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Digital Inclusion and Equity in Maternal and Child Health Services in Uttar Pradesh

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Abstract:
Digital maternal and child health programmes depend on beneficiaries being reachable and able to understand and use information. This study examines inequalities in women's digital access in Uttar Pradesh using published National Family Health Survey 5 (NFHS-5) estimates. A descriptive secondary analysis extracted state, rural and urban percentages for own-use mobile phones, lifetime internet use and SMS-reading ability. Absolute gaps and rural-to-urban prevalence ratios were calculated from rounded published estimates. Phone access was 46.5% overall, 42.4% in rural areas and 59.9% in urban areas, giving a 17.5 percentage-point gap and a rural-to-urban ratio of 0.71. Internet use was 30.6% overall, 24.5% rural and 50.2% urban, a 25.7-point gap and ratio of 0.49. Among women with an own-use phone, SMS-reading ability was 65.7% overall, 60.4% rural and 77.7% urban. Published schooling contrasts also showed substantial differences in text capability. These measures describe digital opportunity and one component of capability; they do not establish private access, reliable assistance or successful conversion of digital engagement into health services. No individual-level association, mediation or intervention effect was estimated. The findings support accessible communication, confidential human assistance and equivalent non-digital routes. Evaluation should distinguish digital reach from comprehension, completed service use and quality of care.

Keywords: digital inclusion; health equity; maternal and child health; NFHS-5; Uttar Pradesh; rural–urban inequality

1 Introduction

Maternal and child health care depends on a sequence of contacts rather than a single encounter. Pregnancy registration, antenatal visits, birth planning, postnatal assessment, immunisation and referral require information to reach families at useful times. Digital reminders and records can support this process, but their usefulness depends on the conditions in which women receive and act on them. A reminder that reaches a household phone may never reach the intended beneficiary.

In Uttar Pradesh, differences between rural and urban women provide an important starting point for examining these conditions. NFHS-5 reports that fewer than half of women aged 15–49 had a mobile phone for their own use. Previous internet use was less common still. These population benchmarks matter for programme design because a service that assumes independent smartphone use may exclude some of the women it is intended to serve (International Institute for Population Sciences [IIPS] & ICF, 2021a, 2021b).

Digital inclusion therefore requires careful definition. This paper distinguishes opportunity, capability, engagement and service conversion. Opportunity concerns access to a usable communication channel. Capability concerns understanding and practical use. Engagement involves receiving or responding to an intervention. Service conversion means obtaining a relevant health service following that engagement. None of these stages should be treated as interchangeable.

The World Health Organization (WHO, 2019) places digital interventions within health-system strengthening. Its guidance makes clear that technology cannot compensate for a health system that does not function. In the same way, a successful message cannot resolve an unavailable appointment, unaffordable transport or poor treatment at a facility. Digital access is one condition of digitally supported care, not a sufficient explanation of health outcomes.

1.1 Scope and contribution

This paper provides a transparent analysis of published digital-access indicators and interprets their relevance for maternal and child health. Its empirical population is women aged 15–49 in Uttar Pradesh. It does not present a survey of pregnant women or caregivers, and the findings cannot be generalised automatically to male caregivers, older caregivers or a particular programme's registered beneficiaries. Its contribution is to quantify observable gaps while identifying the additional evidence needed to evaluate meaningful inclusion.

2 Literature and analytical perspective

Research on digital inequality shows why ownership alone is an incomplete measure of participation. LeFevre et al. (2020) examined women's phone ownership and reproductive, maternal, newborn and child health indicators across 15 countries. Their work establishes the relevance of women's access to phones for health research while also drawing attention to the social inequalities surrounding that access. Associations in comparative observational research do not establish the effect of a specific digital programme in Uttar Pradesh.

Veinot et al. (2018) explain how informatics interventions can reproduce disadvantage through unequal access, assumptions about users and differences in the benefits people obtain. This perspective directs attention to the experience of people who are absent from digital records. Counting registered users alone can conceal those unable to register or those whose records are maintained by intermediaries without meaningful participation.

Crawford and Serhal (2020) situate digital health within wider social determinants. Their framework is relevant because material resources, education and service organisation influence how a person can use technology. It supports an interpretation of residence as a marker of unequal circumstances rather than an explanation in itself. The present analysis does not identify which underlying factors account for the rural–urban differences.

WHO (2019) provides a complementary implementation perspective through attention to benefits, harms, feasibility, resources and equity. Together, these sources support a practical distinction between the availability of technology and a beneficiary's opportunity to obtain appropriate care. They also justify treating privacy and assistance as substantive dimensions that require measurement, rather than assuming them from ownership.

2.1 Research gap and objectives

The immediate evidence gap concerns the distance between published access measures and claims about effective digital care. Aggregate NFHS-5 tables can describe phone access, prior internet use and SMS-

reading ability. They cannot directly establish the prevalence of private on-demand use, dependable digital assistance or completed health services attributable to digital engagement.

The objectives are to describe the three published indicators by residence; calculate absolute and relative rural–urban inequalities; examine selected published schooling contrasts; and develop proportionate implications for maternal and child health services. The analysis is descriptive. It does not test mediation, moderation or causal effects, because the necessary linked individual-level data are unavailable in the published tables.

3 Methodology

3.1 Study design and data sources

The principal sources were the NFHS-5 Uttar Pradesh state report and state fact sheet (IIPS & ICF, 2021a, 2021b). Table 101 of the state report, on printed page 193, supplies own-use mobile-phone and SMS-reading estimates. The state fact sheet supplies residence-specific lifetime internet-use estimates.

3.2 Setting and source survey

NFHS-5 is a population-based household survey coordinated by IIPS under the Ministry of Health and Family Welfare. Uttar Pradesh fieldwork covered all 75 districts in two periods: 13 January to 21 March 2020 and 28 November 2020 to 19 April 2021. The state report records interviews in 70,710 households, with 93,124 women and 12,043 men. These are source-survey totals, not a newly recruited sample for this paper (IIPS & ICF, 2021a, 2021b).

The source survey used stratified multistage sampling, with villages as rural primary sampling units and census enumeration blocks in urban areas, followed by household selection. This paper uses the published weighted percentages rather than recalculating survey weights. The source report's methods govern the original sampling, field procedures and estimation.

3.3 Analytical population and denominators

The indicators concern women aged 15–49. Phone and SMS questions appear in the state-module subsample. Table 101 reports a weighted total of 13,654 women for the ownership-related estimates and 6,354 women with an own-use phone for SMS-reading estimates. These weighted counts must not be substituted for unweighted sample sizes or for the full female sample. The internet indicator is drawn separately from the fact sheet, and its denominator is not assumed to equal the Table 101 subsample.

SMS-reading percentages are conditional on having an own-use phone. They are not the percentage of all women who can read SMS. Preserving this distinction is essential when comparing indicators or considering the reach of a text-based programme.

Methodology continued

3.4 Extraction and operational definitions

Published values were transcribed by indicator, residence, population and denominator. Phone access was defined as having a mobile phone that the woman herself used; it was not relabelled as smartphone ownership or exclusive control. Internet experience was defined as ever having used the internet. SMS capability was defined as reported ability to read SMS among women with an own-use phone. Residence categories followed the source survey.

Privacy, assistance and digital-to-service conversion were retained as conceptual dimensions but excluded from numerical analysis because the selected NFHS tables do not measure them directly.

3.5 Statistical procedures

Two measures summarised inequality. The absolute gap was calculated as the urban percentage minus

the rural percentage, expressed in percentage points. The relative measure was the rural percentage divided by the urban percentage. A ratio below 1 indicates lower rural prevalence. Ratios were rounded to two decimals, and gaps to one decimal, consistent with the precision of the inputs. For schooling comparisons, the same subtraction principle was applied to the specified categories.

The analysis did not calculate confidence intervals or p values from rounded percentages and weighted counts. Valid design-based inference would require appropriate standard errors or survey microdata, including weights, strata and primary sampling units. No regression, mediation, factor analysis, Digital Inclusion Index or qualitative thematic analysis was performed. The three measures have different meanings and denominators and were not combined into a score or treated as a longitudinal cascade.

4 Results:

4.1 Rural and urban digital access

Own-use phone access was 46.5% statewide, compared with 42.4% in rural areas and 59.9% in urban areas. The absolute gap was 17.5 percentage points. The ratio of 0.71 indicates that the rural percentage was approximately 71% of the urban percentage. This is a descriptive comparison and does not isolate an effect of residence.

Lifetime internet use showed a larger absolute and relative inequality. The estimates were 30.6% overall, 24.5% rural and 50.2% urban. The urban–rural gap was 25.7 percentage points, and the rural-to-urban ratio was 0.49. Prior internet use was therefore substantially less common among rural women in these published estimates.

Table 1 Digital indicators and residence inequalities

Indicator	Overall %	Rural %	Urban %	Gap pp	Rural urban ratio
Own-use mobile phone	46.5	42.4	59.9	17.5	0.71
Ever used the internet	30.6	24.5	50.2	25.7	0.49
Can read SMS among own-use phone users	65.7	60.4	77.7	17.3	0.78

4.2 Text capability among phone users

Among women with an own-use phone, 65.7% reported being able to read SMS. The rural estimate was 60.4%, compared with 77.7% in urban areas: a gap of 17.3 percentage points and ratio of 0.78. Consequently, 39.6% of rural phone users and 22.3% of urban phone users did not fall within the reported SMS-reading category. These complements concern phone users only; they do not estimate inability among all women.The finding identifies a potential mismatch between phone-based reach and text comprehension. It does not reveal whether a particular health message was read, understood, trusted or acted upon.

4 Results continued

4.3 Published differences by schooling

Table 101 also permits a limited examination of education-related differences. Among women with no schooling, own-use phone access was 36.9%, compared with 65.8% among women with 12 or more completed years. The difference between these categories was 28.9 percentage points. SMS-reading ability among phone users was 7.3% and 96.4%, respectively, a difference of 89.1 percentage points (IIPS & ICF, 2021b).

Table 2 Selected schooling contrasts in published NFHS 5 estimates

Schooling category	Own-use phone %	SMS reading among phone users %
No schooling	36.9	7.3
Fewer than 5 years complete	44.0	17.4
5 to 7 years complete	40.7	44.8
8 to 9 years complete	39.3	74.4
10 to 11 years complete	40.8	92.6
12 or more years complete	65.8	96.4

Phone access did not increase consistently across every intermediate schooling category. SMS-reading ability showed a much clearer progression. This distinction suggests that device availability and basic text capability capture different aspects of digital opportunity. It would be inappropriate to infer that education alone caused either pattern, because age, household resources and other characteristics may differ across categories.

4.4 Boundaries of the findings

The report provides separate background-characteristic tables, but these contrasts do not establish intersectional estimates for combinations such as rural women without schooling. Likewise, a statewide SMS percentage cannot be assigned to pregnant women, caregivers or platform users without an appropriate subgroup analysis. These are substantive evidence gaps rather than zero-valued outcomes.

5 Discussion

5.1 What the inequalities imply

The principal finding is that digital opportunity was uneven before any specific maternal or child health intervention was considered. Rural women had lower own-use phone access and substantially lower previous internet use. A programme that makes independent internet use a routine entry condition would therefore begin with an unequal distribution of the resources it requires. This is a design concern inferred from the access pattern, not a measured rate of programme exclusion.

The SMS results add a distinct limitation. Even within the more selected group of women who had a phone for their own use, reported text-reading ability was incomplete. Phone access cannot therefore be used as a substitute for the ability to read a health reminder. The schooling contrasts reinforce this concern, although they do not show how women actually interpreted programme messages.

The findings are consistent with the broader literature's distinction between resources and effective participation. LeFevre et al. (2020) make women's phone access relevant to maternal and child health research. Veinot et al. (2018) show why programmes must examine differences in access and use when

evaluating benefits. Here, the evidence supports attention to communication barriers; it does not demonstrate that any digital intervention improved or worsened health outcomes.

5.2 Residence as an inequality marker

Differences may reflect education, income, age composition, infrastructure or household arrangements, but their contributions were not estimated. The same caution applies to urban women. The urban average includes women with widely different circumstances and should not be interpreted as universal readiness or as an estimate for women living in informal settlements.

5.3 Avoiding a false service cascade

Subtracting internet prevalence from phone prevalence would not identify a programme dropout rate. Multiplying the three published percentages would not estimate successful digital health use. Each stage of a service pathway needs a defined eligible population, a measured event and an appropriate denominator. This distinction protects the interpretation from apparently precise but unsupported conversion estimates.

5 Discussion continued

5.4 Assistance and confidentiality

Human assistance is a plausible response to unequal capability, but its availability and effects were not measured here. A worker may help a beneficiary understand a message or correct a record; the same arrangement may require time, travel or disclosure of sensitive information. Programmes should therefore assess whether assistance is timely, voluntary and confidential rather than counting every proxy interaction as successful inclusion.

Privacy also requires direct enquiry. An own-use phone can still be shared, monitored or unavailable at a critical time. Conversely, a woman without her own phone may have a safe and dependable communication arrangement. NFHS access estimates cannot distinguish these situations. The paper therefore makes no claim about the prevalence of household gatekeeping or gender-related restrictions in the study population.

5.5 Connecting communication to care

Digital engagement must be interpreted within the service environment. Understanding a reminder may help a woman plan a visit, but attendance may still depend on transport, appointment availability, household responsibilities and the quality of care offered. WHO (2019) emphasises evaluating digital interventions alongside health-system conditions. The present results support that approach without assigning unmeasured service failures to any particular cause.

Table 3 Evidence and proportionate programme responses

Observed evidence	Programme response to assess	Outcome requiring evaluation
Lower rural own-use phone access	Offer equivalent assisted and in-person routes	Successful access without a personal phone
Lower rural internet experience	Provide low-data and offline-compatible processes	Task completion under actual connectivity conditions
Incomplete SMS reading among phone users	Test understandable voice and visual communication	Comprehension and appropriate response
Strong schooling differences in SMS reading	Co-design communication with low-literacy users	Comprehension gaps across schooling groups

6 Implications for services and evaluation

6.1 Make access routes equivalent

Registration, counselling and referral should be available through practical routes for women with differing access conditions. An in-person option should provide the same entitlement and continuity as a digital route. Service monitoring can test whether people without personal phones experience additional visits, longer waits or unresolved records. These comparisons would convert a general inclusion principle into an observable implementation question.

6.2 Assess comprehension rather than delivery alone

Message dispatch is an administrative event. A useful evaluation should establish whether the intended beneficiary received the communication, understood the next step and could obtain assistance if needed. Short comprehension checks may be more informative than delivery receipts alone. Content should be tested with intended users, including women with little schooling, rather than relying only on staff judgement about readability.

6.3 Resource assistance and correction

Facilities need clear responsibility for helping users, correcting information and resolving failed transactions. Assistance should be accompanied by realistic staffing and time allocations. Workers should not be expected to absorb additional tasks without support. Confidentiality procedures should avoid unnecessary viewing of personal messages or disclosure of passwords and one-time passwords. Beneficiaries should be able to choose a safe contact arrangement.

6.4 Monitor gaps without inventing denominators

District monitoring should distinguish people eligible for a service from those already present on a platform. Relevant measures include successful contact, understood information, completed appointment, resolved referral and time to correct a record. Each measure requires a stated denominator and observation period. Comparisons by residence and schooling should be accompanied by adequate sample sizes and uncertainty estimates when primary or microdata analysis is undertaken.

7 Limitations and future research

The analysis relies on published aggregate estimates. It cannot adjust rural–urban differences for education, age, household wealth or social group, nor can it identify the experiences of particular beneficiaries. The full female survey total does not apply to every indicator. Conditional SMS estimates and rounded input values further limit comparisons and numerical precision.

The measures are narrow. Ever using the internet does not establish current connectivity, affordability, frequency or independent use. Having an own-use phone does not establish privacy, device type or uninterrupted access. SMS reading represents one basic capability and does not validate broader digital literacy, health literacy or application proficiency. Cross-sectional observations cannot establish a temporal or causal pathway to health-service outcomes.

Fieldwork occurred across two periods separated by the COVID-19 interruption. The analysis does not estimate the influence of that disruption. Technological access may have changed since the survey. State and residence averages also conceal district and within-group variation. The analysis cannot estimate outcomes for pregnant women, recently delivered women or caregivers as distinct populations.

7.1 A focused next study

A subsequent beneficiary study could recruit eligible women through community enumeration and facility catchment lists, including those absent from digital registers. Its sample size should be based on

a specified primary outcome and inequality contrast, with allowance for clustering and non-response. The study should directly measure phone control, privacy, current connectivity, assistance and task comprehension, then link consented observations to a defined service contact.

Qualitative interviews could examine how women negotiate access, choose assistance and resolve problems. A prospective design would help establish the ordering of digital contact and service receipt. Any regression or mediation analysis would require an explicit causal rationale, sufficient observations and appropriate adjustment; it should not be added simply because a conceptual pathway has been proposed.

8 Conclusion

NFHS-5 identifies substantial rural–urban inequalities in women's own-use phones, previous internet use and SMS-reading ability in Uttar Pradesh. These findings justify accessible communication and equivalent service routes while leaving the impact of specific digital programmes unresolved. Meaningful inclusion must ultimately be evaluated through understandable communication, safe participation and completed quality care. Access indicators provide a starting point for that evaluation, not evidence that its final outcomes have already been achieved.

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