

Original Article

The Paradox of AI Readiness in Digital Maternal Health Interventions in Abuja, Nigeria

Uchenna P. Ogoke¹, Chibuikem C. Nwagwu², Ethelbert C. Nduka¹, Promise G. Philip³, Ifeoma Ofurum¹, Daniel Ekpah¹, Preye O. Fiebai¹, Bala Shehu⁴, Afolabi O. Adedamola⁵, Bridget C. Anyanwu¹

¹ University of Port Harcourt, Port Harcourt, Nigeria

² SINTEF Industry, Trondheim, Norway

³ University of Silesia, Katowice, Poland

⁴ Bayero University, Kano, Nigeria

⁵ The Polytechnic Ibadan, Nigeria

✉ **Correspondence:** Uchenna P. Ogoke, uchenna.ogoke@uniport.edu.ng

Received: 01 January 2026

Revised: 12 January 2026

Accepted: 03 March 2026

Published: 30 March 2026

HOW TO CITE

Uchenna P. Ogoke et al. 2026. The Paradox of AI Readiness in Digital Maternal Health Interventions in Abuja, Nigeria. *Journal of Health, Wellness and Community Research*. 4, 6 (Mar. 2026), 1–23. DOI:<https://doi.org/10.61919/m21hgm57>

ARTICLE INFORMATION

Author Contributions	Concept: UPO, IO; Design: UPO, CCN, IO; Data Collection: UPO, ECN, POF, DE, BS, AOA, BCA; Analysis: UPO, CCN, ECN; Drafting: UPO, CCN, PGP, IO.
Ethical Approval	Ethical approvals were obtained from the University of Port Harcourt Ethics Committee (UPH/R&D/REC/EXEC/124) and the Federal Capital Territory Health Research Ethics Committee (FHREC/2026/01/35/24-02-2026)
Informed Consent	Written informed consent was obtained from all participants
Conflict of Interest	The authors declare no conflict of interest.
Funding	The project was funded under the 2024 Tertiary Education Trust Fund National Research Fund (NRF) Intervention, grant number TETF/ES/DR&D-CE/NRF2024/SETI/HSW/00394/VOLI.
Data Availability	Available from the corresponding author on reasonable request.
AI Declaration	No generative AI was used for conceptualization, analysis, or content generation. AI use was limited to language refinement, and the authors remain fully responsible for the accuracy, originality, validity, and integrity of the manuscript's content.

ABSTRACT

Background: Artificial intelligence (AI)-supported digital health applications may offer opportunities to support maternal psychological well-being, but their successful implementation requires an understanding of intended users' technology experiences, anticipated willingness, and perceptions of health data governance. Evidence concerning these factors among pregnant women attending different healthcare settings in Nigeria remains limited. **Objective:** To examine previous digital health technology use, stated willingness to use a hypothetical AI-supported application for managing pregnancy-related stress and worries, and perceived data privacy concerns among pregnant women attending primary and secondary healthcare facilities in Abuja, Nigeria. **Methods:** An exploratory cross-sectional pilot study included 40 pregnant women recruited through non-probability sampling from a primary healthcare centre (n = 20) and a secondary healthcare centre (n = 20). Data were collected using an electronically administered questionnaire through KoboCollect. Participant characteristics, previous technology use, anticipated AI application use, and perceptions of data security and personal health data control were assessed. Descriptive statistics and exploratory between-group comparisons were conducted, with exact tests applied to categorical data. **Results:** Overall, 34 participants (85.0%) owned an internet-enabled mobile phone, but only seven (17.5%) reported previous use of digital technologies for pregnancy-related health monitoring. When asked about a hypothetical AI-supported application operating safely and privately, 39 participants (97.5%) expressed positive willingness to use it. Among seven previous technology users, privacy/security concerns were reported by all three primary-care users and one of four secondary-care users; the difference was not statistically significant (Fisher's exact p = 0.143). In the full sample, 65.0% of primary-care attendees and 15.0% of secondary-care attendees were very concerned about personal control over health information, with a difference in the overall three-category response distribution (p = 0.0058). Very high comfort with proposed anonymized data use was reported for medical services (85.0%), academic research (92.5%), and health technology product development (95.0%). **Conclusion:** Pregnant women in this exploratory sample expressed high conditional willingness to consider AI-supported maternal health applications, alongside distinct concerns about personal health data governance. The findings support further patient-centered research but do not establish actual AI adoption or clinical effectiveness. Larger multicentre studies using validated instruments and practical application assessments are warranted. **Keywords:** Artificial intelligence; maternal health; antenatal care; digital health; technology acceptance; data privacy; health data governance; Nigeria.

INTRODUCTION

1.1. Maternal Health, Psychological Distress, and the Need for Integrated Care

Maternal health remains a major global public health priority, particularly in low- and middle-income countries (LMICs), where preventable pregnancy-related morbidity and mortality continue to impose a substantial burden. The World Health Organization (WHO) estimates that more than 700 women died each day in 2023 from preventable causes related to pregnancy and childbirth, highlighting persistent inequalities in access to timely, comprehensive, and high-quality maternal healthcare (1). Nigeria contributes substantially to this burden; estimates for 2020 attributed approximately 28.5% of global maternal deaths to the country, underscoring the need for contextually appropriate approaches to improving maternal healthcare delivery, continuity, and access (2). Although emergency obstetric conditions remain central priorities, comprehensive maternal healthcare must also address psychological well-being, which contributes to women's experiences of pregnancy, engagement with healthcare, and overall quality of life.

Pregnancy involves substantial physiological, psychological, and social changes that may increase vulnerability to emotional distress, including pregnancy-related worries, perceived stress, anxiety, and depressive symptoms. These experiences are clinically distinct and should not be treated as interchangeable conditions. Nevertheless, psychological distress during pregnancy deserves systematic attention because maternal stress has been associated with adverse maternal and neonatal outcomes, although the magnitude and direction of these associations vary according to the outcomes studied and the methods used to assess stress (3). A systematic review and meta-analysis by Missler and colleagues found that preventive psychological interventions delivered during pregnancy could reduce maternal distress, particularly depressive symptoms. The evidence regarding anxiety and stress was more limited, emphasizing the importance of identifying psychological needs and providing appropriate, evidence-based support rather than assuming that any single intervention addresses all dimensions of maternal distress (4).

Integrating psychological assessment and support into routine antenatal care provides an opportunity to identify concerns earlier and improve continuity between pregnancy-related physical and mental healthcare. The WHO guide for integrating perinatal mental health into maternal and child health services recommends culturally appropriate, respectful, and non-stigmatizing approaches to identifying and responding to mental health needs (5). In LMICs, however, implementation is affected by workforce shortages, competing clinical priorities, insufficient specialist resources, and limitations in service organization. Manolova and colleagues emphasized that successful integration requires coordinated service delivery, appropriately trained personnel, and implementation strategies adapted to local health-system capacity (6).

These challenges create a rationale for investigating complementary approaches that could support the identification and monitoring of maternal psychological concerns within existing antenatal services. Digital technologies may facilitate the collection of patient-reported information, provide accessible educational resources, and support communication between pregnant women and healthcare professionals. Their value, however, depends on the accessibility, reliability, acceptability, and clinical appropriateness of the particular application. Digital screening should therefore be considered a potential component of integrated maternal healthcare rather than a replacement for professional assessment or established referral pathways (5,6).

1.2. Digital Health and Artificial Intelligence in Maternal Healthcare

Digital health encompasses a range of technologies used to support health information management, service delivery, monitoring, communication, and clinical decision-making. Within maternal healthcare, mobile applications, electronic questionnaires, remote monitoring systems, and artificial intelligence (AI)-assisted approaches have attracted attention because of their potential to extend healthcare support beyond conventional clinical encounters. A systematic review by Lin and colleagues documented emerging applications of AI-augmented clinical decision-support systems in pregnancy care, highlighting their potential clinical functions while also demonstrating the importance of rigorous evaluation, implementation research, and appropriate integration into healthcare workflows (7).

AI-based approaches have also been investigated for the identification and prediction of perinatal mental health conditions. In a scoping review, Alkhateeb and colleagues mapped the application of machine learning, deep

learning, and related AI techniques for the detection and prediction of postpartum depression. Their findings demonstrated growing research interest while identifying variation in data sources, model development, and validation practices (8). Importantly, predictive performance or technical feasibility does not establish that an AI system is acceptable to pregnant women, clinically effective, equitable, or suitable for implementation in resource-constrained settings. These dimensions require separate investigation.

Furthermore, the availability of AI-generated health information introduces concerns about reliability, clinical accuracy, and the appropriateness of automated responses to sensitive mental health questions. Sezgin and colleagues evaluated responses generated by large language models to postpartum depression questions, illustrating the need for systematic assessment of AI-supported health communication rather than assuming that automatically generated advice is clinically dependable (9). Consequently, AI-supported maternal health applications should be evaluated not only according to technical capabilities but also according to their intended clinical use, user comprehension, potential harms, and relationship with professional care.

In Nigeria, digital health development has progressed through mobile health applications, telehealth services, electronic health information systems, and emerging AI-related initiatives. A scoping review by Oke and Sibomana identified increasing research activity across these technologies, while also documenting challenges concerning infrastructure, interoperability, implementation, and the broader integration of digital innovations within the healthcare system (10). These considerations are particularly relevant in antenatal services, where technological solutions must accommodate differences in access to devices, internet connectivity, digital familiarity, and healthcare resources.

Nigeria's implementation of the District Health Information System, version 2 (DHIS2), provides an established example of digital transformation within its public health infrastructure. Introduced as part of the national health management information system in 2010, DHIS2 subsequently supported the development of routine immunization reporting and monitoring functions. Shuaib and colleagues described its implementation in Nigeria and highlighted the importance of coordinated governance, reporting infrastructure, data quality, and sustained institutional capacity (11). Although this experience demonstrates the feasibility of implementing digital health information systems, population-level reporting infrastructure differs fundamentally from individual-facing AI applications, particularly those intended to process sensitive psychological and reproductive health information.

Therefore, extending digital innovation into maternal mental health requires attention to factors beyond technical functionality. In particular, differences between primary and secondary healthcare settings may influence women's experiences of digital health technologies through variation in available resources, previous technology exposure, and service characteristics. Comparing women receiving antenatal care at different healthcare levels may offer preliminary insight into whether perceived acceptability and ethical concerns warrant further investigation across these contexts.

1.3. Ethical Governance, Data Privacy, and AI Acceptability

The potential benefits of AI in maternal healthcare are accompanied by significant ethical responsibilities. Digital applications designed to assess pregnancy-related worries or psychological distress may collect information concerning mental health, reproductive experiences, personal circumstances, and other sensitive health indicators. Inappropriate collection, storage, access, disclosure, or secondary use of such information may create privacy risks and undermine trust in digital healthcare services.

The African Union's Continental Artificial Intelligence Strategy, endorsed in 2024, emphasizes an Africa-centered approach to AI development that incorporates ethical governance, inclusion, responsible innovation, and the protection of human interests (12). Similarly, the WHO's guidance on ethics and governance of AI for health identifies transparency, accountability, protection of autonomy, inclusiveness, and responsible data management as essential considerations in developing and deploying AI-supported health technologies (13). These frameworks indicate that technical innovation and ethical governance are complementary requirements rather than competing objectives.

Data security and data control represent related but distinguishable dimensions of information privacy. Data security concerns the protection of information against unauthorized access, disclosure, alteration, or loss. Data control concerns individuals' understanding of, and influence over, how their information is collected, stored,

shared, retained, and reused. In digital maternal healthcare, these concerns may be especially consequential because the information involved can be personal, stigmatizing, or sensitive. Security mechanisms alone may be insufficient to establish trust unless users also understand the purposes of processing, the identities of data recipients, and the extent of their control over subsequent data use (13).

Technology acceptance frameworks provide a complementary perspective on these implementation challenges. The Technology Acceptance Model (TAM) identifies perceived usefulness and perceived ease of use as important determinants of technology acceptance (14). The Unified Theory of Acceptance and Use of Technology (UTAUT) extends this perspective by incorporating performance expectancy, effort expectancy, social influence, and facilitating conditions as determinants of behavioral intention and technology use (15). These frameworks offer useful conceptual foundations for exploring women's attitudes toward emerging digital health applications. However, willingness to use a hypothetical application should not be interpreted as evidence of actual adoption, technical competence, or demonstrated implementation readiness.

A particularly important question is whether interest in AI-supported maternal health services can coexist with concerns about privacy, security, or control over personal information. Such attitudes are not necessarily contradictory: individuals may perceive substantial potential benefits from a healthcare application while remaining uncertain about how their information will be protected. Understanding these different perceptions is important when designing patient-centered consent processes, communication strategies, and digital health governance arrangements (12–15).

1.4. Research Gap, Rationale, and Study Objectives

Despite advances in digital maternal healthcare and growing research on AI-assisted clinical applications, an important distinction remains between the technological feasibility of AI systems and the perspectives of the women expected to use them. Existing evidence addresses digital health implementation, AI-supported pregnancy care, and the technical development of perinatal mental health applications (7–10). However, these findings do not directly establish how pregnant women attending different levels of antenatal healthcare in Abuja perceive a hypothetical AI-supported application for managing pregnancy-related worries, particularly in relation to data security and control over personal health information.

Understanding these perceptions is relevant to the early design and feasibility assessment of digital maternal health interventions. Primary and secondary healthcare facilities serve different clinical and organizational functions, and exploring the experiences of their attendees may help identify questions requiring more comprehensive investigation. At an exploratory stage, the emphasis should be on describing current digital health engagement, assessing stated willingness to consider an AI-supported application, and identifying potential ethical concerns rather than establishing the effectiveness, diagnostic accuracy, or real-world adoption of a particular AI system.

Accordingly, this exploratory cross-sectional pilot study aimed to assess current pregnancy-related digital health technology use, stated willingness to use a hypothetical AI-supported application for managing pregnancy-related stress and worries, and perceived data privacy concerns among pregnant women attending primary and secondary healthcare facilities in Abuja, Nigeria.

2. MATERIALS AND METHODS

2.1. Study Design and Setting

This study employed an exploratory, facility-based, cross-sectional pilot design to investigate pregnant women's use of digital health technologies, stated acceptability of hypothetical AI-supported maternal health applications, and perceptions of data privacy and control. A comparative approach was adopted to examine differences between women attending primary and secondary healthcare facilities.

The study was conducted in Abuja, Federal Capital Territory (FCT), Nigeria, among pregnant women receiving routine antenatal care (ANC) at one primary healthcare centre (PHC) and one secondary healthcare centre (SHC). The two healthcare levels were selected to enable an exploratory comparison of participants receiving antenatal

services within different organizational and clinical settings. The healthcare facility was treated as the principal grouping variable, with participants classified as PHC or SHC attendees.

The investigation focused on self-reported technology use, perceptions, and hypothetical willingness to use an AI-supported mobile application. It did not involve the clinical implementation of an AI system, assessment of an AI model's diagnostic performance, or measurement of actual application adoption following deployment. The cross-sectional design permitted characterization of participant responses and exploratory comparisons between facility groups but did not establish temporal or causal relationships.

2.2. Study Population and Eligibility Criteria

The source population comprised pregnant women registered for antenatal care and attending routine clinic sessions at the participating healthcare facilities. The sampling framework targeted women of reproductive age within an initially described age range of 15–45 years; however, study eligibility was restricted to adults aged 18 years or older.

Participants were eligible when they fulfilled the following criteria:

1. Aged 18 years or older.
2. Had a clinically confirmed pregnancy.
3. Were registered for and attending routine antenatal care at one of the participating facilities.
4. Personally owned, or had regular access to, a functioning mobile phone.
5. Were able to provide informed consent, including written or appropriately witnessed consent when necessary.

Pregnant women experiencing an acute medical or obstetric emergency at the time of recruitment were excluded to avoid interference with necessary clinical care. Individuals unable to provide valid informed consent because of cognitive or other relevant limitations were also excluded.

The mobile-phone access criterion ensured that participants had at least a basic opportunity to engage with mobile-based technologies. Nevertheless, mobile-phone access was not equivalent to ownership of an internet-enabled smartphone, previous use of digital health applications, or familiarity with AI-supported technologies. These characteristics were assessed separately through questionnaire items.

2.3. Sampling Strategy and Sample Size

A non-probability, purposive sampling approach incorporating consecutive recruitment of eligible antenatal attendees was adopted. The exploratory sample consisted of 40 pregnant women, with equal allocation across the two healthcare settings: 20 participants from the PHC and 20 from the SHC.

The sample size was determined pragmatically in view of the pilot nature of the investigation, the novelty of its focus on perceptions of AI-supported maternal health applications, and the available research resources. Equal allocation was intended to facilitate preliminary between-facility comparisons rather than produce estimates representative of the wider population of pregnant women in Abuja.

Recruitment continued at each participating facility until the predetermined target of 20 eligible and consenting participants was reached. This approach provided a balanced institutional comparison but did not constitute random or population-probability sampling. Consequently, the sample was intended to generate preliminary descriptive information and identify potential areas for subsequent investigation rather than support definitive population-level estimates or confirmatory hypotheses.

The fixed sample of 40 participants also placed practical limitations on the precision and statistical power of between-group comparisons, particularly for outcomes assessed within small subgroups. Accordingly, the comparative analyses were exploratory in purpose.

2.4. Participant Recruitment and Data Collection Procedures

Recruitment was undertaken by trained research assistants working within the participating antenatal clinics. On scheduled data collection days, pregnant women presenting for routine antenatal care were approached at the clinic registration or waiting areas and assessed against the study's eligibility criteria.

Women meeting the inclusion criteria were invited to participate in the survey. The research assistants provided information about the study and facilitated the informed consent process before questionnaire administration. Where necessary, language support was provided to assist participants in understanding the survey questions and recording their responses.

Data collection was conducted using KoboCollect, an open-source mobile data collection application within the KoboToolbox ecosystem. The electronic questionnaire was administered on mobile devices, with research assistants guiding participants through the response process when required. Responses were recorded electronically and submitted to the designated secure data server.

The digital questionnaire included programmed response-validation rules and mandatory fields for key variables. These controls prevented submission of forms with unanswered mandatory items and were intended to improve data completeness and reduce avoidable entry errors. The resulting analytical dataset was described as containing no missing entries for the mandatory study variables.

Each participant completed a structured questionnaire covering sociodemographic characteristics, previous digital health technology use, interest in AI-supported maternal health applications, and perceptions of personal health data use and privacy.

2.5. Questionnaire Development and Measurement Framework

The questionnaire was organized around three principal domains: sociodemographic and technology-use characteristics, acceptability of AI-supported maternal health applications, and ethical concerns relating to data security, control, and secondary use.

Its conceptual development drew on principles from the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), particularly their emphasis on perceived usefulness, ease of use, behavioral intention, and contextual conditions affecting technology adoption (14,15).

These frameworks were used to inform the conceptual organization of survey questions. The analysis presented individual questionnaire responses rather than a comprehensive assessment of all TAM or UTAUT constructs. Individual survey items were therefore interpreted as descriptive measures of participants' reported attitudes and perceptions.

2.5.1. Sociodemographic and Reproductive Characteristics

The first questionnaire domain collected information on participant characteristics, including age, educational attainment, employment status, healthcare facility type, gestational age, and previous childbirth experience.

Age was recorded as a continuous variable and also categorized into age groups for descriptive comparison. Education was categorized according to reported educational attainment, including no formal education, primary education, secondary education, and tertiary education. Additional information was collected regarding the type of tertiary qualification where applicable.

Employment status was categorized as unemployed, self-employed, or employed. Previous childbirth experience was assessed through the reported number of children or previous births, with numerical and grouped descriptions used in the analysis.

Participants were also asked whether they owned an internet-enabled mobile phone. This variable was examined separately from the broader eligibility requirement of personal ownership of, or regular access to, a functioning mobile phone.

2.5.2. Current Use of Digital Health Technologies

Current engagement with digital health technologies was investigated by asking participants whether they had ever used a mobile application or digital device to monitor their health during pregnancy.

Participants reporting previous use were asked about the types of technologies used, including pregnancy-tracking mobile applications, wearable devices, online forums or groups, and other specified technologies. The questionnaire permitted multiple responses for technology type.

Additional questions assessed the frequency of use, categorized as daily, weekly, monthly, or every few months, and perceived comfort with using mobile technologies for health-related purposes.

Participants were also asked about concerns that might limit the use of mobile applications or wearable devices for pregnancy-related stress management. Response options included privacy and data security, costs associated with devices or internet connectivity, difficulty using technology, and absence of concerns.

Questions relating to technology type, frequency of use, comfort, and technology-related concerns were presented in the study's results for the subgroup reporting previous use of mobile applications or digital devices for pregnancy-related health monitoring ($n = 7$).

Accordingly, the denominators for these subgroup-specific questions differed from the full study population of 40 participants. Multiple-response questions were interpreted according to the relevant subgroup denominator rather than as mutually exclusive categories.

2.5.3. Acceptability of AI-Supported Maternal Health Applications

Acceptability was evaluated through questionnaire items concerning participants' interest in, and willingness to consider, mobile technologies incorporating AI functions for the management of pregnancy-related stress and worries.

The survey measurement framework included a four-point Likert-type agreement format, ranging from strongly disagree to strongly agree, for assessing attitudes toward AI-supported maternal health technology.

The acceptability outcome presented in the results was based on a hypothetical scenario asking participants how likely they would be to use an AI-driven mobile application if it could help manage pregnancy-related stress safely and privately. Responses were tabulated as very likely, likely, or unlikely.

This question was administered as an assessment of anticipated willingness to use a proposed technology rather than as an observation of actual application use. The explicit condition that the application would operate safely and privately formed part of the hypothetical scenario and was therefore integral to interpretation of the resulting responses.

The acceptability analysis included participants from both healthcare facility groups ($N = 40$). Reported willingness was examined descriptively and compared according to facility type.

2.5.4. Perceived Data Security and Privacy Concerns

The questionnaire assessed concerns relating to the potential use of digital health technologies for monitoring pregnancy-related stress and psychological well-being.

Data security was conceptualized as concern about unauthorized access to personal information, possible data breaches, and the possibility that sensitive health information could become accessible to unintended third parties.

For the subgroup of participants who had previously used mobile health applications or devices, privacy and data security concerns were assessed as a potential barrier to using digital technologies for stress management. This item was included among multiple-response questions and was analyzed using the subgroup denominator of seven participants.

These concerns were distinguished from the broader assessment of personal control over health data, which was administered to the full study sample.

2.5.5. Perceived Control Over Personal Health Information

Perceived data control was assessed by asking participants how concerned they were about the extent of control they had over the use of information concerning their health.

The question addressed concerns associated with data ownership, uncertainty regarding storage and subsequent processing, and limited personal influence over how health information might be accessed or used.

Responses were categorized as not at all concerned, somewhat concerned, or very concerned. This variable was assessed among all 40 participants and compared descriptively between PHC and SHC attendees.

Data control was treated as a separate domain from concern about technical data security, recognizing that participants may distinguish unauthorized access risks from uncertainty regarding legitimate data processing, secondary use, and individual autonomy.

2.5.6. Attitudes Toward Sharing Health Data

The questionnaire additionally explored participants' concerns about sharing physical health information with healthcare professionals through mobile applications and their comfort with different potential uses of anonymized health information.

Participants were asked about sharing physiological and activity-related data, including pulse rate, respiratory rate, blood pressure, temperature, and physical activity information, with healthcare professionals through mobile applications. Concern was categorized as not at all concerned, somewhat concerned, or very concerned.

Three further questions assessed participants' comfort with the proposed use of anonymized health data for distinct purposes:

1. Supporting the identification of stress-related health risks and informing the provision of medical services.
2. Supporting academic or university-based research on women's health and pregnancy-related stress.
3. Supporting health technology companies in developing tailored healthcare products.

Responses were categorized as not comfortable, somewhat comfortable, or very comfortable.

These questions permitted comparison of attitudes toward different anticipated recipients and uses of health information. The assessment concerned participants' expressed comfort with hypothetical data-sharing arrangements and did not involve the experimental disclosure of their health information to these recipient groups.

2.6. Data Quality Management

The electronic data collection process incorporated mandatory responses and programmed validation rules to reduce incomplete questionnaire submissions. Research assistants supported survey administration and provided language assistance when required.

Questionnaire data were collected directly through KoboCollect, reducing the need for subsequent transcription from paper forms. Each submitted record was associated with a randomly generated alphanumeric participant identification code.

Before statistical analysis, the dataset was screened and cleaned using R statistical software. Data completeness was assessed for the mandatory questionnaire variables, and the analyzed dataset was reported as containing no missing values for those variables.

The analysis distinguished between questions administered to the complete study sample and questions restricted to participants reporting previous use of pregnancy-related digital health technologies. This distinction was necessary to maintain appropriate denominators and avoid interpreting subgroup percentages as population-wide responses.

2.7. Statistical Analysis

Data were analyzed using R statistical software. The analytical approach combined descriptive statistics with exploratory comparisons between participants attending primary and secondary healthcare facilities.

Continuous variables, including participant age and reported number of children, were summarized using means and standard deviations. Between-group differences in continuous variables were examined using independent-samples t-tests.

Categorical variables were summarized as frequencies and percentages. Comparisons of categorical responses were organized by healthcare facility type, with PHC and SHC participants treated as independent groups.

The statistical approach specified Fisher's exact test for categorical comparisons involving sparse expected cell counts, reflecting the small sample size and the possibility of low-frequency response categories. Categorical comparisons in the reconstructed tables were recalculated from the supplied frequency counts using two-sided Fisher exact tests, including the Fisher-Freeman-Halton extension for response variables with more than two categories.

For questions administered only to participants who previously used pregnancy-related mobile applications or devices had, the analytic denominator was restricted to seven participants, comprising three PHC attendees and four SHC attendees. Full-sample analyses used the respective facility group sizes of 20 participants each.

For multiple-response questions, response frequencies were calculated according to the number of eligible respondents, and percentages were not expected to sum to 100%.

Statistical significance was evaluated using a nominal two-sided threshold of $p < 0.05$. Given the exploratory study design, small sample, and multiple comparisons across questionnaire items, statistical findings were interpreted as preliminary rather than confirmatory evidence of differences between healthcare settings.

2.8. Ethical Approval and Informed Consent

Ethical approval was obtained from the University of Port Harcourt Ethics Committee, Nigeria (Approval No. UPH/R&D/REC/EXEC/124), and the Federal Capital Territory Health Research Ethics Committee (FCT HREC), Nigeria (Approval No. FHREC/2026/01/35/24-02-2026).

The study's ethical procedures were developed with reference to the National Code of Health Research Ethics in Nigeria and the Nigeria Data Protection Act. Participation was subject to informed consent, and the consent process was incorporated into the electronic data collection procedure.

Before proceeding to the questionnaire, participants were presented with a digital informed consent script through KoboCollect. Active confirmation of consent was required before the survey modules could be accessed. The eligibility criteria also accommodated written or appropriately witnessed consent according to participants' circumstances.

Participants experiencing acute obstetric or medical emergencies were excluded from recruitment to prioritize immediate clinical care. Participation was restricted to individuals able to provide valid informed consent.

2.9. Confidentiality, Data Protection, and Data Governance

Data collection procedures were designed to minimize the collection of personally identifiable information. Names, telephone numbers, and clinic registration or file numbers were not collected as study variables.

Participants were assigned randomly generated alphanumeric identification codes to distinguish individual survey records without incorporating direct personal identifiers.

Completed questionnaire data were transmitted to a password-protected cloud server through HTTPS connections. Access to the stored research dataset was restricted to the principal investigator.

The governance framework included restricted dataset access and avoidance of direct personal identifiers during collection. These procedures were intended to support confidentiality and minimize risks associated with unauthorized disclosure of sensitive maternal health information.

Data collected through the study were maintained within the designated electronic research data management environment for analysis and subsequent use within the wider research project.

3. RESULTS

The study included 40 pregnant women attending antenatal care in Abuja, Nigeria, comprising 20 participants recruited from a primary healthcare centre (PHC) and 20 from a secondary healthcare centre (SHC). The mean age of participants was 31.4 years (SD 4.5). Participants attending the SHC were older on average than those attending the PHC (33.2 ± 4.3 versus 29.6 ± 4.0 years; $p = 0.010$). Among the participants, 18 (45.0%) were aged 30–34 years, 14 (35.0%) were younger than 30 years, and eight (20.0%) were aged 35 years or older. The distribution of age categories did not differ significantly between facility groups ($p = 0.160$).

Most participants had completed secondary or tertiary education, with 22 (55.0%) reporting tertiary education and 16 (40.0%) reporting secondary education. Among women with tertiary qualifications, 17 (77.3%) reported bachelor's degree-level or equivalent qualifications, whereas five (22.7%) reported diploma or National Certificate in Education qualifications. Educational attainment was comparable between the two facility groups.

Overall, 34 participants (85.0%) reported owning an internet-enabled mobile phone, including 15 of 20 PHC attendees (75.0%) and 19 of 20 SHC attendees (95.0%). This difference was not statistically significant using Fisher's exact test ($p = 0.182$). Regarding employment, 21 participants (52.5%) were self-employed, seven (17.5%) were employed, and 12 (30.0%) were unemployed. The distribution of employment categories did not differ significantly between the healthcare settings ($p = 0.489$).

Participants reported a mean of 1.7 children (SD 1.5), with corresponding means of 1.4 (SD 1.5) among PHC attendees and 2.0 (SD 1.4) among SHC attendees. Ten participants (25.0%) reported no previous births, whereas 30 (75.0%) reported at least one. Neither the reported mean number of children nor the categorical distribution of previous births showed a statistically significant difference between facility groups. Detailed participant characteristics are presented in Table 1.

Table 1. Sociodemographic and reproductive characteristics of participants by healthcare facility type (N = 40)

Characteristics	Total (N = 40)	PHC (n = 20)	SHC (n = 20)	p-value
Age, years, mean $\pm$ SD	31.4 $\pm$ 4.5	29.6 $\pm$ 4.0	33.2 $\pm$ 4.3	0.010 ^a
Age group, years				0.160 ^b
<30	14 (35.0)	10 (50.0)	4 (20.0)	
30–34	18 (45.0)	7 (35.0)	11 (55.0)	
≥ 35	8 (20.0)	3 (15.0)	5 (25.0)	
Educational attainment				0.748 ^b
No formal education	1 (2.5)	0 (0.0)	1 (5.0)	
Primary	1 (2.5)	0 (0.0)	1 (5.0)	
Secondary	16 (40.0)	9 (45.0)	7 (35.0)	
Tertiary	22 (55.0)	11 (55.0)	11 (55.0)	
Type of tertiary qualification (n = 22)				1.000 ^b
Diploma/NCE	5 (22.7)	3 (27.3)	2 (18.2)	
Bachelor's degree or equivalent	17 (77.3)	8 (72.7)	9 (81.8)	
Owns internet-enabled phone				0.182 ^b
Yes	34 (85.0)	15 (75.0)	19 (95.0)	
No	6 (15.0)	5 (25.0)	1 (5.0)	
Employment status				0.489 ^b
Unemployed	12 (30.0)	6 (30.0)	6 (30.0)	
Self-employed	21 (52.5)	9 (45.0)	12 (60.0)	
Employed	7 (17.5)	5 (25.0)	2 (10.0)	
Number of children, mean $\pm$ SD	1.7 $\pm$ 1.5	1.4 $\pm$ 1.5	2.0 $\pm$ 1.4	0.240 ^a
Number of previous births				0.539 ^b

Characteristics	Total (N = 40)	PHC (n = 20)	SHC (n = 20)	p-value
None	10 (25.0)	7 (35.0)	3 (15.0)	
One	10 (25.0)	5 (25.0)	5 (25.0)	
Two	9 (22.5)	4 (20.0)	5 (25.0)	
Three or more	11 (27.5)	4 (20.0)	7 (35.0)	

Table 1 note. Values are n (%) unless otherwise stated. Percentages are calculated within the relevant column, except tertiary qualification percentages, which use participants with tertiary education as the denominator (n = 22; PHC = 11; SHC = 11). SD, standard deviation; PHC, primary healthcare centre; SHC, secondary healthcare centre; NCE, National Certificate in Education. ^a Independent-samples t-test (reported p-value). ^b Two-sided Fisher exact test, including the Fisher-Freeman-Halton extension for categorical variables with more than two levels; recalculated from the supplied counts. Unadjusted p-values are exploratory.

3.2. Current Use of Digital Health Technologies and Acceptability of AI-Supported Applications

Previous use of digital technologies specifically for monitoring health during pregnancy was reported by seven of the 40 participants (17.5%), comprising three PHC attendees (15.0%) and four SHC attendees (20.0%). The remaining 33 participants (82.5%) had not previously used a mobile application or digital device for pregnancy-related health monitoring. The proportions reporting previous use were comparable between facility groups (Fisher's exact p = 1.000).

Among the seven participants with previous digital health technology experience, online forums or groups were the most frequently reported technology category (5/7; 71.4%), followed by pregnancy-related mobile applications (2/7; 28.6%), wearable devices (1/7; 14.3%), and other technologies (1/7; 14.3%). All three PHC participants in this subgroup reported using online forums or groups, compared with two of four SHC participants (50.0%). Conversely, mobile applications and wearable devices were reported only by SHC attendees within this subgroup. None of the between-facility comparisons for individual technology categories reached the nominal threshold for statistical significance.

Frequency of technology use differed descriptively between the groups. Overall, three of seven participants (42.9%) reported weekly use, two (28.6%) reported daily use, and one participant each (14.3%) reported monthly use or use every few months. Both participants reporting daily use were PHC attendees, whereas all three participants reporting weekly use were SHC attendees. The overall distribution of use frequency did not reach statistical significance in the exact comparison (p = 0.086).

Six of the seven previous technology users (85.7%) reported being very comfortable using mobile technologies for health-related purposes, including all three PHC users and three of four SHC users. The remaining SHC participant reported being somewhat comfortable. The between-facility comparison was not statistically significant (p = 1.000).

Privacy and data security were the most frequently identified concerns among participants with previous digital health technology use, reported by four of seven respondents (57.1%). These included all three PHC technology users (100.0%) and one of four SHC technology users (25.0%). Although the observed difference was 75 percentage points, the corresponding two-sided Fisher's exact test did not demonstrate a statistically significant difference between facility groups (p = 0.143).

High device or internet costs were reported by two participants (28.6%), both attending the SHC. Difficulty using technology and absence of concerns were each reported by one SHC participant (14.3% of the technology-using subgroup). None of these comparisons was statistically significant. The results concerning perceived barriers were based on only seven participants and therefore reflected a limited subgroup of the overall sample.

In contrast to the relatively low proportion reporting previous digital health technology use, most participants expressed willingness to consider a hypothetical AI-supported mobile application for managing pregnancy-related stress and worries, provided that it operated safely and privately.

Of the 40 participants, 27 (67.5%) reported that they would be very likely to use such an application, 12 (30.0%) reported being likely to use it, and one (2.5%) reported being unlikely to use it. Combining the two favorable

response categories, 39 participants (97.5%; 95% exact binomial confidence interval [CI], 86.8%–99.9%) expressed positive anticipated willingness.

Among PHC attendees, 14 (70.0%) reported being very likely and five (25.0%) likely to use the proposed application, whereas one participant (5.0%) was unlikely to use it. Among SHC attendees, 13 (65.0%) reported being very likely and seven (35.0%) likely to use the application; none selected the unlikely category. The three-category response distribution was comparable across healthcare settings ($p = 0.731$).

Detailed results on previous technology use, perceived barriers, and anticipated willingness to use an AI-supported maternal health application are presented in Table 2.

Table 2. Previous digital health technology use, perceived barriers, and anticipated acceptability of an AI-supported maternal health application

Characteristics	Total	PHC	SHC	p-value ^a
Previous use of a mobile app or device for pregnancy-related health monitoring (N = 40)				1.000
Yes	7 (17.5)	3 (15.0)	4 (20.0)	
No	33 (82.5)	17 (85.0)	16 (80.0)	
Type of digital technology used (n = 7) ^b				
Pregnancy-tracking mobile app	2 (28.6)	0 (0.0)	2 (50.0)	0.429
Wearable device	1 (14.3)	0 (0.0)	1 (25.0)	1.000
Online forum or group	5 (71.4)	3 (100.0)	2 (50.0)	0.429
Other technology	1 (14.3)	0 (0.0)	1 (25.0)	1.000
Frequency of technology use (n = 7)				0.086
Daily	2 (28.6)	2 (66.7)	0 (0.0)	
Weekly	3 (42.9)	0 (0.0)	3 (75.0)	
Monthly	1 (14.3)	0 (0.0)	1 (25.0)	
Every few months	1 (14.3)	1 (33.3)	0 (0.0)	
Comfort using mobile technology for health-related purposes (n = 7)				1.000
Very comfortable	6 (85.7)	3 (100.0)	3 (75.0)	
Somewhat comfortable	1 (14.3)	0 (0.0)	1 (25.0)	
Concerns about using technology for stress management (n = 7) ^b				
Privacy and data security	4 (57.1)	3 (100.0)	1 (25.0)	0.143
High cost of devices or internet	2 (28.6)	0 (0.0)	2 (50.0)	0.429
Difficulty using technology	1 (14.3)	0 (0.0)	1 (25.0)	1.000
No concerns	1 (14.3)	0 (0.0)	1 (25.0)	1.000
Likelihood of using a hypothetical AI-supported application, assuming safe and private operation (N = 40)				0.731
Very likely	27 (67.5)	14 (70.0)	13 (65.0)	
Likely	12 (30.0)	5 (25.0)	7 (35.0)	
Unlikely	1 (2.5)	1 (5.0)	0 (0.0)	
Derived favorable willingness: very likely or likely	39 (97.5)	19 (95.0)	20 (100.0)	—

Table 2 note. Data are presented as n (%). For questions administered to the complete sample, denominators were N = 40, PHC = 20, and SHC = 20. For questions restricted to previous digital health technology users, denominators were n = 7, PHC = 3, and SHC = 4. ^a Two-sided Fisher exact tests were recalculated from the supplied categorical counts; the Fisher–Freeman–Halton extension was used for variables with more than two categories. ^b Multiple responses were permitted; individual response categories were tested separately against nonelection of that category. Percentages may exceed 100% when summed. The favorable-willingness row is derived from the two positive categories immediately above it and is not an additional questionnaire response. Tests were unadjusted and exploratory. AI, artificial intelligence; PHC, primary healthcare centre; SHC, secondary healthcare centre.

3.3. Perceptions of Health Data Control, Privacy, and Data Sharing

3.3.1. Concern About Personal Control Over Health Information

Participants expressed varying levels of concern regarding their ability to control how personal health information might be used. Among all 40 respondents, 16 (40.0%) reported being very concerned, eight (20.0%) somewhat concerned, and 16 (40.0%) not at all concerned.

The distribution differed between healthcare settings. Among PHC attendees, 13 of 20 (65.0%) reported being very concerned about data control, three (15.0%) somewhat concerned, and four (20.0%) not at all concerned. In contrast, among SHC attendees, three of 20 (15.0%) were very concerned, five (25.0%) somewhat concerned, and 12 (60.0%) not at all concerned.

Combining the somewhat and very concerned categories, 16 PHC participants (80.0%) and eight SHC participants (40.0%) expressed at least some concern about personal control over health information. The overall three-category distribution differed significantly between the healthcare groups under the two-sided Fisher-Freeman-Halton exact test ($p = 0.0058$). The proportion reporting very high concern was 50 percentage points greater in the PHC group than in the SHC group (65.0% versus 15.0%; 95% CI for the difference, 19.8–69.5 percentage points).

3.3.2. Concerns About Sharing Physiological and Activity Data

Concern about sharing physiological and activity-related information with healthcare professionals through a mobile application was common. Overall, 28 participants (70.0%) reported being very concerned, two (5.0%) somewhat concerned, and 10 (25.0%) not at all concerned.

Very high concern was reported by 16 of 20 PHC participants (80.0%) and 12 of 20 SHC participants (60.0%). Conversely, three PHC participants (15.0%) and seven SHC participants (35.0%) reported no concern. The distribution of response categories did not demonstrate a statistically significant difference between facility groups ($p = 0.366$).

3.3.3. Acceptability of Anonymized Health Data Use for Medical Services

Participants were asked about their comfort with the proposed use of anonymized health information to assess risks of stress-related illness and support the provision of medical services.

Overall, 34 respondents (85.0%) reported being very comfortable, three (7.5%) somewhat comfortable, and three (7.5%) not comfortable. Very high comfort was reported by 18 PHC participants (90.0%) and 16 SHC participants (80.0%).

The distributions of comfort levels were similar between the healthcare groups, with no statistically significant difference ($p = 0.695$).

3.3.4. Acceptability of Anonymized Health Data Use for Academic Research

Participants also expressed high levels of comfort with the hypothetical use of anonymized health information by universities for research on women's health and pregnancy-related stress.

Of the 40 participants, 37 (92.5%) reported being very comfortable, two (5.0%) somewhat comfortable, and one (2.5%) not comfortable.

Very high comfort was reported by 19 PHC attendees (95.0%) and 18 SHC attendees (90.0%). The response distributions did not differ significantly between healthcare groups ($p = 1.000$).

3.3.5. Acceptability of Anonymized Health Data Use by Health Technology Companies

When asked about the proposed use of anonymized health information by health technology companies to develop tailored healthcare products, 38 participants (95.0%) reported being very comfortable and two (5.0%) somewhat comfortable. No participant selected the not comfortable response.

The response distribution was identical across the two facility groups, with 19 participants (95.0%) in each group reporting being very comfortable and one participant (5.0%) reporting being somewhat comfortable ($p = 1.000$).

Taken together, responses across the data-sharing questions showed that substantial concern about personal health data control and the transmission of physiological information coexisted with high stated comfort regarding specific hypothetical uses of anonymized data. The detailed distributions are presented in Table 3.

Table 3. Perceptions of personal health data control and hypothetical data-sharing arrangements by healthcare facility type (N = 40)

Characteristics	Total (N = 40)	PHC (n = 20)	SHC (n = 20)	p-value ^a
Concern about personal control over health data				0.0058
Not at all concerned	16 (40.0)	4 (20.0)	12 (60.0)	
Somewhat concerned	8 (20.0)	3 (15.0)	5 (25.0)	
Very concerned	16 (40.0)	13 (65.0)	3 (15.0)	
Concern about sharing physiological and activity data with healthcare professionals through an app				0.366
Not at all concerned	10 (25.0)	3 (15.0)	7 (35.0)	
Somewhat concerned	2 (5.0)	1 (5.0)	1 (5.0)	
Very concerned	28 (70.0)	16 (80.0)	12 (60.0)	
Comfort with anonymized data use to assess health risks and inform medical services				0.695
Not comfortable	3 (7.5)	1 (5.0)	2 (10.0)	
Somewhat comfortable	3 (7.5)	1 (5.0)	2 (10.0)	
Very comfortable	34 (85.0)	18 (90.0)	16 (80.0)	
Comfort with anonymized data use by universities for maternal health research				1.000
Not comfortable	1 (2.5)	0 (0.0)	1 (5.0)	
Somewhat comfortable	2 (5.0)	1 (5.0)	1 (5.0)	
Very comfortable	37 (92.5)	19 (95.0)	18 (90.0)	
Comfort with anonymized data use by health technology companies for tailored product development				1.000
Somewhat comfortable	2 (5.0)	1 (5.0)	1 (5.0)	
Very comfortable	38 (95.0)	19 (95.0)	19 (95.0)	

Table 3 note. Values are n (%), calculated using the total sample or the corresponding facility group denominator. ^a Two-sided Fisher-Freeman-Halton exact tests were recalculated from the supplied categorical counts. The p-value refers to the entire response distribution for each question, not an isolated comparison of individual response categories. All comparisons were unadjusted and exploratory. PHC, primary healthcare centre; SHC, secondary healthcare centre.

4. DISCUSSION

4.1. Principal Findings and Their Significance

This exploratory cross-sectional pilot study investigated digital health technology use, anticipated acceptability of AI-supported maternal health applications, and perceptions of data privacy among pregnant women attending primary and secondary healthcare facilities in Abuja, Nigeria. Three principal observations emerged. First, previous use of mobile applications or digital devices for pregnancy-related health monitoring was relatively uncommon, whereas almost all participants expressed willingness to consider a hypothetical AI-supported application operating under explicitly safe and private conditions. Second, concern about personal control over health information differed between the two facility groups, with greater concern reported among participants attending the primary healthcare centre. Third, participants simultaneously expressed substantial concern about sharing sensitive physiological information and high levels of comfort with several proposed uses of anonymized health data.

These findings suggest that anticipated willingness, previous technology use, and concerns about data governance represent distinct dimensions of digital health acceptability. They also indicate that a favorable response to a proposed AI-supported application does not necessarily imply confidence in every aspect of its operation.

Importantly, the study examined expressed perceptions rather than actual engagement with an implemented AI system. Consequently, its principal contribution lies in identifying preliminary patient-centered considerations for future intervention design rather than establishing real-world AI adoption, effectiveness, or implementation feasibility.

4.2. High Anticipated Willingness Despite Limited Previous Technology Use

A notable finding was the contrast between previous technology use and stated willingness to consider an AI-supported application. Only seven participants (17.5%) reported previous use of a mobile application or digital device for monitoring their health during pregnancy, despite 34 (85.0%) owning an internet-enabled mobile phone. Conversely, 39 participants (97.5%) indicated that they would be likely or very likely to use an AI-supported application designed to assist with pregnancy-related stress and worries, provided that it operated safely and privately.

This contrast is relevant to established technology acceptance frameworks. The Technology Acceptance Model and the Unified Theory of Acceptance and Use of Technology distinguish behavioral intention from realized technology use and emphasize the influence of perceived usefulness, ease of use, facilitating conditions, and social context (14,15). Although the present study did not formally test these theoretical constructs, its findings are consistent with the conceptual distinction between favorable anticipated attitudes and actual engagement with digital technologies. Moreover, the conditional phrasing of the acceptability question is important: participants were asked to consider an application already described as safe and private, potentially reducing the salience of concerns that might arise when evaluating a functioning application with specific data-collection and storage practices.

The findings should also be interpreted within Nigeria's developing digital health landscape. In their scoping review, Oke and Sibomana identified substantial growth in Nigerian digital health research across mobile health, telemedicine, electronic health systems, and other technologies, while noting that practical implementation has not advanced uniformly with research activity (10). The current pilot findings are compatible with this broader implementation challenge, although differences in population, setting, and outcome definitions prevent direct quantitative comparison.

Technology access alone therefore appears insufficient as an indicator of readiness for sustained digital maternal healthcare engagement. Future assessments should examine practical access to compatible devices, affordability of internet connectivity, digital literacy, perceived usefulness, confidence in service providers, and willingness to use an application after receiving realistic information about its functions and data practices. Longitudinal evaluation of actual application use would be necessary to determine whether favorable initial intentions translate into meaningful adoption or continued engagement.

4.3. Healthcare Setting, Technology Access, and Differences Between Participant Groups

The exploration comparison of primary and secondary healthcare attendees revealed differences in selected sociodemographic and technology-related characteristics. Women attending the secondary healthcare centre were older on average than those attending the primary healthcare centre (33.2 versus 29.6 years). Ownership of internet-enabled mobile phones was also descriptively higher among secondary-care attendees (95.0%) than primary-care attendees (75.0%), although this difference did not reach statistical significance under the exact test ($p = 0.182$). Educational attainment and employment categories were broadly similar between groups.

These observations suggest that healthcare setting may be a useful contextual consideration when exploring digital health implementation. However, the study cannot determine whether the observed differences reflect characteristics of the healthcare level, variation between the two individual facilities, or differences in the women attending those facilities. The relatively small sample also limits the precision of the observed contrasts.

Evidence from broader maternal healthcare interventions demonstrates the importance of considering local service delivery conditions when introducing digital or community-based strategies. A systematic review by Akinola and colleagues identified several community- and facility-based approaches associated with improvements in timely antenatal care initiation in sub-Saharan Africa, including mobile communication interventions and organizational improvements (16). Although these findings concern antenatal service utilization

rather than AI-supported psychological screening, they illustrate the potential relevance of embedding appropriate technologies within existing maternal healthcare pathways instead of relying solely on standalone applications.

For AI-supported maternal health applications, implementation strategies may therefore need to accommodate variations in patient access, healthcare staff capacity, local infrastructure, and the extent of support available during initial use. Future multicentre investigations would help determine whether differences observed between healthcare settings remain present when several facilities within each level of care are included.

4.4. Privacy Concerns and Personal Control Over Health Information

Data privacy emerged as an important dimension of participant perceptions, although the findings differed according to the survey question and population assessed. Among the seven participants who had previously used digital technologies for pregnancy-related health monitoring, four reported privacy or data security as a potential concern. All three previous technology users attending the primary healthcare centre identified this concern, compared with one of four attending the secondary healthcare centre. Despite the apparent difference in percentages (100.0% versus 25.0%), the two-sided Fisher's exact test was not statistically significant ($p = 0.143$). This result should therefore be interpreted as an exploratory descriptive pattern rather than evidence of an established between-group difference.

A clear difference emerged from the full-sample assessment of concern regarding personal control over health information. Very high concern was reported by 65.0% of primary-care attendees compared with 15.0% of secondary-care attendees. The overall distribution of responses across the three concern categories differed between the groups ($p = 0.0058$). Nevertheless, this was an unadjusted comparison within a small exploratory study, and the statistical finding does not establish that healthcare level independently predicts concern about data control.

These two measures also capture different aspects of the privacy construct. The technology-related concern question addressed privacy and data security among participants with previous digital health technology experience, whereas the full-sample item assessed perceived control over personal health data. Data security concerns primarily relate to the protection of information against unauthorized access or disclosure, while data control concerns the individual's ability to understand, influence, and authorize the collection, processing, sharing, and subsequent use of personal information. The WHO's ethical guidance for AI in health and the African Union's Continental Artificial Intelligence Strategy emphasize the importance of accountability, individual autonomy, transparency, and responsible data governance within the development and deployment of AI-supported healthcare systems (12,13).

The distinction has practical relevance for maternal healthcare applications. An application may employ technical safeguards yet still generate uncertainty if users do not understand who controls their information, whether data may be transferred to external organizations, or how long records remain accessible. Conversely, participants may be willing to share selected information when the purpose and anticipated benefits are clearly explained. The findings consequently support further investigation into the relative importance of technical security assurances, perceived institutional trustworthiness, and meaningful patient control over secondary data use.

4.5. The Coexistence of Data-Sharing Concerns and Acceptance of Specific Data Uses

Another notable observation was the coexistence of substantial concern about sharing health information with high stated comfort regarding specific proposed uses of anonymized data. Overall, 70.0% of participants were very concerned about sharing physiological and activity-related information through a mobile application. Nevertheless, 85.0% reported being very comfortable with anonymized health data being used to inform medical services, 92.5% with use by universities for maternal health research, and 95.0% with use by health technology companies to develop tailored healthcare products.

Rather than representing a straightforward contradiction, these responses may reflect differences in how participants interpreted the purposes, recipients, and anticipated consequences of health information sharing. The questions addressing medical services, academic research, and product development explicitly referred to anonymized information, whereas the question about sharing physiological measurements focused on transmitting

personal health indicators through an application. The wording therefore differed in ways that may have influenced participants' perceptions of risk.

These findings should not be interpreted as proof of informed acceptance of unrestricted commercial use, cross-border processing, or secondary sharing of maternal health data. Nor do they establish that participants understood the technical distinction between anonymized and identifiable information. Instead, the responses demonstrate favorable hypothetical attitudes toward certain stated uses of anonymized data in the context of the questionnaire.

The African Union's strategy and WHO guidance highlight the need to incorporate responsible governance, transparency, and mechanisms for protecting individual rights into AI development and implementation (12,13). At the regional level, Ngongo and colleagues have emphasized the importance of coordinated digital public health priorities for Africa, reinforcing the policy relevance of aligning technological development with sustainable public health systems (17).

For maternal health applications, these considerations support the provision of understandable privacy notices, clearly defined purposes for data collection, meaningful consent procedures, and transparent communication concerning data recipients and subsequent use. Future research would benefit from presenting participants with realistic data-sharing scenarios to determine whether their stated preferences remain consistent when specific trade-offs, uncertainties, and governance arrangements are explained.

4.6. Implications for Digital Health Infrastructure and Institutional Governance

The findings have implications for the relationship between patient-facing digital applications and established healthcare information systems. Nigeria's experience with DHIS2 demonstrates the importance of coordinated reporting infrastructure, data quality processes, and sustained organizational support for digital health implementation. Shuaib and colleagues documented the implementation of routine immunization reporting functions within Nigeria's DHIS2 infrastructure, illustrating the role of health information governance and standardized reporting procedures in public health service delivery (11).

Experience from other African settings also suggests that technological infrastructure does not automatically translate into effective information use. Kiwanuka and colleagues examined the factors influencing DHIS2 data use in Uganda and identified organizational and implementation conditions associated with differences in data utilization across health system settings (18). Although that investigation concerned health information management rather than AI-assisted maternal mental health applications, it offers a relevant systems-level perspective: data platforms require appropriate institutional arrangements, personnel capacity, and operational support to function effectively.

These considerations caution against assuming that integration with an existing national health information system would, by itself, establish patient trust or provide adequate safeguards for sensitive psychological and reproductive health information. The requirements of individual-level AI-supported screening may differ substantially from those of aggregate public health reporting. Any proposed integration would require a defined clinical purpose, appropriate access permissions, interoperability assessment, consent arrangements, and governance procedures consistent with applicable legal and institutional requirements.

The present findings consequently support a governance-oriented approach to the development of AI-supported maternal health applications. Such an approach should consider not only technical connectivity but also responsibilities for data stewardship, mechanisms for accountability, and the communication of data handling practices to intended users.

4.7. Maternal Mental Health Screening and Patient-Centered Implementation

The potential contribution of AI-supported applications to maternal psychological well-being must be considered within the wider context of integrated perinatal mental healthcare. Digital tools may provide convenient opportunities for repeated symptom reporting, information delivery, or structured communication; however, these functions cannot substitute for clinically appropriate assessment, interpretation, and follow-up. The WHO's guidance for integrating perinatal mental health services emphasizes respectful identification of mental health needs and coordinated responses within maternal and child healthcare systems (5). Manolova and colleagues

similarly argued that effective integration requires appropriate task-sharing, cultural adaptation, workforce preparation, and sustained service capacity (6).

The importance of patient attitudes has also been demonstrated in research on perinatal mental health help-seeking. In a cross-sectional investigation among Chinese perinatal women, Huang and colleagues found that help-seeking intentions were associated with attitudes toward professional psychological support, mental health knowledge, and self-stigma (19). Although that study did not evaluate AI applications or Nigerian participants, it illustrates the broader importance of psychological, informational, and social factors in interpreting expressed intentions to engage with mental healthcare.

Evidence syntheses concerning antenatal screening and non-pharmacological interventions further reinforce the importance of linking identification of psychological concerns with appropriate clinical support. Irianti and colleagues reviewed screening and intervention approaches in antenatal care, including emerging digital methods, and emphasized the integration of screening and healthcare personnel competencies within routine maternal services (20). However, evidence supporting a digital screening approach should not be interpreted as establishing the clinical utility of every AI-enabled application.

AI-related systematic and scoping reviews have documented the expanding use of computational methods in pregnancy care and the detection or prediction of perinatal mental health conditions (7,8). At the same time, evidence on the reliability of AI-generated responses to maternal mental health questions demonstrates that technical outputs require clinical evaluation and safeguards (9). Accordingly, any subsequent development of an AI-supported application informed by the present study would need to distinguish symptom monitoring, screening, risk prediction, and therapeutic support as separate clinical functions, each requiring appropriate evaluation.

Importantly, the current study did not examine an implemented AI tool, measure changes in psychological symptoms, assess diagnostic accuracy, or evaluate maternal or neonatal outcomes. Its results should therefore inform preliminary design and acceptability research, not claims of clinical effectiveness.

4.8. Implications for Future Intervention Development and Research

The findings identify several priorities for future development of AI-supported maternal health technologies in similar healthcare settings. Patient-centered design should address differences between anticipated willingness and practical technology use, while enabling participants to understand the purpose, limitations, and information requirements of proposed applications. The substantial proportion of participants expressing concern about personal data control indicates that transparency regarding health information handling deserves particular attention during early application design.

Privacy communication should distinguish between confidentiality, technical data security, and patient control over legitimate information processing. Consent mechanisms should make clear whether data are used for individual care, research, product development, or combinations of these purposes. These recommendations are consistent with international ethical frameworks promoting transparency, meaningful autonomy, accountable governance, and inclusive AI development (12,13,17).

Future studies should also investigate access-related implementation conditions, including differences in smartphone capabilities, connectivity, affordability, digital literacy, and preferred methods of receiving support. In view of the potential variation between healthcare settings, recruitment across multiple primary and secondary facilities would provide a stronger basis for comparing different service contexts. The broader literature on digital health adoption in Nigeria and antenatal service delivery in sub-Saharan Africa supports the importance of considering local infrastructure and service organization when developing implementation strategies (10,16).

Qualitative interviews, cognitive testing of questionnaire items, and participatory design activities could help clarify why women distinguish between personal data sharing and specific uses of anonymized information. Such approaches would be particularly useful for exploring concepts that were not directly measured in this study, including perceived institutional trustworthiness, understanding of anonymization, experiences of privacy violations, and expectations regarding individual control over health data.

Subsequent research could progress from hypothetical acceptability assessments to structured usability testing, feasibility evaluation of a functioning prototype, and longitudinal observation of actual engagement. If clinical

screening or decision-support functions are introduced, their validity, safety, fairness, and implications for referral and clinical management would require assessment before wider implementation (7–9).

Collectively, these considerations position the present study as an exploratory contribution to understanding patient perspectives during the early conceptual development of AI-supported maternal health applications. Its value lies in identifying questions for more rigorous investigation rather than establishing definitive differences between healthcare settings or demonstrating intervention effectiveness.

5. STRENGTHS AND LIMITATIONS

5.1. Strengths of the Study

This study provides preliminary evidence concerning the intersection of maternal healthcare, emerging AI applications, and perceptions of health data governance among pregnant women in Abuja, Nigeria. A principal strength is its simultaneous examination of three related but conceptually distinct dimensions: previous engagement with digital health technologies, stated willingness to consider a hypothetical AI-supported application, and perceived concerns about health information privacy and control.

The inclusion of participants from primary and secondary healthcare settings permitted an initial comparison of perspectives across two different service contexts. Equal group allocation facilitated the presentation of descriptive differences, while the questionnaire addressed several potential recipients and purposes of sharing health information rather than treating data privacy as a single undifferentiated concern.

The electronic data collection procedure incorporated mandatory response fields and data validation checks, supporting completeness of the collected questionnaire responses. In addition, the study received institutional ethical approvals and incorporated consent procedures and measures intended to protect participant confidentiality. These features provide a foundation for further research, although they do not eliminate the methodological limitations described below.

5.2. Limitations of Study Design, Sample Size, and Generalizability

The primary limitation is the small, non-probability sample of 40 participants, with only 20 women recruited from each healthcare setting. Although this allocation was appropriate for an initial exploration comparison, it limits statistical precision, increases uncertainty around estimated proportions, and reduces the ability to detect modest differences between groups.

The study involved one primary healthcare centre and one secondary healthcare centre. Consequently, healthcare facility and healthcare level were completely confounded: any observed difference between groups could have reflected characteristics of the two individual facilities, differences in their patient populations, or organizational features unrelated to the broader distinction between primary and secondary care. The findings therefore cannot establish systematic differences across healthcare levels in Abuja or Nigeria.

The use of purposive recruitment among women attending routine antenatal services further limits population representativeness. Women who attend antenatal care may differ from those who do not access such services in their socioeconomic circumstances, healthcare engagement, literacy, and technology access. Accordingly, the estimated frequencies should not be interpreted as population prevalence estimates.

An additional source of selection bias arose from the requirement that participants own or have regular access to a functioning mobile phone. This criterion excluded women without such access and potentially reduced the representation of individuals experiencing the greatest barriers to digital healthcare participation. The relatively high proportion of participants with tertiary education (55.0%) and employment or self-employment (70.0%) may also limit the applicability of findings to populations with lower educational attainment or fewer economic resources.

Recruitment-flow information was insufficient to establish the number of women screened, the number meeting eligibility criteria, and the proportion declining participation. Consequently, the magnitude and direction of potential nonresponse bias could not be assessed.

5.3. Limitations of Questionnaire Development and Construct Measurement

The questionnaire was informed conceptually by established technology acceptance models but did not constitute a demonstrated psychometric validation of those frameworks in the study population. In particular, the use of study-specific items to assess AI-related attitudes and privacy concerns limits the ability to interpret individual responses as measurements of a validated, multidimensional construct of AI readiness.

Several outcomes were assessed through individual categorical questions rather than established multi-item instruments with demonstrated reliability, construct validity, and measurement equivalence. Consequently, the findings reflect responses to specific questions rather than standardized scores of technology acceptance, digital literacy, perceived trust, privacy anxiety, or data governance literacy.

The acceptability question also incorporated a hypothetical condition that the proposed AI application would operate safely and privately. This framing may have encouraged favorable responses by assuming the presence of safeguards that had not been evaluated in a functioning application. Accordingly, the very high proportion reporting positive willingness (97.5%) should be understood as conditional anticipated acceptance, not demonstrated readiness for adoption.

The study did not provide participants with an implemented AI application for practical evaluation. Therefore, respondents could not assess actual usability, accuracy, transparency, interaction quality, technical reliability, or the consequences of real-world data processing. Differences in participants' familiarity with AI terminology and expectations of application functionality may also have influenced the interpretation of survey questions.

Furthermore, questions involving anonymized data did not independently assess participants' understanding of anonymization, residual reidentification risks, data ownership, or the distinction between identifiable and identified information. Favorable responses to proposed anonymized data uses therefore cannot establish informed authorization for specific data processing practices.

5.4. Limitations of Data Collection and Response Bias

Questionnaires were administered within antenatal healthcare environments with assistance from trained research personnel. Although this approach facilitated participation, researcher-assisted administration may have introduced interviewer or social desirability bias, particularly for questions concerning willingness to use emerging technologies and approval of health information sharing.

The provision of language support may have improved participants' understanding of survey questions, but variation in the interpretation of technical concepts such as artificial intelligence, data security, anonymity, and personal data control could have affected response comparability.

The electronic questionnaire's mandatory response requirements minimized missing entries but did not ensure that every recorded response accurately represented a participant's preference. Mandatory responses may also increase the risk of being satisfied when participants are uncertain, ambivalent, or unable to select an option that adequately represents their views. Data completeness should therefore be distinguished from measurement accuracy.

The study relied on self-reported previous technology use, and these reports were not independently verified against device records or application usage data. Recall errors or differing interpretations of what constituted a health-monitoring technology could consequently have affected reported frequencies.

5.5. Statistical Limitations and Uncertainty

The small sample created substantial limitations for inferential comparisons, particularly when outcomes contained several response categories or low-frequency observations. These limitations were most pronounced for the analysis of technology-related privacy concerns, which involved only seven previous technology users, comprising three PHC and four SHC participants.

Although the observed percentage difference in privacy concerns between these groups was large, the corrected two-sided Fisher's exact comparison was not statistically significant ($p = 0.143$). Therefore, the data provide insufficient statistical evidence to conclude that previous technology users attending primary healthcare facilities had greater security concerns than those attending secondary healthcare facilities.

The difference in the full-sample distribution of concern about personal control over health data reached nominal statistical significance ($p = 0.0058$). Nevertheless, this finding arose from an exploratory analysis involving multiple questionnaire outcomes and comparisons. No multiplicity-adjusted inferential framework was established, and the p -value should not be interpreted as confirmatory evidence without independent replication.

The two facility groups also differed in mean age, which could have influenced technology perceptions. Other potentially relevant characteristics included educational attainment, employment, previous technology exposure, and internet-enabled phone ownership. The limited sample did not permit sufficiently robust multivariable analysis of these potential confounders. Consequently, the study cannot determine whether facility-group differences persist independently of participant characteristics.

The analysis primarily compared categorical responses between groups and did not establish explanatory mechanisms, causal relationships, or predictors of technology adoption. The absence of longitudinal follow-up further prevents assessment of whether anticipated willingness predicts subsequent use.

5.6. Limitations of Clinical and Implementation Interpretation

The study assessed perceptions of a proposed AI-supported application rather than an implemented digital maternal mental health intervention. No AI screening algorithm, prediction model, or intervention was clinically evaluated.

Accordingly, the investigation provides no direct evidence regarding screening sensitivity or specificity, predictive accuracy, reduction in pregnancy-related stress, improvement in psychological well-being, patient safety, or changes in maternal and neonatal outcomes. It also did not measure implementation outcomes such as sustained usage, adherence, technical feasibility, clinical workflow integration, or cost-effectiveness.

The study did not distinguish systematically between responses related to general pregnancy-related worries, perceived stress, anxiety disorders, or depressive symptoms. Since these represent different psychological constructs and clinical conditions, the findings cannot establish acceptability or effectiveness for screening any particular maternal mental health disorder.

Finally, the investigation did not directly assess participants' previous experiences of data misuse, trust in particular healthcare institutions, preferences regarding national versus international data storage, or detailed knowledge of data protection legislation. Although the responses identify data governance as a relevant consideration, they cannot establish why particular participants were concerned or which specific governance arrangements would increase their willingness to use an application.

Future studies incorporating larger and more representative samples, validated measurement instruments, qualitative exploration, multiple healthcare facilities, and practical evaluation of functioning applications would be required to address these limitations and establish more robust evidence for implementation.

5.7. Measurement and Reporting Constraints

The interpretation of the findings is additionally constrained by uncertainties concerning questionnaire operationalization and analytical reproducibility. The stated four-point measurement framework and the three-category acceptability outcome are not fully reconciled within the available measurement description. Although the categorical comparisons can be reconstructed from the reported frequencies, independent verification of continuous-variable analyses is limited without the original statistical output or deidentified participant-level data. The reporting of recruitment-flow details is incomplete, including numbers screened and declining participation, which prevents adequate assessment of nonresponse bias. Information on questionnaire piloting, cultural adaptation, and psychometric evaluation is also insufficient to assess measurement consistency and construct validity fully, particularly for concepts such as AI acceptability and data privacy. Although ethical approvals and confidentiality safeguards were documented, limited detail about data storage, retention, access authorization, and consent implementation constrains assessment of data governance transparency and reproducibility.

6. CONCLUSION

This exploratory pilot study identified substantial conditional willingness among pregnant women in Abuja to consider an AI-supported mobile application for managing pregnancy-related stress and worries, despite relatively limited previous use of digital health monitoring technologies. Concern about personal control over health information differed between participants attending the primary and secondary healthcare centres, whereas the apparent difference in technology-related privacy and security concerns among previous technology users was not statistically significant under exact testing. Participants also expressed high comfort with several proposed uses of anonymized health data, despite substantial concerns about sharing personal physiological information.

These findings suggest that anticipated AI acceptability and perceptions of data governance are distinct considerations in the early development of digital maternal health interventions. However, the small, non-probability sample, single facility at each healthcare level, hypothetical assessment, and measurement limitations restrict generalizability and preclude conclusions regarding actual adoption or clinical effectiveness. Future research should prioritize validated assessment of user perspectives, participatory application design, transparent data governance, and evaluation of functioning technologies within diverse antenatal healthcare settings.

DECLARATIONS

Data Availability: The data collected and analysed in this study are hosted on KoboCollect's secure cloud server and are available upon request from the corresponding author. The data are not publicly available because this study is part of a larger project that has not yet been finalized.

Ethical Approval: Ethical approvals were obtained from the University of Port Harcourt Ethics Committee (UPH/R&D/REC/EXEC/124) and the Federal Capital Territory Health Research Ethics Committee (FHREC/2026/01/35/24-02-2026), as detailed in the Methods.

Informed Consent: Informed consent was obtained from participants as described in the Methods.

Consent for Publication: All authors consent to publication of the manuscript in its final form.

Funding: The project was funded under the 2024 Tertiary Education Trust Fund National Research Fund (NRF) Intervention, grant number TETF/ES/DR&D-CE/NRF2024/SETI/HSW/00394/VOL.I.

Acknowledgements: The authors thank the technical assistants who supported data collection at the participating hospitals. Their contributions did not meet the criteria for authorship.

AI Declaration: ChatGPT was used to brainstorm the structure and flow during early manuscript drafting, and Grammarly was used to improve grammar and flow. The authors take responsibility for the integrity and accuracy of the final content.

REFERENCES

1. World Health Organization, UNICEF, UNFPA, World Bank Group, UNDESA/Population Division. Trends in maternal mortality estimates 2000 to 2023: estimates by WHO, UNICEF, UNFPA, World Bank Group and UNDESA/Population Division. Geneva: World Health Organization; 2025. Available from: <https://www.who.int/publications/i/item/9789240108462>
2. World Health Organization, UNICEF, UNFPA, World Bank Group, UNDESA/Population Division. Trends in maternal mortality 2000 to 2020: estimates by WHO, UNICEF, UNFPA, World Bank Group and UNDESA/Population Division. Geneva: World Health Organization; 2023. Available from: <https://www.who.int/publications/i/item/9789240068759>
3. Aldinger JK, Abele H, Kranz A. Prenatal maternal psychological stress (PMPS) and its effect on the maternal and neonatal outcome: a retrospective cohort study. *Healthcare (Basel)*. 2024;12(23):2431. doi:10.3390/healthcare12232431.

4. Missler M, Donker T, Beijers R, Ciharova M, Moyse C, de Vries R, et al. Universal prevention of distress aimed at pregnant women: a systematic review and meta-analysis of psychological interventions. *BMC Pregnancy Childbirth*. 2021;21:276. doi:10.1186/s12884-021-03752-2.
5. World Health Organization. WHO guide for integration of perinatal mental health in maternal and child health services. Geneva: World Health Organization; 2022. Available from: <https://www.who.int/publications/i/item/9789240057142>
6. Manolova G, Waqas A, Chowdhary N, Salisbury TT, Dua T. Integrating perinatal mental healthcare into maternal and perinatal services in low and middle income countries. *BMJ*. 2023;381:e073343. doi:10.1136/bmj-2022-073343.
7. Lin X, Liang C, Liu J, Lyu T, Ghumman N, Campbell B. Artificial intelligence-augmented clinical decision support systems for pregnancy care: systematic review. *J Med Internet Res*. 2024;26:e54737. doi:10.2196/54737.
8. Alkhateeb M, Nayeem A, Ahmed A, Alsahli M, Sheikh J, Abd-Alrazaq A. AI for detecting and predicting postpartum depression: scoping review. *J Med Internet Res*. 2026;28:e77376. doi:10.2196/77376.
9. Sezgin E, Chekeni F, Lee J, Keim S. Clinical accuracy of large language models and Google Search responses to postpartum depression questions: cross-sectional study. *J Med Internet Res*. 2023;25:e49240. doi:10.2196/49240.
10. Oke GI, Sibomana O. Adoption of digital health technology in Nigeria: a scoping review of current trends and future directions. *Adv Public Health*. 2025;2025:4246285. doi:10.1155/adph/4246285.
11. Shuaib F, Garba AB, Meribole E, Obasi S, Sule A, Nnadi C, et al. Implementing the routine immunisation data module and dashboard of DHIS2 in Nigeria, 2014–2019. *BMJ Glob Health*. 2020;5(7):e002203. doi:10.1136/bmjgh-2019-002203.
12. African Union Commission. Continental Artificial Intelligence Strategy. Addis Ababa: African Union Commission; 2024. Available from: https://au.int/sites/default/files/documents/44004-doc-EN-Continental_AI_Strategy_July_2024.pdf
13. World Health Organization. Ethics and governance of artificial intelligence for health: WHO guidance. Geneva: World Health Organization; 2021. Available from: <https://www.who.int/publications/i/item/9789240029200>
14. Davis FD. Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Q*. 1989;13(3):319–340. doi:10.2307/249008.
15. Venkatesh V, Morris MG, Davis GB, Davis FD. User acceptance of information technology: toward a unified view. *MIS Q*. 2003;27(3):425–478. doi:10.2307/30036540.
16. Akinola O, Zimba R, Banda K, Mangani CL, Shakwelele H, Abdallah I, et al. A systematic review of implementation strategies to improve timely initiation of antenatal care among pregnant women in sub-Saharan Africa. *J Public Health Afr*. 2026;17(1):1461. doi:10.4102/jphia.v17i1.1461.
17. Ngongo N, Dereje N, Hall S, Kaseya J. Charting Africa's digital public health future: five priorities for action. *J Public Health Afr*. 2026;17(1):1857. doi:10.4102/jphia.v17i1.1857.
18. Kiwanuka SN, Kabwama SN, Namuhani N, Gupta S, Layer E, Mechael P, et al. Barriers and facilitators of the effective use of DHIS2 data to improve program planning and monitoring in Uganda: a sequential mixed methods study. *Oxf Open Digit Health*. 2026;4:oqag002. doi:10.1093/oodh/oqag002.
19. Huang S, Hu Y, Fu B, Tang G, Chen Z, Zhang L, et al. Help-seeking intentions for depression and associated factors among Chinese perinatal women: a cross-sectional study. *Int J Environ Res Public Health*. 2023;20(3):2288. doi:10.3390/ijerph20032288.
20. Irianti S, Fuadi MF, Ningsih SR, Puspitasari I, Nugraheni SA. Health screening and non-pharmacological interventions in antenatal care for pregnant women: a systematic review. *Faletehan Health J*. 2026;13(1):118–131. Available from: <https://journal.lppm-stikesfa.ac.id/index.php/FHJ/article/view/908>