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Digital Health Literacy and Health Information Inequality in Rural India: A Multidimensional Assessment

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Abstract—Digital health platforms are increasingly positioned as the primary channel through which rural Indian populations will access diagnostic advice, medical records and public health information. Whether this shift narrows or widens existing health inequities depends on the distribution of digital health literacy (DHL) across the rural population. This cross-sectional study assessed DHL across four dimensions — access, operational skill, appraisal and application — among 1,096 adults in rural blocks of Uttar Pradesh and Madhya Pradesh. A composite Digital Health Literacy Index (DHLI, 0–100) was constructed alongside the eHealth Literacy Scale (eHEALS). Mean DHLI was 41.6 (SD 15.2) and mean eHEALS was 21.4 (SD 6.8), with only 28.4% of respondents reaching the conventional eHEALS adequacy threshold. Appraisal (33.1) and application (35.2) scored substantially below access (52.3) and operational skill (45.9), indicating that connectivity gains have not translated into evaluative competence. Hierarchical regression explained 56.4% of DHLI variance, with education (β = 0.312), personal smartphone ownership (β = 0.268) and age (β = −0.241) as dominant predictors. A concentration index of 0.238 confirmed that DHL is systematically concentrated among wealthier households. Respondents in the lowest DHLI tertile were substantially more likely to accept false health claims (61.4% vs 22.9%) and far less likely to have used teleconsultation services (9.8% vs 39.2%). The findings indicate that digital health expansion in rural India risks reproducing a second-order divide organised around evaluative capability rather than device access.

Keywords—digital health literacy, eHealth literacy, health information inequality, rural India, digital divide, telemedicine, health misinformation

Introduction

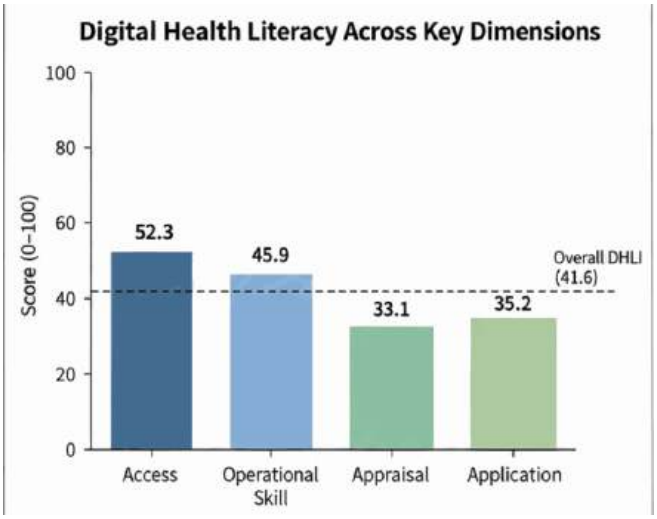
India's digital health architecture has expanded rapidly through the Ayushman Bharat Digital Mission, the eSanjeevani teleconsultation platform and the widespread issuance of health identifiers. These programmes assume that connectivity translates into usable access. Telecom penetration figures partly support this optimism: rural internet subscribers per 100 population rose to 44.16 as against 111.75 in urban areas, indicating both substantial rural uptake and a persistent structural gap.

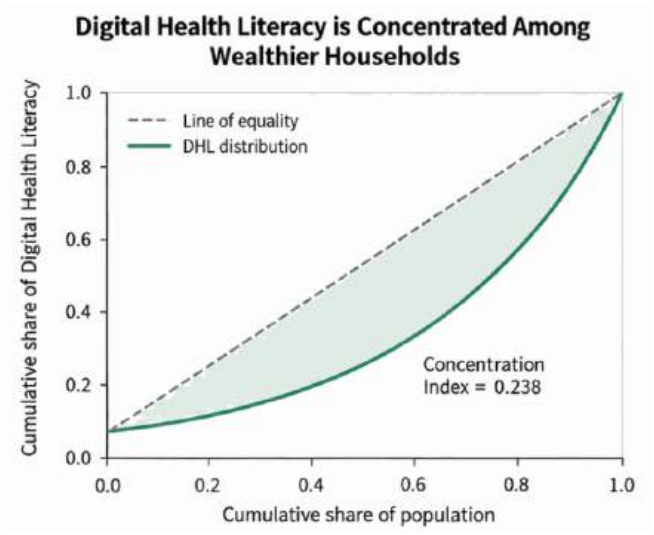
Connectivity, however, is a necessary rather than sufficient condition for benefit. The capacity to locate, interpret, appraise and act upon electronic health information — digital health literacy — mediates the relationship between infrastructure and health outcome. Where that capacity is unevenly distributed, digital health delivery can amplify rather than reduce inequity, a phenomenon described in the literature as the second-level digital divide. Rural India presents a demanding test case: low formal educational attainment, gendered restrictions on device use, dependence on shared household handsets, and a dense circulation of unverified health claims through messaging platforms.

Existing Indian evidence is dominated by single-dimension self-report instruments and geographically narrow samples. This study addresses that limitation by measuring DHL multidimensionally across a larger two-state rural sample, quantifying the socioeconomic concentration of DHL, and linking DHL directly to two behavioural outcomes of policy relevance: susceptibility to health misinformation and uptake of government teleconsultation services.

Literature Review

The conceptual foundation of this field is the eHealth literacy model of Norman and Skinner, who defined it as the composite ability to read, use computers, search, comprehend health content and contextualise it, and who operationalised the construct through the eight-item eHEALS. Subsequent psychometric work by van der Vaart and colleagues confirmed strong internal consistency but demonstrated that eHEALS loads on a single component and correlates only weakly with actual performance, implying that it captures perceived rather than demonstrated competence.





Broader health literacy scholarship anticipated this limitation. Nutbeam distinguished functional, interactive and critical literacy, arguing that critical appraisal constitutes a distinct and more demanding tier. Sørensen and colleagues, in their systematic integration of definitions and models, similarly separated accessing, understanding, appraising and applying health information. Nørgaard and colleagues extended these distinctions into the digital domain through the eHealth Literacy Framework, specifying seven dimensions spanning individual capability, system quality and user experience, later operationalised by Kayser and colleagues in the eHLQ. Collectively this body of work establishes that unidimensional measurement understates inequality, since appraisal and application skills are typically scarcer and more socially stratified than access and operational skills.

Digital divide research reinforces the point. Van Deursen and van Dijk documented that as physical access gaps close, inequality migrates to differences in usage type and benefit realisation. Neter and Brainin demonstrated empirically that eHealth literacy extends the digital divide into the health domain, with lower-literacy users deriving less benefit from identical online resources.

Indian evidence is comparatively thin but consistent. Rasekaba and colleagues, studying 150 older adults in rural Mysore and Suttur, found digital literacy at 11% and health literacy ranging from 3% to 27% across domains, with mobile ownership at 50% but smartphone use and online contact with health professionals negligible. Yadav, Gurav and Samel, in a rural–urban comparative survey of 380 adults, reported daily internet use of 46.32% in rural versus 70.53% in urban respondents and correspondingly lower eHealth literacy in rural areas, with education, occupation and smartphone ownership emerging as significant correlates. Kumar, Tandon and Meratwal, surveying 306 elderly patients in Ajmer, similarly identified low eHealth literacy alongside notable demand for digital health technology — a demand–capability mismatch of direct policy significance.

Service-side studies describe the mirror image of the same problem. Kanwar, Chaudhary and Sharma, examining telemedicine implementation in remote Himachal Pradesh, identified lack of awareness (75.9%), patient education level (44.8%) and institutional resistance to change (80%) as principal barriers. Sood and colleagues, analysing national eSanjeevani programme data, recorded over 163 million consultations by September 2023 but noted that more than 93% occurred through the provider-assisted hub-and-spoke model rather than direct citizen access, implying that unmediated patient-initiated use remains limited. Bajpai and Wadhwa's policy analysis of India's digital health mission anticipated precisely this dependence on intermediaries where end-user capability is weak.

Two gaps follow. First, no Indian study has decomposed DHL into access, operational, appraisal and application dimensions on a sample large enough to support multivariate inference. Second, the distributional properties of DHL — how sharply it concentrates by socioeconomic position — remain unquantified, despite their centrality to equity-oriented policy.

Objectives

The study sought to measure DHL across four dimensions in rural India; identify its sociodemographic determinants; quantify its socioeconomic concentration; and test its association with health misinformation susceptibility and teleconsultation uptake.

Methodology

Design and setting. A community-based analytical cross-sectional study was conducted across eight rural blocks in four districts of Uttar Pradesh and Madhya Pradesh between August 2024 and February 2025.

Sampling. Multi-stage stratified random sampling was used. Districts were stratified by composite development index; two blocks per district and six villages per block were

selected by probability proportional to size; households were chosen by systematic random sampling from village registers; and one adult aged 18 years or above was selected per household using the Kish grid. Assuming an expected DHL adequacy proportion of 30%, 5% absolute precision, 95% confidence, a design effect of 1.8 and 10% non-response, the required sample was 1,065. A total of 1,200 households were approached and 1,096 complete interviews obtained (response rate 91.3%).

Instruments. Three instruments were administered face-to-face in Hindi by trained investigators. The eHEALS (8 items, 5-point Likert, range 8–40) measured perceived eHealth literacy, with scores of 26 or above treated as adequate. A 24-item Digital Health Literacy Index was constructed from the Nørgaard framework and Sørensen's four-competency structure, comprising six items each on Access, Operational skill, Appraisal and Application, scored 1–5 and linearly transformed to 0–100. Misinformation susceptibility was assessed using six locally circulating false health claims verified as false by two independent public health physicians. Teleconsultation use, ABHA identifier ownership, device access, ASHA contact and household characteristics were captured through a structured schedule.

Validation. The DHLI was pre-tested on 80 respondents excluded from the main sample. Content validity index was 0.91. Internal consistency was acceptable overall ($\alpha = 0.89$) and by dimension (access 0.81, operational 0.84, appraisal 0.78, application 0.80). Confirmatory factor analysis supported the four-factor structure ($\chi^2/df = 2.41$; CFI = 0.952; TLI = 0.943; RMSEA = 0.036, 90% CI 0.031–0.041; SRMR = 0.044).

Analysis. Analyses were performed in SPSS 29 and Stata 18. Group differences were tested by independent-samples t-test and one-way ANOVA with Bonferroni post-hoc correction. Hierarchical multiple regression entered demographic variables in Block 1, socioeconomic and access variables in Block 2, and social-mediation variables in Block 3. Socioeconomic concentration was quantified using the Erreygers-corrected concentration index against a wealth index derived by principal component analysis. Binary logistic regression modelled teleconsultation use. Significance was set at $p < 0.05$.

Ethics. Institutional ethics approval was obtained and written informed consent recorded from all participants, with thumb impression and independent witness where respondents were unable to sign.

Results

Sample characteristics. Table 1 presents respondent characteristics.

Table 1. Sociodemographic profile of respondents (n = 1,096)

Characteristic	Category	n	%
Age (years)	18–29	296	27.0
	30–44	351	32.0
	45–59	263	24.0
	≥60	186	17.0
Sex	Male	559	51.0
	Female	537	49.0
Education	No formal schooling	241	22.0
	Primary	285	26.0
	Secondary	329	30.0
	Higher secondary and above	241	22.0
Monthly household income (₹)	< 10,000	471	43.0
	10,000–20,000	405	37.0
	> 20,000	220	20.1
Device access	Personal smartphone	613	55.9
	Household smartphone only	296	27.0
	No smartphone access	187	17.1

Digital health literacy levels. Mean DHLI composite score was 41.6 (SD 15.2). Mean eHEALS was 21.4 (SD 6.8), and 311 respondents (28.4%) achieved the adequacy threshold. The two instruments correlated moderately ($r = 0.61$, $p < 0.001$), consistent with the view that eHEALS captures perceived confidence rather than the full competence range. Dimensional scores diverged sharply (Table 2).

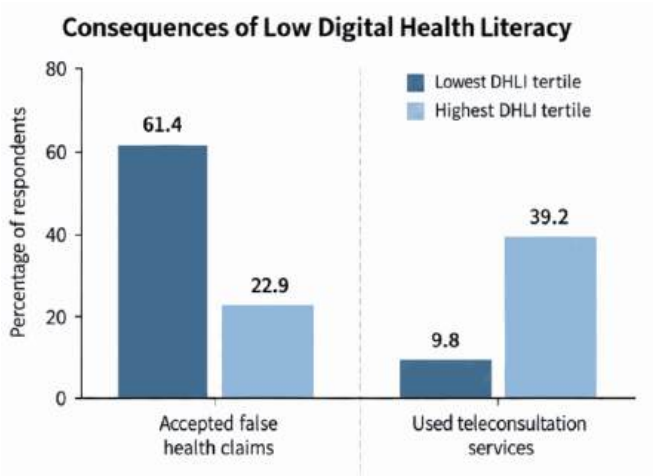


Table 2. DHLI dimension scores (n = 1,096)

Dimension	Mean	SD	95% CI	Cronbach's α
Access	52.3	17.8	51.2–53.4	0.81
Operational skill	45.9	18.6	44.8–47.0	0.84
Appraisal	33.1	16.4	32.1–34.1	0.78

Application	35.2	17.1	34.2–36.2	0.80
Composite	**41.6**	**15.2**	**40.7–42.5**	**0.89**

Repeated-measures ANOVA confirmed significant variation across dimensions ($F(3,3285) = 486.2$, $p < 0.001$, partial $\eta^2 = 0.307$), with appraisal significantly lower than every other dimension in post-hoc comparison (all $p < 0.001$).

Determinants. Bivariate differences were large and uniformly in the expected direction (Table 3).

Table 3. DHLI composite by respondent characteristics

Variable	Category	n	Mean (SD)	Test statistic	p
Education	No formal schooling	241	24.8 (12.1)	$F(3,1092) = 312.6$	< 0.001
	Primary	285	35.6 (13.4)		
	Secondary	329	45.2 (13.0)		
	Higher secondary +	241	60.5 (13.8)		
Sex	Male	559	45.8 (15.0)	$t(1094) = 9.72$	< 0.001
	Female	537	37.2 (14.3)		
Age (years)	18–29	296	51.7 (14.2)	$F(3,1092) = 178.4$	< 0.001
	30–44	351	45.3 (14.6)		
	45–59	263	35.8 (13.9)		
	≥60	186	26.9 (12.4)		
Device access	Personal smartphone	613	50.9 (13.9)	$F(2,1093) = 402.7$	< 0.001
	Household only	296	34.5 (12.7)		
	None	187	22.4 (10.8)		

Effect sizes were substantial for education ($\eta^2 = 0.462$) and age ($\eta^2 = 0.329$), and moderate for sex (Cohen's $d = 0.59$).

Hierarchical regression is reported in Table 4. Demographics alone explained 34.1% of variance; socioeconomic and access variables added 17.7 percentage points; social-mediation variables added a further 4.6, for a final model R^2 of 0.564 ($F(11,1084) = 127.3$, $p < 0.001$). Variance inflation factors ranged from 1.14 to 2.37, indicating no problematic multicollinearity.

Table 4. Hierarchical regression predicting DHLI composite (final model)

Predictor	B	SE	β	p
Education (years)	1.284	0.121	0.312	< 0.001
Age (years)	−0.318	0.039	−0.241	< 0.001
Female sex	−3.596	0.847	−0.118	< 0.001
Monthly household income	0.096	0.031	0.104	0.002
Personal smartphone ownership	8.147	0.934	0.268	< 0.001
Daily internet use	5.983	0.871	0.197	< 0.001
Distance to PHC (km)	−0.412	0.201	−0.058	0.041
Regional-language interface dependence	−2.771	0.958	−0.091	0.004
ASHA/CHW contact (past 3 months)	3.842	0.912	0.126	< 0.001
Chronic condition in household	1.310	0.870	0.043	0.132
Agricultural land ownership	0.944	0.884	0.031	0.287

Model: $R^2 = 0.564$; adjusted $R^2 = 0.560$; $F(11,1084) = 127.3$, $p < 0.001$

Distribution of information advantage. The Erreygers-corrected concentration index for DHLI was 0.238 (SE 0.021, $p < 0.001$), against 0.147 for conventional health literacy measured in the same sample, indicating that digital health capability is roughly 1.6 times more pro-wealthy than offline health literacy. Mean DHLI in the highest wealth quintile was 57.8 against 25.3 in the lowest, an inter-quintile ratio of 2.28.

Behavioural consequences. Acceptance of at least three of six false health claims declined monotonically across DHLI tertiles: 61.4% in the lowest, 42.7% in the middle and 22.9% in the highest ($\chi^2(2) = 148.6$, $p < 0.001$). Teleconsultation use in the preceding twelve months was reported by 260 respondents (23.7%) overall, rising from 9.8% to 22.1% to 39.2% across tertiles. ABHA identifier ownership stood at 31.5%, though only 12.4% of holders had ever retrieved a record using it.

Logistic regression (Table 5) identified DHL as the strongest modifiable determinant of teleconsultation uptake.

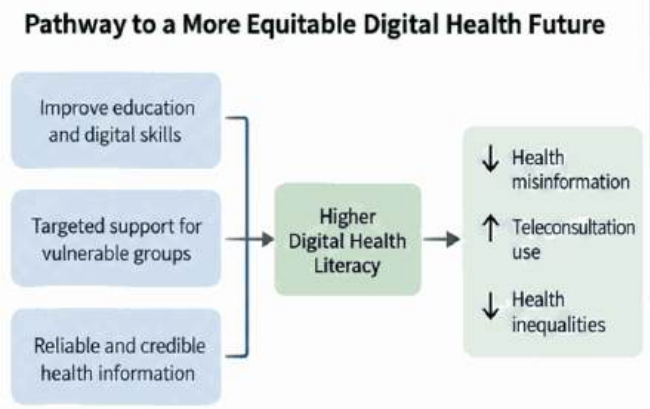
Table 5. Logistic regression predicting teleconsultation use (n = 1,096)

Predictor	aOR	95% CI	p
DHLI (per 10-point increase)	1.62	1.44–1.83	< 0.001
Personal smartphone ownership	2.14	1.49–3.07	< 0.001
ASHA/CHW contact	1.87	1.37–2.55	< 0.001
Female sex	0.74	0.55–0.99	0.043
Age ≥ 60 years	0.48	0.29–0.79	0.004

Model fit: Nagelkerke $R^2 = 0.284$; Hosmer–Lemeshow $\chi^2 = 7.42$, $p = 0.492$; AUC = 0.771

Discussion

Three findings carry policy weight. First, the internal profile of DHL is markedly uneven. Access scores exceeded appraisal scores by 19.2 points, meaning rural respondents can reach health content far more readily than they can judge it. This mirrors Nutbeam's argument that critical literacy is the scarcest tier and van Deursen and van Dijk's contention that inequality migrates from access to usage as infrastructure diffuses. Programmes measured on connectivity targets will therefore record progress while the binding constraint remains untouched.



Second, DHL is more steeply concentrated by wealth than offline health literacy. A concentration index of 0.238 against 0.147 implies that digitalisation has not merely carried existing inequality forward but sharpened it. The regression results explain why: personal smartphone ownership carried a standardised coefficient nearly as large as education, and respondents dependent on a shared household device scored 16.4 points lower than personal owners. Shared access is structurally gendered, which is consistent with the negative coefficient on female sex in both the regression and logistic models, and with the lower rural internet participation documented by Yadav and colleagues.

Third, low DHL has measurable downstream cost. The near-threefold gradient in misinformation acceptance and the fourfold gradient in teleconsultation uptake indicate that DHL operates simultaneously as a protective factor against harmful information and as a gateway to legitimate services. The 23.7% overall teleconsultation rate alongside 31.5% identifier ownership but only 12.4% record retrieval reproduces, at household level, the pattern Sood and colleagues observed nationally, where provider-mediated consultations vastly outnumber citizen-initiated ones. The strong association with ASHA contact (aOR 1.87) suggests that human intermediation currently substitutes for individual capability — an effective short-term bridge but a fragile foundation for self-service digital health.

Findings align closely with Rasekaba and colleagues' rural Karnataka results and with the awareness and education barriers reported by Kanwar and colleagues, supporting external validity beyond the two study states.

Implications

Three interventions follow directly from the data. Digital health training should prioritise appraisal and application rather than device operation, since operational skill is already 12.8 points ahead of appraisal. Device-sharing should be treated as an equity variable in its own right, with targeted handset or subsidised-access schemes for women and the lowest wealth quintile. Finally, ASHA and community health officer cadres should be formally resourced as digital health navigators, given their independent association with uptake.

Limitations

The cross-sectional design precludes causal inference. Self-reported measures may be subject to social desirability bias, particularly for device use and consultation history. The sample was drawn from two north Indian states and may not represent southern or north-eastern rural contexts with different literacy baselines. The misinformation instrument used locally circulating claims and may not be directly comparable across regions.

Conclusion

Digital health literacy in the studied rural population is low, internally uneven and systematically concentrated among wealthier, younger, better-educated and male respondents with personal device access. Appraisal capability lags access by a wide margin, and this gap translates directly into greater misinformation acceptance and lower use of public teleconsultation services. Expanding connectivity and issuing health identifiers will not, by themselves, deliver equitable digital health; without deliberate investment in evaluative capability and in the intermediaries who currently compensate for its absence, India's digital health transition

risks converting an infrastructure gap into a more durable information advantage for those already best served.

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