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Integrating vaginal microbiota, metabolites, and cervical elastography to predict preterm birth



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Objective

- This study aimed to develop a prediction model for preterm birth (PTB) by comparing vaginal microbiota, metabolites, and cervical elastography.

Methods

- In this case–cohort study, pregnant women who visited our hospital between December 2023 and August 2025 were enrolled.
- Vaginal fluid samples were collected between 15 and 36 weeks of gestation, and a matched case–control analysis was performed in 96 Korean women, including 37 with PTB and 59 with term birth (TB).
- Twelve bacterial species were quantified using multiplex quantitative real-time PCR, six cytokines were measured by immunoassay, and three short-chain fatty acids were analyzed by gas chromatography–mass spectrometry.
- Cervical elastography was performed transvaginally in the second and third trimesters, and five elastographic parameters, including elasticity contrast index (ECI), were evaluated.

Results

- During the second and third trimesters, ECI on elastography differed significantly between the PTB and TB groups ($p=0.03945$).
- In the TB group, *Lactobacillus crispatus* decreased and then increased over time, whereas *L. iners* showed a gradual increase.
- In the PTB group, *L. crispatus* demonstrated a similar decrease-then-increase pattern, while *L. iners* increased initially and then decreased at period 3.
- In period 2, XGBoost analysis for PTB prediction identified *Ureaplasma parvum*, cervical length, *Gardnerella vaginalis*, *L. crispatus*, IP-10, and *Prevotella amnii* as the most important features.
- The model to be created to predict preterm birth can identify safe patients with 89.2% accuracy when predicting negative results, while detecting 84.7% of at-risk patients. (Table 1)

Table 1. Performance evaluation results of the prediction model

Characteristic	Results	SD
AUC-ROC	0.825	0.038
Sensitivity	84.7%	5.5%
Specificity	72.6%	3.5%
PPV	68.2%	3.7%
NPV	89.2%	3.6%
Brier score	0.174	0.014

Conclusion

- For clinical application of this technology, larger studies are required to validate these findings, and incorporation of clinical risk factors will be necessary to construct a high-performance bacterial risk score model for PTB.

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