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Digital Transformation in Non-Communicable Disease Management in Pregnant Women: The Effectiveness of Telemedicine on Patient Therapy Compliance

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Abstract

Non-Communicable Diseases (NCDs) in pregnant women, such as gestational diabetes and hypertension, increase the risk of maternal and perinatal complications. Low adherence to therapy is the main challenge in managing NCDs. Telemedicine has the potential to improve compliance through service access and remote monitoring. This study aims to analyze the factors that affect therapy adherence in pregnant women with NCDs, especially the frequency of telemedicine use, perception of convenience, and trust in services. This study uses a cross-sectional design with a quantitative approach. A total of 185 pregnant women with NCDs in Malang were selected as respondents through purposive sampling. Data were collected using an online questionnaire and analyzed using logistic regression to determine factors influencing therapy adherence. The results of the multivariate analysis showed that the frequency of telemedicine use, the perception of ease of use, and the level of trust in services were factors that significantly affected therapy adherence in pregnant women with non-communicable diseases. Respondents who used telemedicine ≥2 times per month had a higher chance of therapy adherence (AOR = 3.21; 95% CI: 1.33–7.76; p = 0.009). Perceived ease of use also increases the likelihood of compliance (AOR = 2.97; 95% CI: 1.28–6.90; p = 0.011). In addition, high levels of trust in telemedicine services were associated with increased therapeutic adherence (AOR = 2.56; 95% CI: 1.15–5.71; p = 0.022). Telemedicine plays an important role in improving pregnant women's therapeutic adherence to NCDs through increased access, ease of use, and trust in services.

Introduction

Non-Communicable Diseases (NCDs) are the main causes of morbidity and mortality in the world, including in developing countries such as Indonesia (Arifin et al., 2022). The World Health Organization (WHO) reports that about 74% of all global deaths are caused by NCDs, including diabetes mellitus, hypertension, heart disease, cancer, and other metabolic disorders. In recent years, attention to NCDs in pregnant women groups has increased significantly due to its complex impact on maternal and fetal health (Firoz et al., 2022). Conditions such as gestational diabetes, hypertension in pregnancy, and maternal obesity not only increase the risk of obstetric complications, but also contribute to an increased risk of chronic diseases in the future, both for both mother and child (Lourenço & Guedes-Martins, 2025).

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In Indonesia, the prevalence of Non-Communicable Diseases (NCDs) in pregnant women shows an increasing trend and is a serious challenge for the maternal health care system (Syairaji et al., 2024). Data from the Basic Health Research (Riskesdas) in 2018 shows that around 6.18% of pregnant women experience hypertension in pregnancy, while the prevalence of gestational diabetes is estimated to reach 5–10% of all pregnancies, with a tendency to increase in mothers over 30 years old and with a high body mass index (BMI) (Sheiner, 2020). Not only does this condition increase the risk of obstetric complications such as preeclampsia, premature labor, and low birth weight, but it also has a long-term impact on maternal and child metabolic health, including an increased risk of type 2 diabetes and metabolic syndrome in the future (Stephansson & Sandström, 2024).

Low adherence to antenatal therapy and control is one of the key factors that worsen the condition (Al-Mamun et al., 2025; Amoakoh-Coleman et al., 2016; Esopo et al., 2020). Studies show that many pregnant women with NCDs have difficulty maintaining checkup routines, adherence to taking medications, and following proper dietary and physical activity recommendations (Davies et al., 2023; Sontakke et al., 2021). This barrier is exacerbated by limited access to health facilities, especially in rural or archipelagic areas, as well as socioeconomic factors and low health literacy. On the other hand, traditional healthcare systems still focus on episodic face-to-face meetings, while NCD conditions require continuous monitoring and a more adaptive approach to patient needs (Aljerian et al., 2025; Maher et al., 2009; Smedslund et al., 2025). Therefore, there is a need for service system innovation that is able to bridge the gap between the need for continuous monitoring and limited access to direct services (Vudathaneni et al., 2024).

Digital transformation in the health sector has emerged as a strategic solution to strengthen the management of chronic diseases, including NCDs in pregnant women (Neto & Wyl, 2024). Through the use of information and communication technology, digital transformation enables the creation of faster, more efficient, and patient-oriented services (Fitzpatrick, 2023). The Government of Indonesia has affirmed this commitment through the Health Digital Transformation program which is part of the Six Pillars of Health Transformation of the Ministry of Health of the Republic of Indonesia (Solikha et al., 2025). This program encourages the strengthening of the national health information system, data integration through the SATUSEHAT platform, and the expansion of access to telemedicine-based services. In the context of maternal health, the integration of telemedicine is expected to support the digital antenatal care (ANC) process, monitoring vital parameters, and two-way communication between pregnant women and health workers (Mohamed et al., 2025).

Telemedicine has great potential to improve therapeutic adherence in pregnant women with NCDs through various mechanisms (Omboni et al., 2020). Online consultation services make it easier for pregnant women to access doctors or midwives without having to come directly to health facilities, reducing geographical barriers and transportation costs (Hawkins, 2023). Digital reminder features and self-monitoring tools such as blood pressure tracking, blood sugar levels, and daily activity logs help patients understand their condition in real time and increase responsibility for self-management. In addition, app-based interactive health education can strengthen digital literacy and health, so that pregnant women better understand the importance of therapy adherence (Jaeger et al., 2025). A number of international studies have proven that telemedicine-based interventions can increase adherence in patients with gestational diabetes by up to 20–30%, as well as improve clinical outcomes such as glucose and blood pressure control. However, similar evidence in Indonesia is still very limited, especially those that specifically examine the effect of telemedicine on therapeutic adherence behavior in pregnant women with NCDs. Therefore, this research is very relevant to fill this gap while supporting the national agenda of digital-based healthcare transformation.

From a behavioral and technology adoption perspective, the effectiveness of telemedicine is strongly influenced by users' psychological acceptance of the technology, including perceived ease of use and trust, which determine sustained utilization and health behavior outcomes. The Technology Acceptance Model (TAM) suggests that perceived ease of use facilitates continued engagement with digital health services, while trust enhances users' willingness to rely on telemedicine for clinical decision-making. Similarly, the Health Belief Model (HBM) frames adherence behavior as a function of perceived benefits and reduced barriers, positioning telemedicine as a tool that may lower structural and psychological obstacles to consistent therapy adherence.

However, although the potential of telemedicine is enormous, empirical evidence on its effectiveness on therapeutic adherence in pregnant women with NCDs in Indonesia is still limited. Most research in Indonesia still focuses on technology acceptance or user perception, rather than on real outcomes on health behavior or patient compliance (Li et al., 2021). In addition, variations in the level of digital literacy, internet access, and support for health workers in various regions are also challenges in optimizing the use of telemedicine evenly (Mumtaz et al., 2023). Therefore, research is needed that comprehensively assesses the extent to which telemedicine can contribute to improving therapeutic adherence in pregnant women with NCDs.

This study seeks to fill this gap by examining the effectiveness of telemedicine in supporting therapeutic adherence in pregnant women with non-communicable diseases in Indonesia. Through this approach, it is hoped that a deeper understanding of the role of digital transformation in maternal health management can be obtained, especially in populations that are prone to chronic complications. The results of this research are expected to be a scientific basis for the development of digital health-based national policies and programs, as well as strengthen the integration of telemedicine in antenatal services and NCD management at the primary health facility level.

Methods

This study employed a cross-sectional analytical design to examine the relationship between telemedicine utilization and therapeutic adherence among pregnant women diagnosed with non-communicable diseases (NCDs) in Malang, East Java. The cross-sectional approach was considered appropriate to assess associations between exposure variables related to telemedicine use and adherence behavior at a single point in time.

The study population consisted of pregnant women residing in Malang, East Java, who were diagnosed with non-communicable diseases, including gestational diabetes, hypertension in pregnancy, and thyroid disorders. Purposive sampling was applied to ensure that participants had direct experience with telemedicine services relevant to the study objectives. The inclusion criteria were: (1) pregnant women aged 18–35 years, (2) diagnosed with at least one non-communicable disease during pregnancy, (3) having used telemedicine services at least twice during the current pregnancy, and (4) willingness to complete the questionnaire in full. Based on these criteria, a total of 185 respondents were included in the final analysis.

The study was conducted online and involved respondents from five sub-districts in Malang, East Java. Data collection took place between May and August 2025 using an online self-administered survey format.

The primary data collection instrument was a structured questionnaire developed through a systematic, multi-stage process to ensure conceptual relevance, validity, and reliability. The development of the questionnaire began with an extensive literature review of previous empirical studies on telemedicine utilization, digital health acceptance, and therapeutic adherence in chronic disease management, as well as guidelines issued by the World Health

Organization (WHO) on digital health interventions for maternal care. These sources informed the identification of key constructs, including frequency of telemedicine use, perceived ease of use, trust in digital health services, and therapeutic adherence.

Questionnaire items were formulated by adapting statements from previously published and widely used instruments rather than creating entirely new items. Conceptual frameworks such as the Technology Acceptance Model (TAM) and prior telemedicine adherence studies guided the operationalization of complex constructs, including "perceived ease of use" and "trust in digital services." Items were contextually adapted to reflect the Indonesian maternal health setting while preserving their original conceptual meaning.

The final questionnaire consisted of four sections: (1) socio-demographic characteristics, (2) type and frequency of telemedicine use, (3) perceptions of ease of use and trust in telemedicine services, and (4) therapeutic adherence. Perception and adherence items were measured using a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5).

Content validity was assessed using a structured expert judgment approach. Two independent experts one specializing in maternal health and one in health information technology, evaluated each questionnaire item for relevance, clarity, and representativeness of the intended construct. The Content Validity Index (CVI) was calculated at both the item level (I-CVI) and scale level (S-CVI). Items with an I-CVI value below the acceptable threshold of 0.78 were revised based on expert feedback to reduce ambiguity and improve conceptual alignment.

Prior to the main data collection, a pilot study was conducted involving 25 pregnant women who met the inclusion criteria but were not included in the final sample. The pilot testing aimed to assess item clarity, questionnaire flow, and respondent comprehension, particularly given the online, self-administered nature of the survey. Feedback from the pilot study resulted in minor revisions to wording and sentence structure to enhance readability and minimize misinterpretation.

Table 1. Reliability analysis of questionnaire constructs

Construct	Number of Items	Cronbach's Alpha
Perception of ease	5	0.76
Trust in telemedicine	4	0.81
Therapeutic adherence	6	0.79

Reliability analysis was conducted to evaluate the internal consistency of the questionnaire using Cronbach's Alpha coefficients calculated from the pilot study data. The results demonstrated acceptable reliability across all constructs, with Cronbach's Alpha values of 0.76 for perceived ease of use, 0.81 for trust in telemedicine services, and 0.79 for therapeutic adherence. All values exceeded the commonly accepted threshold of 0.70, indicating satisfactory internal consistency of the instrument.

Data collection was carried out by distributing the finalized questionnaire through an online survey platform (Google Forms), which was disseminated via social media channels and pregnant women community networks. All respondents received written information explaining the study objectives, voluntary participation, confidentiality of data, and informed consent prior to completing the questionnaire. Participants were informed of their right to withdraw at any stage without any consequences.

The collected data were first screened to ensure completeness and consistency. Data analysis was performed using SPSS version 26. Descriptive analysis was used to summarize respondents' socio-demographic characteristics, types of non-communicable diseases, and patterns of telemedicine use. Bivariate analysis using the Chi-square test was conducted to examine associations between independent variables (frequency of telemedicine use, perceived

ease of use, and trust in telemedicine services) and the dependent variable (therapeutic adherence). Crude Odds Ratios (CORs) with 95% confidence intervals were calculated to estimate the magnitude of associations. Multivariate analysis was subsequently performed using logistic regression to identify independent predictors of therapeutic adherence after controlling for potential confounding variables. Prior to regression modeling, multicollinearity among independent variables was assessed using Variance Inflation Factors (VIFs). All VIF values were below the acceptable threshold, indicating no significant multicollinearity and supporting the stability of the regression coefficients. Model fit was evaluated using the Hosmer–Lemeshow goodness-of-fit test, which indicated an adequate fit of the model to the data ($p > 0.05$), and pseudo R^2 values were calculated to estimate the explanatory capacity of the model.

Results and Discussion

Table 2. Characteristics of respondents

Characteristics	Category	n	%
Age (years)	18–25	62	33.5
	26–30	78	42.2
	31–35	45	24.3
Education	Junior High School/Equivalent	21	11.4
	High School/equivalent	96	51.9
	College	68	36.7
Occupation	Housewives	103	55.7
	Private employees	47	25.4
	Self employed	24	13.0
	Other	11	5.9
Types of Non-Communicable Diseases (NCDs)	Diabetes gestasional	82	44.3
	Hypertension in pregnancy	71	38.4
	Thyroid disorders	32	17.3
Frequency of telemedicine use	< 2 times/month	54	29.2
	≥ 2 times/month	131	70.8
Perception of the ease of use of telemedicine	Not easy	39	21.1
	Easy	146	78.9
Trust in telemedicine services	Low	44	23.8
	High	141	76.2
Adherence to therapy	Non-compliant	57	30.8
	Compliant	128	69.2

A total of 185 pregnant women suffering from non-communicable diseases (NCDs) participated in this study. Based on age distribution, most respondents were in the age group of 26–30 years (42.2%), followed by the age group of 18–25 years (33.5%), and 31–35 years (24.3%). These results show that the majority of respondents are at a relatively young active reproductive age. In terms of education level, more than half of the respondents had a high school education/equivalent (51.9%), while 36.7% were university graduates, and only 11.4% had a junior high school education. Based on occupation, the majority of respondents were housewives (55.7%), followed by private employees (25.4%), self-employed (13.0%), and other occupations (5.9%). The most common type of non-communicable disease is gestational diabetes (44.3%), followed by hypertension in pregnancy (38.4%), and thyroid disorders (17.3%). In terms of the frequency of telemedicine use, most respondents (70.8%) used the service more than twice a month, while 29.2% used it less than twice. In terms of perception, most respondents considered telemedicine easy to use (78.9%), while only 21.1% considered it not easy. In addition, the level of trust in telemedicine services is also relatively high, with

76.2% of respondents stating trust in these services. The level of adherence to therapy showed that the majority of respondents were classified as compliant (69.2%), while the other 30.8% were categorized as non-compliant.

Table 3. The Relationship between Telemedicine Use and Therapy Adherence in Pregnant Women with NCDs

Independent Variables	Category	Non-compliant	Compliant	p-value	COR (95% CI)
Frequency of telemedicine use	< 2 times/month	26 (48.1)	28 (51.9)	0.003	2.87 (1.42–5.79)
	≥ 2 times/month	31 (23.7)	100 (76.3)		
Perception of ease	Not easy	20 (51.3)	19 (48.7)	0.001	3.20 (1.55–6.61)
	Easy	37 (25.3)	109 (74.7)		
Trust in telemedicine	Low	22 (50.0)	22 (50.0)	0.004	2.75 (1.36–5.56)
	High	35 (24.8)	106 (75.2)		

The results of the bivariate analysis showed a significant relationship between the use of telemedicine services and the level of therapy adherence in pregnant women with non-communicable diseases (NCDs). Based on the frequency of telemedicine use, it is known that respondents who used telemedicine services more than twice a month had a higher rate of therapy adherence (76.3%) compared to those who used less than twice a month (51.9%). The results of the Chi-square test showed a value of p = 0.003, with a Crude Odds Ratio (COR) = 2.87 (95% CI: 1.42–5.79). These findings suggest that pregnant women who use telemedicine more often are almost three times more likely to adhere to therapy compared to those who use it less. Furthermore, the perception of ease of use of telemedicine also showed a significant association with therapeutic adherence (p = 0.001). Respondents who rated telemedicine services as easy to use had a higher level of compliance (74.7%) compared to those who considered the service not easy to use (48.7%). A COR value of 3.20 (95% CI: 1.55–6.61) indicates that positive perceptions of the ease of use of telemedicine increase the chances of adherence to therapy by more than three times compared to negative perceptions. In addition, trust in telemedicine services also had a significant effect on therapy adherence with a value of p = 0.004. Respondents with a high level of trust in telemedicine services showed therapeutic adherence of 75.2%, while respondents with low trust were only 50.0%. A COR value of 2.75 (95% CI: 1.36–5.56) indicates that pregnant women who have a high level of trust in telemedicine services are almost three times more likely to comply with treatment than those who have less trust in the service.

Table 4. Multivariate Analysis of Factors Affecting Therapy Adherence in Pregnant Women with NCDs

Variable	β	SE	Wald	p-value	AOR (95% CI)
Frequency of telemedicine use (≥2 times/month)	1.17	0.45	6.78	0.009	3.21 (1.33–7.76)
Perception of ease (easy)	1.09	0.43	6.42	0.011	2.97 (1.28–6.90)
Trust in telemedicine (high)	0.94	0.41	5.23	0.022	2.56 (1.15–5.71)

Multivariate analysis using logistic regression was conducted to identify the factors that most affected therapy adherence in pregnant women with non-communicable diseases (NCDs) after taking into account variables that showed a significant relationship in bivariate analysis. The three variables included in the final model were the frequency of telemedicine use, the perception of ease of use, and the level of trust in telemedicine services. The results of the analysis showed that the frequency of telemedicine use ≥2 times per month had a significant effect on therapy adherence (p=0.009) with an Adjusted Odds Ratio (AOR) of 3.21 (95% CI: 1.33–7.76). This means that pregnant women who use telemedicine services more often are 3.2 times more likely to comply with therapy than those who rarely use them. This magnitude of effect suggests a clinically meaningful behavioral difference, as more frequent telemedicine engagement likely facilitates continuous monitoring, timely clinical feedback, and improved self-management during pregnancy. In addition, the perception of ease of use of telemedicine also plays an important role in improving compliance. Respondents who rated the use of telemedicine as easy had a 2.97 times higher chance of adherence to therapy compared to those who found telemedicine difficult to use (AOR=2.97; 95% CI: 1.28–6.90; p=0.011). In line with the Technology Acceptance Model, this finding indicates that usability is a critical determinant of sustained technology use, which subsequently translates into improved adherence behavior. These findings suggest that the usability aspect of digital technology is a key factor in ensuring the active involvement of patients in their care. Another significant variable was trust in telemedicine services, where respondents with high levels of trust in the security, accuracy, and professionalism of services were 2.56 times more likely to demonstrate good therapeutic adherence than those with low confidence levels (AOR=2.56; 95% CI: 1.15–5.71; p=0.022). High trust reflects confidence in data security, clinical accuracy, and provider professionalism, reinforcing patients' willingness to follow medical recommendations delivered through digital platforms.

The results of this study confirm that the application of telemedicine has an important role in improving therapeutic adherence for pregnant women with non-communicable diseases (NCDs). In general, the group of pregnant women is at a productive age and has a secondary to high level of education, which allows them to adapt to the advancement of digital technology in the health sector. These characteristics are a major supporting factor in the adoption of telemedicine technology, as digital literacy and better health awareness tend to increase the ability to utilize online-based services. In the context of pregnancy, this condition is particularly relevant given the need for continuous monitoring and medical consultation that is fast and safe.

Conceptually, the perception of the convenience and usefulness of technology affects the intention and behavior of use (Wang et al., 2024). Pregnant women who feel the ease of accessing telemedicine are more likely to use it consistently, which ultimately contributes to adherence to therapy (Andrejek et al., 2025; Asadollahi et al., 2025). Positive perceptions of the ease of access and use of the application play a key driver in strengthening patient engagement. In addition, technology that is easy to operate can reduce psychological and technical barriers that are often the cause of low utilization of digital services in the health sector (Borges do Nascimento et al., 2023).

The trust factor in telemedicine services also emerged as an important determinant. In the context of maternal health services, trust includes not only belief in the accuracy of medical information, but also in the security of personal data and the professionalism of health workers (Dhagarra et al., 2020). This trust is the basis for the formation of a digital therapeutic relationship between health workers and patients. When pregnant women feel confident in the system and the staff who provide services, they tend to adhere to medical recommendations and follow therapy schedules more consistently (Ladak et al., 2024). These findings are in line

with previous research that emphasized that high levels of trust in digital systems drive continuity of care and improve maternal health outcomes.

The frequency of telemedicine use also reflects the level of patient involvement in the disease management process (Xiao & Han, 2023). More regular use can improve understanding of health conditions, strengthen communication with medical personnel, and expand access to relevant health information. From a health behavioral perspective, this describes the formation of self-management behavior in which patients actively monitor and follow up on their health conditions (Cravo et al., 2022). In the context of pregnant women with NCDs, regularity in the use of telemedicine has the potential to reduce the risk of complications, as patients can obtain prompt medical guidance without having to wait for a face-to-face visit (Xie et al., 2020).

In addition to technological and behavioral aspects, adherence to therapy is also influenced by the psychosocial dimension (Religioni et al., 2025). Pregnant women with good social support and high intrinsic motivation tend to be more responsive to the use of health technology (McCarthy et al., 2021). Telemedicine can serve as a means of emotional support through continuous communication between patients and medical personnel, thereby increasing confidence and a sense of self-control over their health conditions. The results of this study reinforce the view that digital transformation in maternal health services is not only a technological innovation, but also a strategy to improve the quality of care. Telemedicine has the potential to be a sustainable solution in the management of NCDs during pregnancy, especially in areas with limited access to health services (Mueller et al., 2025). However, its effectiveness depends on the readiness of the system, the quality of the applications used, and the competence of health workers in providing empathetic and personalized remote services.

Practically, these results imply that the development of telemedicine in Indonesia needs to be accompanied by an increase in the digital literacy of pregnant women, training for health workers in virtual communication, and policies that ensure the security of patient data. By strengthening the factors of trust, ease of access, and active patient engagement, telemedicine can become an integral part of a non-communicable disease management system that focuses on the sustainability of pregnant women's care.

Conclusion

This study shows that the use of digital technology, especially telemedicine services, has an important role in improving therapeutic adherence in pregnant women with non-communicable diseases (NCDs). Pregnant women who use telemedicine more regularly, have a perception of high ease of use, and show a strong level of trust in the service, tend to be more compliant in carrying out the therapy recommended by health workers. This confirms that the effectiveness of digital interventions in the context of NCD management in pregnancy depends not only on access to technology, but also on a positive user experience and trust in the security and credibility of the systems used. These findings suggest that enhancing ease of use and trust in telemedicine platforms can result in significant improvements in adherence behavior, which is an important outcome associated with better maternal and fetal health.

Based on the findings of this study, it is recommended that health service providers optimize the use of telemedicine as a means of supporting therapeutic adherence in pregnant women with non-communicable diseases. Efforts to improve infrastructure and provide a telemedicine platform that is easy to use, secure, and responsive to user needs is important to pay attention to. Health workers are also expected to improve digital competence through training and mentoring that focuses on the use of health technology, so as to be able to provide effective guidance to patients in carrying out therapy.

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