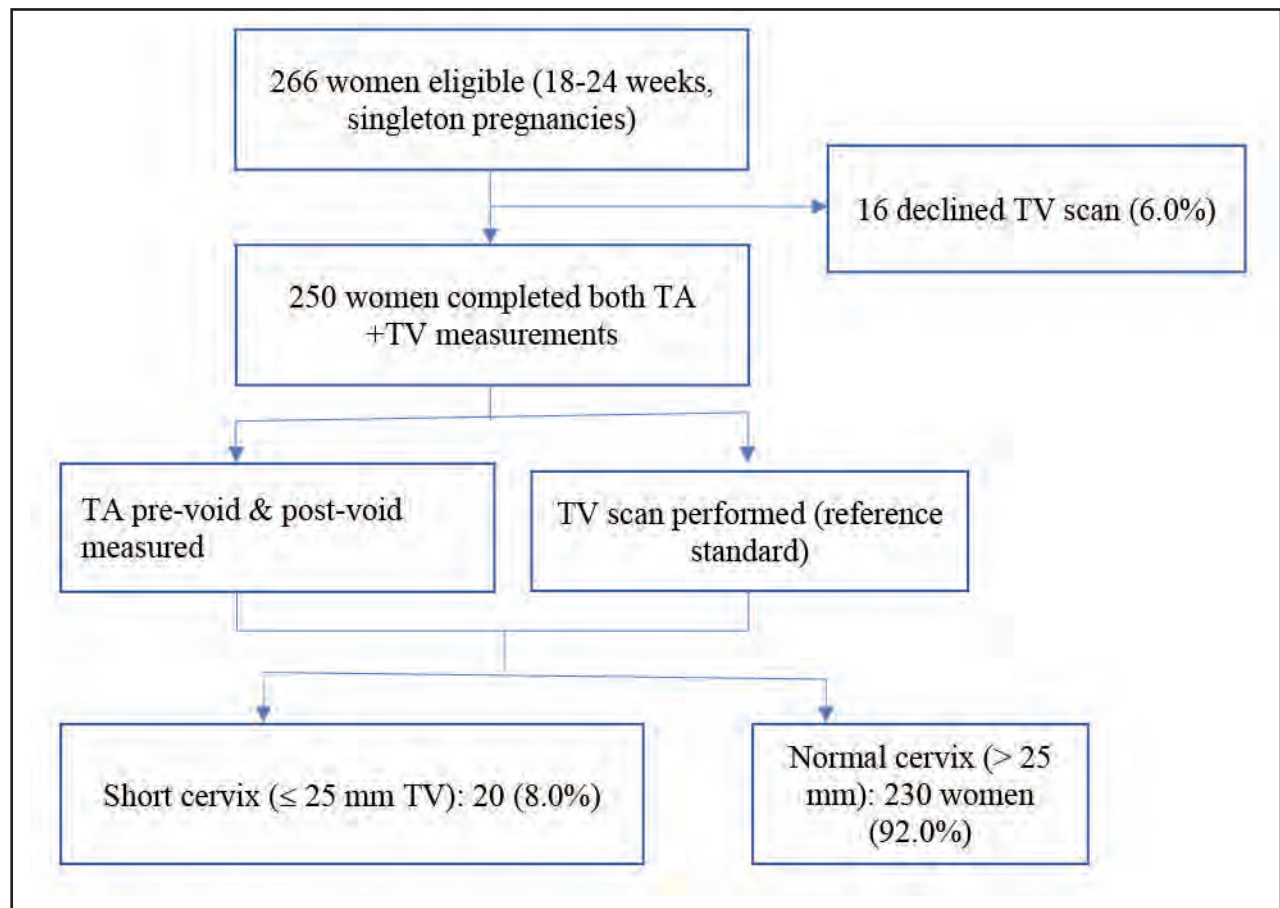


Fig. 1: Participant flow diagram for the study cohort

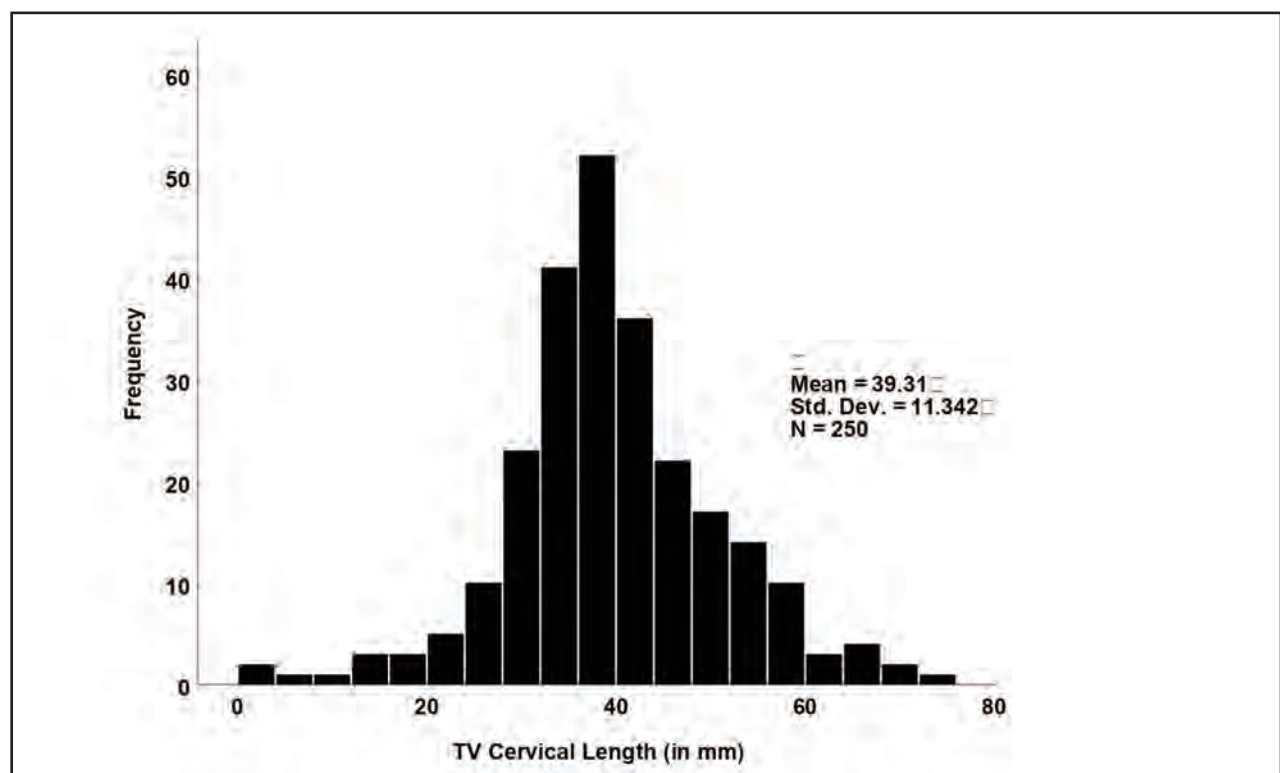


Fig. 2: Distribution of transvaginal cervical length measurements

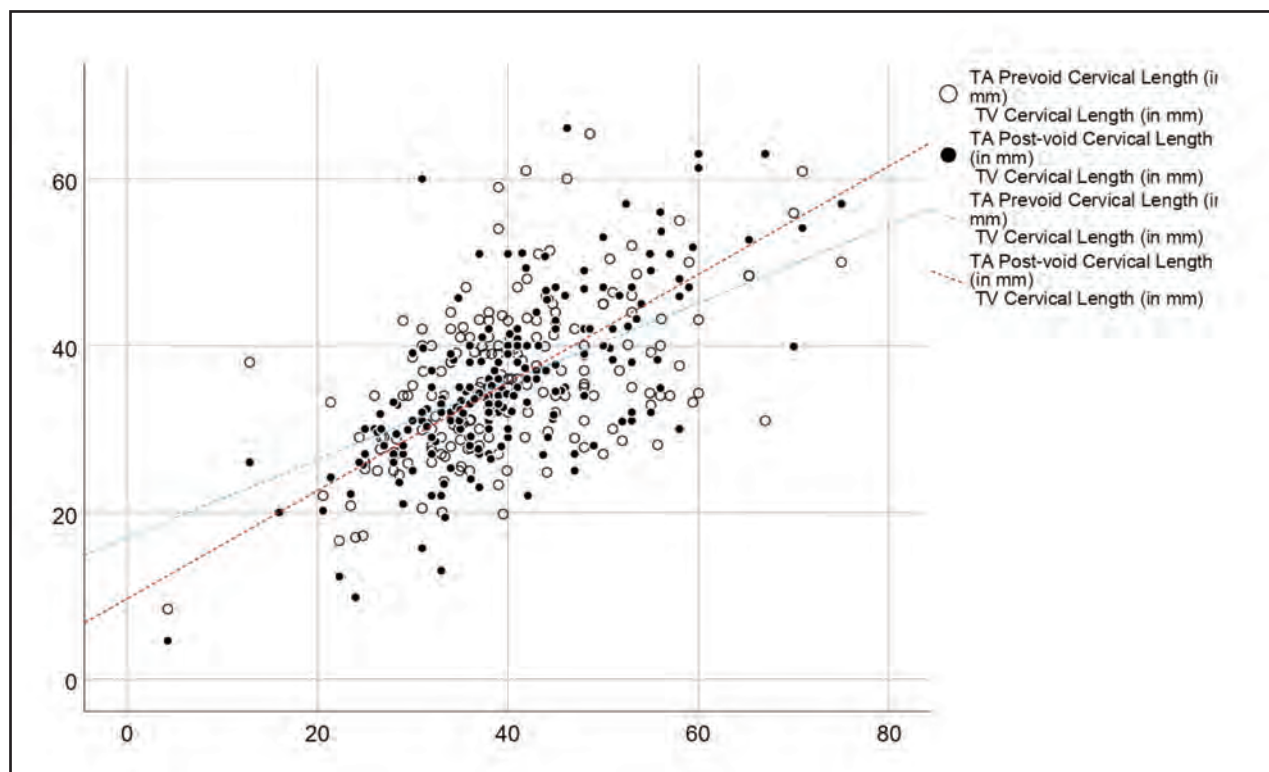


Fig. 3: Prevoid and postvoid transabdominal cervical length measurement compared with transvaginal measurement

caesarean scar. Refusals were documented to reduce selection bias. Women with non-visualised cervix on TA were included in analysis as missing data; no imputation was performed. Statistical analysis excluding these cases was undertaken. A flow diagram of participants, exclusions, and refusals is provided. (Figure 1).

This study received no external funding. Ethical approval was obtained from the Medical Research & Ethics Committee (MREC) and registered with the National Medical Research Register Malaysia (NMRR ID-22-02567-BGW). Authors declare no conflicts of interest.

RESULTS

Of 266 recruited, 250 completed both TA and TV measurements. 16 (6.0%) women declined TV ultrasound. Demographic data and preterm birth risk factors among the women screened are shown in Table I.

Self-reported mean household income, categorized based on the Department of Statistics' data, was used as a surrogate for socioeconomic status.¹⁷ Mean prevoid TA cervical length was 35.7 mm (95% CI 34.5 - 36.9 mm) and postvoid TA cervical length was 35.6 mm (95% CI 34.3 - 36.9) compared to 39.3 mm (95% CI 37.9 - 40.7) (Figure 2) when measured through TV. Short cervix (TV cervical length of ≤ 25 mm) was observed in 8.0%. Non-visualization occurred in 17 (6.4%) prevoid and 25 (10.0%) postvoid TA scans and these were excluded from analysis. Postvoid TA had stronger agreement with TV (ICC=0.818) than prevoid TA (ICC=0.765) (Figure 3).

The agreement of measurements was higher amongst Maternal-Fetal Medicine consultants 0.762 (95% CI 0.646 - 0.840; $p < 0.001$) compared to MFM fellows 0.697 (95% CI 0.55-0.781; $p < 0.001$). In a multivariate analysis, maternal BMI and presence of previous caesarean section scar, two potential confounders for visualization of cervical length TA did not affect the agreement of measurements ($p > 0.05$).

DISCUSSION

Our study shows TA cervical length measurement can be used as a surrogate to TV scan in detection of short cervix. The mean cervical length in our study and incidence of short cervix in our cohort was consistent with previously published studies.^{5,11,18-19} Postvoid TA was more accurate than prevoid TA but associated with higher non-visualization rates. A cut-off of 30 mm improved sensitivity to 87.5% with acceptable trade-off in specificity. Previous authors have suggested a higher cut-off of 30 mm to 32 mm be used when the cervix was measured transabdominally.^{5,16,20} Importantly, TA high negative predictive value supports its use as triage tool in population where TV is declined.

The strength of this study includes its prospective design, standardized protocol, blinded measurements, and assessment of confounders. Limitations includes single-centre setting and experienced operators performing the scan, which may limit generalisability. A transperineal scan was not included as a separate arm in this study as it is an equally intimate examination like TV and technically more challenging.

Clinically, TA scans as first-line screening allows identification of women requiring TV confirmation, enabling timely interventions such as vaginal progesterone or cerclage. This may help reduce preterm birth burden in settings when TV acceptance or availability is limited.

CONCLUSION

TA cervical length measurement has a high negative predictive value and is a reasonable first-line strategy for identifying women with a short cervix. It can be used to triage women for TV confirmation, particularly in culturally-conservative or resource-limited settings. As the scans were performed by trained operators, the findings may not be generalizable to all clinical settings.

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