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Effectiveness of E-KSPR Telemedicine in Pregnancy Risk Assessment and Antenatal Care Quality

Nahdiyah Karimah[1]*, Emma Anastya Puriastuti[2], Ririn Indriani[3]

[1,2] Midwifery Department, Vocational School, Sebelas Maret University, Indonesia
[3] Diploma Tiga Kebidanan Kediri, Poltekkes Kemenkes Malang

nahdiyahkarimah@staff.uns.ac.id[1]*
emmaanastya@staff.uns.ac.id[2]
ririnindrianimiori79@gmail.com[3]

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ABSTRACT

Background: Perceived health status is an important subjective indicator reflecting individuals' physical and psychological conditions and is closely associated with productivity in occupational settings. This study aimed to analyze factors associated with perceived health status among lecturers at the Faculty of Nursing, Universitas Padjadjaran.
Method: This analytic observational study used a cross-sectional design. A total of 68 lecturers were included using total sampling. Data were collected using structured questionnaires assessing perceived health status and associated factors, including behavioral, health service, environmental, and genetic factors. Data were analyzed using Chi-square tests and logistic regression, with a significance level of $p < 0.05$.
Result: Among 68 respondents, 86.8% reported a positive perceived health status. Behavioral factors ($p = 0.001$) and genetic factors ($p < 0.001$) were significantly associated with perceived health status, while health service and environmental factors were not significantly associated ($p > 0.05$). Multivariate analysis showed that behavioral factors ($p = 0.012$) and genetic factors ($p = 0.008$) remained significant predictors, with behavioral factors identified as the most dominant factor.
Conclusion: Behavioral factors and family history of disease significantly influence perceived health status among nursing lecturers. The novelty of this study lies in identifying these determinants in a specific lecturer population within nursing education. Faculty-based workplace health promotion programs focusing on healthy lifestyle behaviors, stress management, periodic health check-ups, and early detection of non-communicable disease risk factors are recommended to improve lecturers' well-being, academic productivity, and the quality of nursing education.

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INTRODUCTION

Maternal mortality remains a critical global public health challenge. Maternal mortality refers to the death of a woman during pregnancy or within 42 days after termination of pregnancy due to pregnancy-related causes (Van Dijk et al., 2024). In 2023, the global maternal mortality ratio (MMR) reached 197 per 100,000 live births, and most of these deaths were considered preventable. To achieve the Sustainable Development Goals (SDG) target 3.1 of reducing the global MMR to fewer than 70 per 100,000 live births by 2030, an annual reduction of approximately 15% is required (World Health Organization, 2025). Achieving this target requires not only expanding service coverage but also strengthening the quality of antenatal care (ANC) delivery, especially in primary healthcare settings where early risk detection occurs. This highlights the critical role of accurate, timely, and standardized pregnancy risk assessment as a core component of quality antenatal care. Despite progress in maternal healthcare, many countries continue to face persistent structural and systemic barriers in delivering timely and high-quality antenatal services. The foundational obstetric literature emphasizes that systematic antenatal risk identification and timely referral are essential components in preventing maternal complications and deaths (Cunningham et al., 2022).

Indonesia continues to experience significant maternal mortality burden. In 2023, the national MMR increased to 111 per 100,000 live births, compared to 80 per 100,000 live births in 2022. The leading causes of maternal death were hypertensive disorders in pregnancy (412 cases), obstetric hemorrhage (360 cases), and other obstetric complications (204 cases) (KEMENKES RI, 2024). Although national ANC coverage indicators have improved, disparities in maternal outcomes persist, suggesting that increased utilization alone does not ensure effective clinical risk identification and decision making. Within the SDG framework, improving maternal health requires strengthening both access and quality of care, aligning with SDG 3 (Good Health and Well-being) and SDG 9 (Industry, Innovation, and Infrastructure), which emphasizes the role of health system innovation in improving service quality and clinical effectiveness. Therefore, improving the effectiveness and reliability of pregnancy risk screening at the primary care level is critical to accelerating SDG achievement in maternal health.

Early screening during pregnancy is widely recognized as a key strategy for preventing maternal mortality. Health workers can significantly reduce complications by conducting early detection of maternal risk factors (Marshall & Raynor, 2020). Evidence suggests that timely identification of risk conditions can reduce the likelihood of severe complications by up to 80% (Hromadnikova et al., 2024). For example, systematic screening and preventive management of preeclampsia have successfully contributed to reductions in maternal mortality in developing countries (Stefanovic, 2023). Although some screening strategies focus on specific conditions such as hemoglobin in pregnant women to prevent preterm birth and low birth weight (Hoffmann et al., 2023). Condition specific screening alone does not provide an integrated or cumulative assessment of overall maternal risk. Fragmented screening approaches may therefore fail to adequately guide holistic care planning and referral decisions. Therefore, a standardized, cumulative risk stratification tool integrating multiple maternal risk factors is essential to support structured clinical decision making in antenatal care.

In Indonesia, the Poedji Rochjati Score Card (KSPR) is widely used as a standardized tool for early detection of high-risk pregnancies. The KSPR assigns an initial score of 2 to every pregnant woman, with additional scores of 4 or 8 added according to specific maternal risk factors. The total score categorizes pregnancies into low-risk (score = 2), high-risk (score 6–10), or very high-risk (score >12), which directly informs care planning and referral pathways (Damaraji et al., 2022). KSPR is recommended for use from the first trimester and functions not only as a screening instrument but also as a monitoring and reporting tool throughout pregnancy and childbirth (Sihotang & Hidayatullah, 2024). Women who do not undergo early screening are less able to anticipate or prevent complications (Saddam & Purbawa, 2020).

Despite its clinical importance, the conventional implementation of KSPR remains predominantly manual. The scoring process requires midwives or health cadres to calculate cumulative scores manually, which introduces the risk of user-related errors. Previous studies have demonstrated that 66.2% of midwives showed inadequate performance in completing KSPR accurately, particularly among those with lower levels of knowledge (Andriani, 2019). Furthermore, 85% of health cadres were reported to be incapable of implementing KSPR correctly, and all cadres with weak knowledge failed to perform accurate scoring (Retnaningtyas, 2022). Given that KSPR scores directly determine pregnancy risk classification and referral decisions, inaccuracies in scoring may compromise clinical decision making and increase the risk of adverse maternal and fetal outcomes (Irfan et al., 2021). These challenges are commonly observed in primary healthcare centers, including Sangkrah Public Health Center in Surakarta City, which represents typical urban primary maternal healthcare conditions in Central Java.

The rapid development of digital health technologies offers promising opportunities to address these challenges. Telemedicine and clinical decision support systems (CDSS) have been shown to improve guideline adherence, reduce documentation errors, and enhance workflow efficiency (Kruse et al., 2018; Sutton et al., 2020). Systematic reviews have reported that digital maternal health interventions can improve service accessibility, monitoring, and quality of care (DeNicola et al., 2020; Golinelli et al., 2020). However, most existing digital maternal health applications primarily focus on education, reminders, communication, or general monitoring functions and do not embed standardized national pregnancy risk scoring systems into their core clinical logic. As a result, these technologies often function as supportive tools rather than as integrated decision-support systems that directly influence clinical risk stratification and referral pathways. Consequently, the persistent issue of manual KSPR miscalculation remains largely unresolved.

This reveals a critical research gap: while telemedicine and CDSS are increasingly implemented in maternal healthcare, there is limited evidence on digital systems that conceptually integrate standardized, cumulative pregnancy risk assessment into automated clinical decision frameworks aligned with national guidelines. The required novelty therefore lies not merely in digitizing existing screening tools, but in transforming manual, error-prone risk assessment processes into automated, guideline-embedded decision support that enhances accuracy, consistency, and clinical utility.

To address this gap, the E-KSPR Telemedicine application was developed as a targeted digital innovation integrating automated KSPR scoring, real-time risk classification, explicit explanations of contributing risk factors, teleconsultation features, and monitoring spanning antenatal, intrapartum, and postpartum care. Unlike general maternal health applications, E-KSPR embeds national KSPR logic directly into the decision-making process, positioning pregnancy risk assessment as a continuous, system-supported clinical function rather than a manual calculation task.

Therefore, this study purpose to evaluate the effectiveness of E-KSPR Telemedicine compared with the conventional KSPR in pregnancy risk assessment and antenatal care quality using a within-subject single-visit repeated assessment design conducted at Sangkrah Public Health Center as a primary healthcare setting.

METHOD

Research Design

This study employed an observational analytic study with a within-subject (single-visit repeated assessment) design to evaluate the effectiveness of E-KSPR Telemedicine compared with conventional KSPR in pregnancy risk assessment and antenatal care (ANC) quality. Each participant was assessed once during a single antenatal care visit, and the same clinical information

obtained from that visit was independently evaluated using two different assessment methods. The within-subject design was selected to control for inter-individual variability in maternal characteristics and clinical conditions, allowing direct comparison between assessment methods while minimizing temporal bias.

Participant

Participants were pregnant women in trimester I–III who attended routine antenatal care services at Sangkrah Public Health Center, during the study period. Eligibility criteria included undergoing a routine antenatal care examination with complete clinical data and providing written informed consent. Pregnant women presenting with obstetric emergencies requiring immediate referral or those with incomplete antenatal examination records were excluded. Participants were selected using purposive sampling based on the predefined eligibility criteria. A total of 100 pregnant women were included in the final analysis.

Population and the Methods of Sampling Instrumentation

The study population comprised all pregnant women receiving antenatal care services at the selected healthcare facilities during the study period. A purposive sampling technique was employed to recruit participants who met the predefined inclusion criteria, ensuring the availability of complete and comparable clinical data required for within-subject comparative assessment conducted during a single antenatal care visit.

Pregnancy risk assessment was conducted using two instruments: the conventional KSPR and the E-KSPR Telemedicine application. The conventional KSPR instrument consists of standardized items encompassing maternal demographic characteristics, obstetric history, current pregnancy conditions, and medical risk factors. Each identified risk factor contributes to a cumulative pregnancy risk score, which is subsequently categorized into low-risk, high-risk, or very high-risk pregnancy classifications according to established guidelines. The E-KSPR Telemedicine application incorporates variables and scoring logic equivalent to those of the conventional KSPR, with pregnancy risk scores and classifications generated automatically following structured digital data entry.

Pregnancy risk scoring was performed by two independent observers. Observer 1 completed the conventional KSPR form, while Observer 2 conducted the assessment using the E-KSPR Telemedicine application. Both observers were licensed midwives with adequate knowledge and clinical skills in pregnancy risk screening and had received prior training in the use of both assessment tools. Each observer independently calculated the pregnancy risk score only once per participant, based on the same clinical findings obtained during a single antenatal care visit, with no repeated measurements conducted across multiple visits.

To minimize observer dependency, both observers used standardized antenatal examination data recorded during the same visit and followed uniform data extraction procedures. Blinding was applied at the observer level: Observer 1 was blinded to the E-KSPR assessment results, and Observer 2 was blinded to the conventional KSPR scores. Observers performed their assessments independently and were not permitted to discuss or access each other's results.

The duration required to complete each pregnancy risk assessment was measured using a timer. For the conventional KSPR, timing commenced at the initiation of manual form completion and concluded when the final risk classification was determined. For the E-KSPR Telemedicine assessment, timing began at the start of digital data entry and ended when the automated risk classification was generated by the system. Time was recorded in minutes and seconds.

Antenatal care (ANC) quality was evaluated using a structured checklist developed based on national antenatal care standards. The checklist assessed the completeness of ANC examination components, appropriateness of follow-up planning, and consistency of clinical documentation.

Each item was scored dichotomously (1 = completed, 0 = not completed), with higher total scores indicating better ANC service quality.

Content validity of the ANC quality checklist was established through expert review by senior midwives and maternal health academicians. Agreement between pregnancy risk classifications generated by the conventional KSPR and E-KSPR Telemedicine was evaluated using Cohen's Kappa statistic. Reliability testing was not applied to the KSPR instruments, as they function as clinical screening tools rather than psychometric measurement scales.

Instrument

The instruments used in this study comprised both assessment tools under evaluation and supporting measurement instruments. The assessment tools under evaluation were the conventional KSPR form and the E-KSPR Telemedicine application, which were independently applied to the same clinical data to assess pregnancy risk status. Antenatal care (ANC) quality was measured using a structured checklist adapted from Abanga et al. (2025). The checklist consisted of 24 items grouped into five domains, namely history taking, physical examination, laboratory assessment, counseling and health education, and clinical documentation. Each item was scored using a binary scale (performed = 1, not performed = 0), with total scores ranging from 0 to 24, where higher scores indicated better quality of ANC service delivery.

Content validity of the checklist was assessed by three maternal health experts, resulting in a scale-level content validity index (S-CVI) of 0.92, indicating excellent content validity. Internal consistency reliability testing demonstrated good reliability, with a Cronbach's alpha coefficient of 0.87. To ensure consistency of scoring between assessors, inter-rater reliability was evaluated using Cohen's kappa coefficient, which yielded a value of 0.84, indicating strong agreement between raters. Time efficiency was measured using a manual stopwatch for conventional KSPR assessment and system-generated timestamps automatically recorded by the E-KSPR Telemedicine application.

Procedures

Data collection was conducted during routine antenatal care visits at Sangkrah Public Health Center over the period of July–August 2024. Following informed consent, each participant underwent a standardized antenatal examination. Clinical data obtained from this single visit were then independently entered by two trained observers into their respective assessment tools. Data entry duration, pregnancy risk classification, and antenatal care quality indicators were recorded immediately after each assessment.

Measurement contamination and potential carry-over bias were minimized by ensuring that both observers used identical raw clinical data and completed their assessments sequentially without access to prior assessment outputs.The automated scoring process embedded in the E-KSPR system further reduced subjective interpretation and calculation variability.

Analysis

Data analysis was performed using IBM SPSS Statistics version 31.0. Descriptive statistics were used to summarize the characteristics of the respondents (maternal age, gestational age, parity, educational level, and employment status) and the main study variables. The Wilcoxon signed-rank test was applied to compare pregnancy risk scores between the conventional KSPR and the E-KSPR Telemedicine. The paired t-test was used to compare data entry duration and antenatal care quality scores between the two methods. Agreement between pregnancy risk classifications was assessed using Cohen's Kappa statistic. Statistical significance was defined as $p < 0.05$.

Scope and Limitations

This study evaluated pregnancy risk assessment and ANC service quality based on a single antenatal visit per participant, which may not reflect longitudinal changes in pregnancy risk over time. Additionally, assessments were performed by trained observers under controlled conditions, which may differ from routine clinical practice.

Ethical Considerations

This research adhered to established ethical standards governing medical research involving human participants. Ethical clearance was granted by the Health Research Ethics Committee of Dr. Moewardi General Hospital, Surakarta (approval number: 1.250/V/HREC/2024). Before participation, all respondents received comprehensive information regarding the study's objectives, procedures, potential risks, and anticipated benefits. Written informed consent was obtained from each participant prior to data collection. Participant confidentiality and data privacy were rigorously protected throughout all stages of the research process.

RESULTS AND DISCUSSION

Results

A total of 68 lecturers from the Faculty of Nursing, Universitas Padjadjaran were included in this study. All respondents met the inclusion and exclusion criteria and were fully analyzed. There were no respondents who refused to participate, and no missing data were identified in this study.

Characteristics of Respondents

The characteristics of respondents in this study included maternal age, gestational age, parity, educational level, and employment status, as presented in Table 1.

Table 1. Characteristics of Respondents (n=100)

Characteristics	f	%
Maternal age (years)		
≤20	11	11.0
20-35	68	68.0
>35	21	21.0
Gestational age		
Trimester I	30	30.0
Trimester II	39	39.0
Trimester III	31	31.0
Parity		
Primigravida	45	45.0
Multigravida	40	40.0
Grand multigravida	15	15.0
Educational level		
Primary	14	14.0
Secondary	57	57.0
Higher	29	29.0
Employment status		
Employed	46	46.0
Housewife	54	54.0

Table 1 shows that the majority of respondents were within the optimal reproductive age of 20–35 years (68.0%), indicating a predominantly low baseline obstetric risk population. Most respondents were in the second trimester of pregnancy (39.0%), allowing pregnancy risk assessment to be evaluated at mid-pregnancy. Nearly half of the respondents were primigravida (45.0%), while the remainder had previous pregnancy experience. The majority of respondents had

completed secondary education (57.0%), which may support acceptance and use of digital health tools. In terms of employment status, most respondents were housewives (54.0%), reflecting a homogeneous socioeconomic background relevant to ANC access and utilization.

E-KSPR Telemedicine

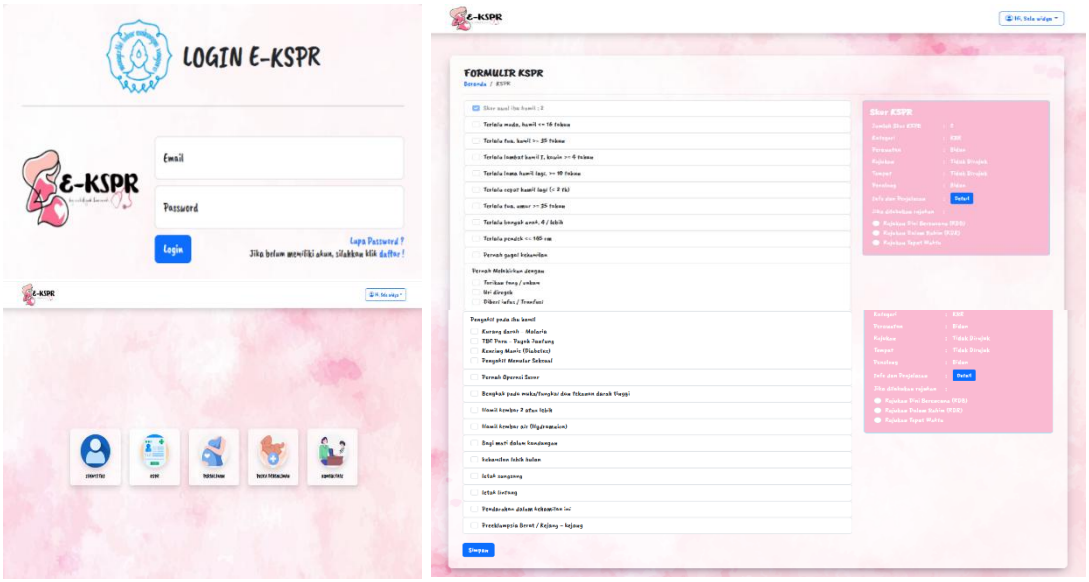


Figure 1. E-KSPR Telemedicine Application Interface

Participants accessed the E-KSPR Telemedicine application via the following URL: https://kspr-fe-dot-live-english-400305.et.r.appspot.com/. The assessment was conducted using version 1.0 (production build), which was officially deployed between June and August 2024. This specific build remained unchanged throughout the entire data collection phase to ensure methodological consistency and reproducibility. Figure 1 illustrates the login interface and main user dashboard. The application comprises multiple functional modules, including patient identity, KSPR risk assessment, labor monitoring, postpartum care, and consultation services.

Pregnancy Risk Scores

The comparison of pregnancy risk scores generated by the conventional KSPR and the E-KSPR Telemedicine application is shown in Table 2

Table 2. Comparison of Pregnancy Risk Scores between Conventional KSPR and E-KSPR Telemedicine (n = 100)

Method	Median	IQR	Z	p
Conventional KSPR	6.0	4.0-10.0	-3.02	0.003
E-KSPR Telemedicine	7.0	5.0-11.0		

Wilcoxon signed-rank test

As shown in Table 2, pregnancy risk scores obtained using the E-KSPR Telemedicine tended to be higher than those generated by the conventional KSPR. This indicates that the digital application was more sensitive in identifying pregnancy risk factors during the same antenatal visit. Statistical analysis using the Wilcoxon signed-rank test demonstrated a significant difference between the two methods ($p < 0.05$), suggesting that E-KSPR Telemedicine provides a more comprehensive risk assessment.

Agreement of Pregnancy Risk Classification

The level of agreement between pregnancy risk classifications obtained using the conventional KSPR and E-KSPR Telemedicine is presented in Table 3.

Table 3. Agreement of Pregnancy Risk Classification between Conventional KSPR and E-KSPR Telemedicine (n = 100)

Conventional KSPR	Low Risk	High Risk	Very High Risk	Total	Cohen's Kappa	p
Low Risk	34	8	2	44	0.81	0.001
High Risk	4	36	2	42		
Very High Risk	1	3	10	14		
Total	39	47	14	100		

Cohen's Kappa

Table 3 demonstrates almost perfect agreement between pregnancy risk classifications produced by the two methods. However, E-KSPR Telemedicine identified a greater number of respondents as high-risk or very high-risk compared to the conventional KSPR. Cohen's Kappa analysis indicated substantial agreement, confirming consistency between methods while also highlighting the enhanced detection capability of the digital system.

Duration of KSPR Entry

The comparison of data entry duration between the conventional KSPR and E-KSPR Telemedicine is summarized in Table 4.

Table 4. Comparison of Data Entry Duration between Conventional KSPR and E-KSPR Telemedicine (n = 100)

Method	Mean±SD (minutes)	t	p
Conventional KSPR	7.84 ± 1.92	16.73	0.001
E-KSPR Telemedicine	4.26 ± 1.14		

Paired T-Test

Table 4 indicates that the mean time required to complete pregnancy risk assessment using E-KSPR Telemedicine was significantly shorter than that required for the conventional KSPR. The paired t-test showed a statistically significant reduction in data entry duration ($p < 0.05$), demonstrating that the digital application improves efficiency in antenatal care services.

Antenatal Care Quality

The comparison of antenatal care quality scores between documentation using the conventional KSPR and the E-KSPR Telemedicine application is presented in Table 5.

Table 5. Comparison of Antenatal Care Quality Scores (n = 100)

Method	Mean±SD (minutes)	t	p
Conventional KSPR	82.3 ± 6.8	−9.54	0.001
E-KSPR Telemedicine	88.9 ± 5.7		

Paired T-Test

As shown in Table 5, antenatal care quality scores were significantly higher when documentation was performed using E-KSPR Telemedicine compared to conventional KSPR. This finding indicates that the digital system supports more complete and standardized ANC documentation. Statistical analysis confirmed a significant difference between methods ($p < 0.05$), suggesting that E-KSPR Telemedicine contributes to improved quality of antenatal care delivery.

Discussion

Implications

This study employed a within-subject observational analytic design in which pregnancy risk assessment and antenatal care (ANC) quality were evaluated during a single antenatal visit using two parallel methods: the conventional KSPR and the E-KSPR Telemedicine application. By utilizing the same clinical data assessed independently by two trained observers, this design minimized inter-participant variability and allowed direct method-to-method comparison under controlled conditions.

The E-KSPR Telemedicine application is designed to automatically generate the cumulative pregnancy risk score immediately after completion of structured KSPR data entry. Once all relevant variables are entered, the system calculates the total score, displays the corresponding risk classification (low, high, or very high risk), and provides a structured explanation outlining the contributing risk factors responsible for the obtained score. This automated transparency enhances clinical clarity and reduces potential manual misclassification. Beyond antenatal risk assessment, the application supports continuous maternal monitoring through integrated modules covering labor and postpartum care, enabling documentation of maternal condition across the continuum of care. Additionally, the embedded telemedicine feature facilitates remote consultation and professional communication, thereby strengthening care coordination and decision-making support within primary maternal healthcare services.

The findings indicate that E-KSPR Telemedicine generated significantly higher median pregnancy risk scores compared with the conventional KSPR ($p = 0.003$), while demonstrating almost perfect agreement in categorical risk classification (Cohen's Kappa = 0.81; $p = 0.001$). Because both instruments applied identical variables and scoring logic, the difference in risk score magnitude likely reflects enhanced standardization, automated computation, and reduction of manual scoring inconsistencies rather than true clinical variation.

The within-subject structure strengthens internal validity by ensuring that both methods operated on identical clinical inputs during the same visit. Thus, differences observed are attributable to system performance rather than patient-related heterogeneity.

1. Enhanced Sensitivity in Risk Detection

   The higher median risk scores generated by E-KSPR suggest that digital automation may improve detection sensitivity for pregnancy risk factors. Clinical decision-support systems (CDSS) embedded within telemedicine platforms have been shown to reduce omission errors and enhance adherence to standardized screening protocols (Cockburn et al., 2024; Sutton et al., 2020). In maternal health contexts, improved risk stratification is essential for timely referral and prevention of obstetric complications.

   Given that this study was conducted during routine ANC services at primary care level (including Sangkrah Public Health Center), the integration of automated scoring may be particularly valuable in settings where provider workload is high and manual calculation may introduce variability.

2. Workflow Efficiency and Time Reduction

   The E-KSPR significantly reduced documentation time compared to the conventional method ($p = 0.001$). In a single-visit ANC context, time efficiency is critical for optimizing provider-patient interaction. Digital systems reduce cognitive load by automating risk calculation and classification, consistent with evidence that telehealth tools can improve clinical workflow efficiency and reduce documentation burden (Golinelli et al., 2020; Kruse et al., 2018).

Because timing was measured from data entry initiation to final classification generation under standardized conditions, the reduction observed reflects system efficiency rather than differences in clinical examination processes.

3. Improvement in ANC Quality Indicators

The significantly higher ANC quality scores observed with E-KSPR ($p = 0.001$) suggest that structured digital data entry may improve completeness and consistency of documentation. The ANC quality checklist used in this study was based on national standards and evaluated examination completeness, follow-up planning, and documentation consistency.

Digital health systems have been associated with improved adherence to standardized clinical pathways due to mandatory input fields and automated prompts (Salleh et al., 2021). In this within-subject design, the improved quality scores likely reflect structured digital documentation rather than differences in clinical care delivered during the visit.

Importantly, since both assessments were conducted during the same visit and based on identical examination findings, the quality improvement observed reflects documentation and system-level performance rather than variation in patient care.

Research Contribution

This study contributes to the advancement of digital maternal health research in several important respects. First, by employing a within-subject repeated assessment design in a single clinical encounter, the study enables a direct method-to-method comparison, thereby isolating the effect of the assessment modality itself and strengthening causal inference regarding system effectiveness. Second, the evaluation framework extends beyond statistical agreement (Cohen's κ) to incorporate scoring performance, time efficiency, and structured antenatal care (ANC) quality indicators, offering a multidimensional and more comprehensive approach to assessing digital screening tools. Third, while prior digital maternal health research has largely focused on tertiary care settings or remote monitoring contexts, such as those reported by (Aziz et al., 2020; DeNicola et al., 2020), this study provides empirical evidence from routine primary healthcare ANC services, thereby enhancing its relevance for scalability within frontline maternal care systems. Finally, by demonstrating almost perfect agreement between the conventional KSPR and its digital adaptation, the findings support the reliability of digitizing established standardized risk assessment instruments without compromising classification accuracy or clinical integrity.

Limitations

Several limitations should be acknowledged in accordance with the study design. First, pregnancy risk assessment was conducted during a single antenatal care (ANC) visit for each participant, whereas pregnancy risk is inherently dynamic and may vary across trimesters; consequently, the longitudinal effectiveness and responsiveness of the E-KSPR system were not evaluated. Second, the assessments were performed by trained observers under controlled conditions, which may limit generalizability to routine clinical practice, where variations in digital literacy, provider workload, and infrastructure availability could potentially influence real-world implementation and overall system effectiveness.

Suggestions

Future research should address the identified limitations by conducting longitudinal studies across multiple antenatal visits to evaluate the responsiveness of E-KSPR to dynamic changes in pregnancy risk throughout gestation. Additionally, pragmatic implementation studies in routine clinical settings are necessary to assess real-world effectiveness, considering variations in provider digital literacy, workload, and infrastructure readiness.

CONCLUSION

This study indicates that E-KSPR Telemedicine is a feasible digital adaptation of the conventional Poedji Rochjati Score Card (KSPR) for pregnancy risk assessment in primary healthcare settings. Using a within-subject single-visit design, the findings show almost perfect agreement with the conventional method in risk classification, while higher median risk scores suggest greater sensitivity in capturing documented maternal risk factors within the same antenatal visit.

The use of E-KSPR Telemedicine was associated with shorter assessment time and higher antenatal care (ANC) quality scores, suggesting improved efficiency and more complete documentation at the process level. Given the observational nature of this study, these findings should be interpreted as indicative of workflow and documentation improvements rather than definitive evidence of superior clinical decision-making or outcomes.

Further longitudinal and multi-visit studies are needed to evaluate the sustained performance, scalability, and clinical impact of E-KSPR Telemedicine on maternal and neonatal outcomes.

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AUTHOR CONTRIBUTION STATEMENT

EAP and RI were responsible for obtaining ethical clearance, preparing the ANC quality checklist, and entering the research data into the data processing application.

AI DISCLOSURE STATEMENT

The author declares that this research was designed, conducted, analyzed, written, and edited entirely without the use of Artificial Intelligence (AI) tools or techniques. The author takes full responsibility for the content of this publication.

CONFLICTS OF INTERES

The author declares that there are no conflicts of interest that could have influenced the conduct of this study, the data analysis, the preparation of the manuscript, or its publication.

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