

The Impact of Digital Health Literacy on Health Decision-Making Among Pregnant Women Regarding the Use of Antenatal Care

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ABSTRACT

Digital health literacy is increasingly recognized as a cognitive factor influencing maternal health decision-making, particularly in urban settings with high digital access such as Tangerang City. Purpose: This study examined the association between digital health literacy and antenatal care (ANC) decision-making among pregnant women, and whether this persisted after adjusting for sociodemographic and healthcare-access factors. Method: A quantitative cross-sectional study was conducted among 100 pregnant women receiving ANC at selected community health centers (Puskesmas) in Tangerang City between January and April 2025, recruited through consecutive sampling. Data were collected using a structured questionnaire including the eight-item eHealth Literacy Scale (eHEALS) and an adapted ANC decision-making measure. Pearson correlation and hierarchical multiple linear regression were performed ($p < 0.05$). Results: Digital health literacy was positively associated with ANC decision-making ($r = 0.46$, $p < 0.001$; 95% CI 0.29–0.60) and remained independently associated after adjustment ($B = 0.35$, $p < 0.001$; 95% CI 0.17–0.53). Access to information and family support were also significantly associated, whereas age, education, parity, employment status, and health facility access were not. The final model explained 38% of variance. Implications: Integrating digital health literacy education and family involvement into routine ANC services may strengthen pregnant women's ability to evaluate online information and support appropriate care decisions. Conclusion: Digital health literacy is independently associated with ANC decision-making among pregnant women in this urban setting. Longitudinal and intervention studies are needed to clarify temporal relationships and evaluate digital literacy programs.



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INTRODUCTION

Pregnancy requires continuous monitoring through antenatal care (ANC) services to enable early detection of complications, monitoring of maternal and fetal conditions, preventive interventions, and preparation for childbirth. Utilization of ANC is influenced not only by the availability of facilities but also by pregnant women's capacity to recognize, evaluate, and act on health information. Sociodemographic factors (age, education, parity, occupation), access to services, knowledge, and family support have been widely documented as determinants of ANC adherence in Indonesia (Denny et al., 2021; Idris & Sari, 2023). However, cognitive-digital determinants remain under-examined.

Digital transformation has expanded pregnant women's access to health information via the internet, social media, and mobile applications concerning warning signs, nutrition, visit schedules, and service options (Conrad, 2022). High exposure to digital information does not automatically translate into appropriate health decisions; the quality of information varies, and women risk encountering incomplete or misleading content. Digital health literacy—the ability to access, understand, critically evaluate, and apply health information obtained through digital technologies—has therefore been recognized as a key enabler of informed decision-making and a “super determinant of health” (Van Kessel et al., 2022). Recent evidence links higher eHealth literacy with improved health perceptions, healthcare utilization, and maternal–neonatal outcomes among pregnant women (Sahin et al., 2022; Keles et al., 2024; Kim & Lee, 2025), and positions it as a mediator between social support and behavioral decisions in specific pregnancy conditions (Yumei et al., 2024; Zhou et al., 2025).

In Indonesia, rising internet penetration and smartphone ownership create opportunities for digital health engagement, yet also heighten the risk of misinformation and unequal evaluative capacity. Most Indonesian studies on ANC utilization continue to emphasize structural and sociodemographic predictors (Denny et al., 2021; Idris & Sari, 2023; Putri et al., 2023), while treating digital exposure and digital health literacy as distinct constructs only rarely. Empirical evidence specifically examining the association between digital health literacy and the quality of decision-making regarding ANC utilization among pregnant women in urban Indonesian settings remains limited. Tangerang City, an urban area with relatively high access to both health facilities and digital technology, provides a relevant context in which abundant information does not necessarily equate to appropriate care decisions.

This study therefore addresses the specific gap concerning the relationship between digital health literacy and health decision-making in ANC utilization among pregnant women in Tangerang City. The primary objective is to analyze this association while examining whether digital health literacy remains an independent predictor after adjustment for sociodemographic characteristics and healthcare-access factors. Secondary objectives are to describe levels of digital

health literacy and patterns of ANC-related decision-making, and to identify additional contributing factors.

METHODS

This quantitative, analytic, cross-sectional study examined the relationship between digital health literacy and health decision-making regarding antenatal care (ANC) utilization among pregnant women in Tangerang City, Indonesia. The study was conducted at selected community health centers (Puskesmas) that provide routine ANC services in Tangerang City. Reporting followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.

The study population comprised all pregnant women attending ANC examinations at the participating Puskesmas during the data-collection period (specify exact months/year, e.g., January–April 2025, according to actual fieldwork). Consecutive sampling was applied. Inclusion criteria were: age ≥ 19 years, gestational age in the first to third trimester, prior use of the internet or digital devices to seek health information, ability to read and write, and provision of written informed consent. Exclusion criteria were obstetric emergencies at the time of data collection or cognitive impairments preventing questionnaire completion. Sample-size calculation for a correlation test (assumed $r = 0.30$, $\alpha = 0.05$, power = 80%) yielded a minimum of 85 participants; allowing for 10% incomplete data produced a target of 95–100 respondents. A total of 100 eligible women completed the study.

The independent variable was digital health literacy; the dependent variable was health decision-making regarding ANC utilization. Covariates comprised age, education, parity, employment status, access to information, family support, and access to health facilities.

Data were collected with a structured questionnaire administered once per respondent (paper or online format) while women waited for ANC services, after explanation of the study and obtaining informed consent. Digital health literacy was measured with the eight-item eHealth Literacy Scale (eHEALS; Norman & Skinner, 2006), scored on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree; total range 8–40). Higher scores indicate greater digital health literacy. The Indonesian version of eHEALS has demonstrated acceptable validity and reliability in local populations (Cronbach's $\alpha \approx 0.91$). In the present study, content validity was reviewed by maternal-and-child-health experts, and internal consistency was confirmed in a pilot sample of 20–30 non-study respondents (Cronbach's $\alpha \geq 0.70$ required).

Health decision-making regarding ANC utilization was assessed with an 8-item instrument adapted from shared decision-making frameworks (including principles reflected in the Mothers' Autonomy in Decision Making [MADM] scale and related maternity SDM measures) and contextualized to ANC. Items covered timeliness of ANC visits, selection of service facilities, adherence to health-worker recommendations, and prompt help-seeking when pregnancy danger signs appeared. Each item used a 5-point Likert scale (1–5); total scores ranged from 8 to 40, with higher scores reflecting better-quality decision-making. Content validity was established by at least



three maternal-and-child-health experts. Construct validity and reliability were examined in the same pilot sample; the instrument was retained when Cronbach's $\alpha \geq 0.70$.

Access to information was measured by frequency and diversity of digital health-information sources (e.g., internet, social media, health applications) and treated as a continuous or ordinal score in analyses (higher scores indicating greater access). Family support was assessed with a brief multi-item scale addressing emotional, informational, and practical support from family members (particularly husbands); scores were dichotomized into low versus high support based on the median or established cut-off for descriptive presentation and entered as a continuous or dummy variable in regression. Access to health facilities was measured by self-reported ease of reaching ANC services (distance, travel time, or perceived accessibility) and similarly treated as continuous or dichotomous according to distribution.

Univariate analysis described respondent characteristics and variable distributions (frequencies, proportions, means, standard deviations). Bivariate association between digital health literacy and decision-making was examined with Pearson correlation. Hierarchical multiple linear regression was used to evaluate the independent contribution of digital health literacy after sequential adjustment for covariates. Hierarchical entry was chosen to quantify the incremental explanatory power of digital health literacy beyond sociodemographic and enabling factors: Model 1 entered age, education, parity, and employment; Model 2 added access to information, family support, and access to health facilities; Model 3 entered digital health literacy. Assumptions of normality, linearity, multicollinearity, and homoscedasticity were checked. Statistical significance was set at $p < 0.05$. Analyses were performed with appropriate statistical software.

Ethical approval and institutional research permits were obtained prior to data collection. Informed consent, confidentiality, anonymity, and the right to withdraw without affecting care were ensured in accordance with the principles of beneficence and non-maleficence.

RESULTS

1. Respondent Characteristics

This study involved 100 pregnant women who met the inclusion criteria and completed all stages of data collection. Respondent characteristics included age, education level, parity, employment status, trimester of pregnancy, access to digital health information, family support, and access to healthcare facilities.

Table 1. Respondent Characteristics (n = 100)

Characteristics	n	%
Age		
19–24 years	29	29.0
25–34 years	56	56.0
≥35 years	15	15.0
Education		
Primary/secondary education	38	38.0
Higher education	62	62.0

Parity		
Primigravida	43	43.0
Multigravida	57	57.0
Employment status		
Does not work	61	61.0
Works	39	39.0
Trimester of pregnancy		
I	22	22.0
II	39	39.0
III	39	39.0
Access to digital health information		
Low	34	34.0
High	66	66.0
Family support		
Low	31	31.0
High	69	69.0
Access to health facilities		
Limited	28	28.0
Adequate	72	72.0

The respondent profile was dominated by women of reproductive age (25–34 years) with higher education. The proportion of multigravida slightly exceeded that of primigravida. Most respondents were not employed and reported relatively high levels of family support as well as adequate access to health facilities. Access to digital health information was predominantly high, consistent with the urban setting of Tangerang City. The distribution across trimesters indicated balanced representation of gestational stages.

2. Digital Health Literacy and Decision-Making Distribution

Digital health literacy was measured using the eight-item eHEALS (score range 8–40). Decision-making regarding ANC utilization was assessed with an eight-item adapted instrument covering timeliness of visits, facility selection, adherence to health-worker recommendations, and help-seeking for pregnancy danger signs (score range 8–40).

Table 2. Descriptive Statistics of Main Variables

Variables	Mean $\pm$ SD	Median	Min–Max
Digital health literacy	31.42 $\pm$ 4.68	32.00	19–40
Decision-making on ANC utilization	34.76 $\pm$ 4.21	35.00	23–40

Respondents generally demonstrated relatively high digital health literacy and favorable decision-making scores regarding ANC utilization. Score variation indicated that a subset of participants still exhibited lower capacity in managing digital health information and in the quality of related health decisions.



3. Association Between Digital Health Literacy and ANC Decision-Making

Table 3. Pearson Correlation Between Digital Health Literacy and Decision-Making Regarding ANC Utilization

Variables	r	p-value	95% CI
Digital health literacy	0.46	<0.001	0.29–0.60

A positive and statistically significant correlation was observed between digital health literacy and decision-making regarding ANC utilization. Higher scores on digital health literacy were associated with higher scores on the decision-making measure. The coefficient indicated a moderate association.

4. Multivariate Analysis and Regression Assumptions

Prior to hierarchical multiple linear regression, residual diagnostics were examined. Residual normality was supported by a non-significant Shapiro–Wilk test ($p > 0.05$) and approximately normal Q–Q plot. Linearity was confirmed through residual-versus-predicted plots showing no systematic curvature. Multicollinearity was acceptable (all variance inflation factors [VIF] < 2.5 ; tolerance > 0.40). Homoscedasticity was supported by a non-significant Breusch–Pagan test ($p > 0.05$) and randomly scattered residuals. No influential outliers were detected (Cook’s distance < 1). Hierarchical multiple linear regression was performed to assess the association between digital health literacy and ANC decision-making after sequential adjustment for covariates. The final model included digital health literacy together with age, higher education, multigravida status, employment, access to information, family support, and access to health facilities.

Table 4. Hierarchical Multiple Linear Regression on ANC Utilization Decision-Making (Final Model)

Predictor	B	SE	β	t	p-value	95% CI
Digital health literacy	0.35	0.09	0.39	3.89	<0.001	0.17–0.53
Age	0.08	0.06	0.12	1.33	0.187	–0.04–0.20
Higher education	1.21	0.72	0.16	1.68	0.096	–0.22–2.64
Multigravida	0.64	0.61	0.10	1.05	0.296	–0.57–1.85
Employment (works)	0.58	0.63	0.09	0.92	0.361	–0.67–1.83
Access to information	0.74	0.32	0.21	2.31	0.023	0.10–1.38
Family support	1.17	0.55	0.19	2.13	0.036	0.08–2.26
Access to health facilities	0.69	0.49	0.12	1.41	0.162	–0.28–1.66

Model summary: $R^2 = 0.38$; $Adjusted R^2 = 0.32$; $F(8,91) = 7.01$; $p < 0.001$.

After adjustment for the covariates, digital health literacy remained independently associated with decision-making scores regarding ANC utilization ($B = 0.35$, $p < 0.001$). Among the covariates, access to information and family support were also significantly associated with the outcome, whereas age, education, parity, employment status, and access to health facilities were not independently associated in the final model. The model accounted for approximately 38% of the variance in ANC decision-making scores.

Overall, higher digital health literacy was positively associated with higher-quality decision-making concerning ANC utilization, independent of the sociodemographic and access-related factors examined. Access to information and family support emerged as additional associated factors.

DISCUSSION

The findings indicate that higher digital health literacy among pregnant women in Tangerang City was positively associated with the quality of decision-making regarding antenatal care (ANC) utilization, and that this association persisted after adjustment for sociodemographic characteristics and service-access factors. Access to information and family support also emerged as independently associated factors, whereas age, education, parity, employment status, and access to health facilities did not retain independent associations in the final model. These patterns suggest that cognitive-digital capacities may play a prominent role in shaping ANC-related decisions within an urban setting characterized by relatively high digital connectivity.

The results are consistent with Andersen's Behavioral Model of Health Services Use, which distinguishes predisposing, enabling, and need factors in the utilization of health services (Alkhawaldeh et al., 2023). Within this framework, digital health literacy can be conceptualized as a contemporary cognitive enabling factor that facilitates the conversion of available information into informed care decisions. The independent associations of access to information and family support further align with the enabling domain of the model, indicating that individual digital capacity operates alongside interpersonal and informational resources.

The positive association between digital health literacy and decision-making quality accords with several recent studies. Sahin et al. (2022) demonstrated that digital health literacy among pregnant women contributed to health perceptions and decision-making models related to pregnancy risks. Yumei et al. (2024) found that e-health literacy mediated the pathway between social support and behavioral decision-making in women with gestational diabetes, a pattern that parallels the concurrent significance of family support observed here. Keles et al. (2024) reported that higher eHealth literacy scores were linked to improved healthcare utilization and maternal-neonatal outcomes, while Zhou et al. (2025) identified self-efficacy as a mediator between eHealth literacy and childbirth readiness. Collectively, these studies support the interpretation that digital health literacy is associated with clinically relevant health behaviors during pregnancy, although the precise mechanisms (including possible mediation by self-efficacy) were not tested in the present cross-sectional design.

Certain findings diverge from the broader literature on ANC utilization in Indonesia, in which education and age frequently appear as important associated factors (Denny et al., 2021; Idris & Sari, 2023; Putri et al., 2023). One plausible explanation is that the eHEALS instrument primarily captures functional digital skills rather than general health knowledge. As noted in a systematic review and meta-analysis by Edwards et al. (2025), education tends to correlate more consistently with conventional health literacy than with eHealth literacy specifically, and age does not significantly moderate the relationship between the two constructs in adult samples. In an urban



environment with high smartphone penetration, women with secondary education may still develop adequate digital evaluation skills through routine exposure to online platforms; consequently, the unique contribution of formal education may be attenuated once digital health literacy is entered into the same model. This interpretation does not imply that sociodemographic factors are irrelevant, but rather that their relative contribution may differ when cognitive-digital capacity is explicitly measured.

The absence of an independent association for access to health facilities admits several possible interpretations. Tangerang City is characterized by relatively dense distribution of community health centers and other ANC providers, which may compress variation in geographic or logistical accessibility among respondents. Under such conditions, differences in facility access may be insufficient to produce detectable associations with decision-making scores. This possibility is consistent with the enabling-factor logic of Andersen's model: when structural barriers are comparatively low, cognitive and interpersonal enabling factors may assume greater relative importance (Alkhawaldeh et al., 2023). However, this interpretation remains contextual and requires confirmation in settings with greater heterogeneity in service availability.

The observed contribution of family support suggests that digital health literacy does not operate in isolation. Family members, particularly partners, may function as informational filters or co-interpreters of online content, thereby reinforcing or refining the decisions that pregnant women ultimately make. This interpersonal dimension aligns with findings that social support and e-health literacy jointly influence behavioral decisions during pregnancy (Yumei et al., 2024).

Taken together, the results indicate that digital health literacy is an independent associated factor of ANC decision-making quality in this urban sample. Claims of relative decisiveness compared with sociodemographic factors should be tempered by the modest sample size and the single-city urban context; the patterns observed here may not generalize to rural areas or populations with lower digital exposure. Nevertheless, the findings highlight the relevance of cognitive-digital capacity within contemporary maternal health service environments.

Future research would benefit from longitudinal or experimental designs capable of clarifying temporal order and potential causal pathways. Examination of mediating mechanisms, such as self-efficacy (Zhou et al., 2025) or attitudes toward online health information, could further elucidate how digital health literacy translates into care decisions. Intervention studies testing brief, facility-based digital literacy training for pregnant women and their families would provide direct evidence of whether improvements in literacy produce measurable gains in decision-making quality. Replication across diverse geographic and digital-access settings is also needed to assess the robustness of the associations reported here.

Several limitations warrant consideration. The cross-sectional design precludes causal inference; reverse causation whereby women who already engage in more active decision-making seek digital information more intensively cannot be excluded. Self-report measures introduce the possibility of social-desirability and recall bias. Consecutive sampling within selected urban health centers limits generalizability. The sample size, while adequate for the primary correlation analysis, constrains power to detect small effects for certain covariates. Finally, potential mediators and

moderators were not assessed, leaving the pathways linking digital health literacy to decision-making incompletely specified.

In summary, digital health literacy was independently associated with the quality of ANC-related decision-making among pregnant women in Tangerang City, alongside access to information and family support. These findings underscore the value of integrating digital health literacy education and family engagement into routine antenatal services, while recognizing that further research is required to establish causality and broader applicability.

CONCLUSIONS

This study demonstrates that digital health literacy is positively and independently associated with the quality of health decision-making regarding antenatal care utilization among pregnant women in Tangerang City, after adjustment for sociodemographic and service-access factors. Access to information and family support also emerged as significant associated factors, whereas age, education, parity, employment status, and access to health facilities did not retain independent associations in the final model.

These findings indicate that cognitive-digital capacity constitutes a relevant associated factor of ANC-related decision-making in an urban setting with high digital connectivity. Practically, the results support the integration of digital health literacy education into routine antenatal care services and the active involvement of family members, particularly partners, in pregnancy-related health information activities.

Given the cross-sectional design and single urban context, causal inferences cannot be drawn. Longitudinal and intervention studies are recommended to clarify temporal relationships, test potential mediating mechanisms, and evaluate the effectiveness of digital literacy programs in improving maternal health decision-making.

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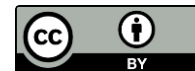
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