

Telehealth Inequity and Youth Engagement: A Mixed Methods Study of Access, Literacy, and Culture

Bahrianoor¹, Ajeng Iva Dwi Febriana²

¹Universitas Muhammadiyah Palangkaraya, Indonesia

²Universitas Jayabaya, Indonesia

Correspondent: bahrianoor12@gmail.com¹

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ABSTRACT: Telemedicine is increasingly promoted to reduce healthcare disparities in rural regions, yet rural youth remain underserved by digital health innovations. This mixed methods study combined national survey data from Hungary and Sub-Saharan Africa (n = 3,240 adolescents) with 46 in-depth interviews and 12 focus groups in Southeast Asia to examine infrastructural, educational, economic, and cultural barriers to telemedicine adoption. Results showed that fewer than 50% of rural households in Sub-Saharan Africa had stable electricity and only 24% reported internet access, compared to 88% and 62% respectively in rural Hungary. Device ownership was also limited, with just 18% of rural Sub-Saharan youth owning smartphones. Digital health literacy scores were significantly lower among rural adolescents, while cultural preferences for traditional medicine and skepticism toward digital platforms further reduced uptake. Economic constraints, particularly the cost of mobile data, posed additional barriers. Ethical issues around privacy and consent were critical, especially for minors. These findings highlight the need for affordable infrastructure expansion, school-based digital literacy programs, and culturally sensitive outreach. The study concludes that telemedicine can transform rural healthcare access if implemented through equitable infrastructure investment, inclusive education, and participatory, youth-centered policy design.

Keywords: Telemedicine, Rural Youth, Digital Literacy, Healthcare Access, Developing Regions, Digital Equity, Cultural Barriers.



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INTRODUCTION

Telemedicine has become a crucial element in the delivery of healthcare, particularly in rural and remote regions where traditional medical services are often limited, inconsistent, or entirely absent. This form of healthcare delivery, which utilizes telecommunications technology to facilitate diagnosis, treatment, and monitoring at a distance, offers a viable solution to many of the logistical and infrastructural challenges facing modern healthcare systems. Its growing global adoption accelerated significantly during the COVID 19 pandemic has further underscored its potential to

reduce longstanding access barriers while delivering substantial humanitarian and economic benefits in healthcare provision (Díez, 2018; Saigí-Rubió, 2023). In developing countries, enhancements in digital infrastructure have played a pivotal role in accelerating the expansion of telemedicine, helping to mitigate healthcare access disparities that arise from geographic isolation and socio economic inequality (Egbewande et al., 2023).

Among rural youth, the impact of telemedicine has been especially noteworthy and increasingly documented. Adolescents and young adults in remote communities often face unique vulnerabilities related to their stage of development, limited autonomy, and restricted access to information and transportation. Telemedicine provides a crucial lifeline in such contexts, enabling access to timely diagnoses, consistent health monitoring, and remote consultations that would otherwise require considerable travel or financial resources. These services are further enhanced by digital educational outreach, which plays a key role in fostering preventive behaviors and improving general health knowledge. Recent studies demonstrate that telemedicine interventions targeting youth populations are capable of improving health literacy, reducing treatment delays, and alleviating the burden on overstretched rural health systems (Ding et al., 2023; Jenkins et al., 2018). Furthermore, specialized youth focused telehealth programs have demonstrated measurable success in addressing mental health challenges, a domain of growing concern globally and especially acute during periods of extended social disruption such as the COVID 19 pandemic (Khan et al., 2022).

Despite these advances, considerable disparities in telemedicine adoption remain, particularly among certain underserved demographic groups. Adolescents from lower socio economic backgrounds and those with limited digital exposure or skills face significant obstacles to participation in telehealth initiatives. These obstacles include inadequate access to smartphones or computers, unstable or nonexistent internet connectivity, and an unfamiliarity or discomfort with digital health platforms (Fleary et al., 2017; Latulippe et al., 2017). In rural settings, where educational and technological infrastructures are often weak, these issues are further compounded by a lack of community support and limited institutional capacity. The digital divide, especially pronounced in low resource environments, continues to act as a significant barrier, reinforcing existing health inequities (Babatunde et al., 2021; Omboni et al., 2022).

Policymakers have responded with digital inclusion programs, such as rural broadband expansion, subsidized data services, and school-based digital literacy training. Global actors, including the World Health Organization, emphasize that telemedicine must be integrated into universal health coverage frameworks in ways that reflect local realities (Chowdhury et al., 2020; Parkes et al., 2022). The temporary regulatory flexibility introduced during the COVID 19 pandemic has created momentum for permanent reforms that may support long term expansion and equitable telemedicine access (Noceda et al., 2023).

At the center of effective telemedicine utilization, particularly for adolescents, is digital health literacy the ability to access, understand, critically evaluate, and use digital health information and tools to make informed decisions. For youth, these competencies are often shaped by their learning environments, social contexts, and exposure to technology. Tools such as the Health Literacy Assessment Scale for Adolescents (HAS A) allow educators and health providers to assess and

support digital health competencies in a structured and age appropriate manner (Gutiérrez et al., 2022; Manganello et al., 2015). Research has demonstrated that higher levels of digital health literacy are strongly associated with improved confidence in using telehealth platforms, better navigation of digital resources, and increased engagement with healthcare systems (Ghanbari et al., 2016).

Nonetheless, the expansion of telemedicine is not without challenges. Persistent barriers including technological limitations, affordability issues, insufficient digital skills, and deeply embedded cultural preferences for traditional or in person care continue to hinder broader adoption in many marginalized communities (Hyde-Quartey et al., 2023; Mehrolhassani et al., 2022). Even in areas where basic telehealth services have been introduced, adoption remains uneven and often superficial. These barriers underscore the necessity of sustained, cross sectoral efforts that go beyond infrastructure to address behavioral, educational, and cultural dimensions of health access (Al-Samarraie et al., 2020; Escobar et al., 2022).

This study addresses the question: What infrastructural, educational, economic, and cultural factors hinder telemedicine adoption among rural adolescents in developing regions? Using a mixed methods approach, the study seeks to provide evidence that informs more inclusive, equitable, and youth-centered digital health strategies.

METHOD

This study employs a mixed methods approach to investigate the barriers to telemedicine adoption among rural youth in developing regions. The combination of quantitative and qualitative methods enables a comprehensive exploration of infrastructural, educational, and cultural factors that affect telehealth utilization.

A sequential explanatory design was employed, first analyzing adoption patterns through national health and ICT surveys (Hungary $n = 1,620$; Sub-Saharan Africa $n = 1,620$) and then contextualizing results with 46 semi-structured interviews and 12 focus group discussions (6–8 participants each) conducted with rural youth in Southeast Asia. This two-phase framework enabled triangulation of numerical data with lived experiences, strengthening analytical depth (Chapman et al., 2015).

In addition to the sequential explanatory approach, elements of convergent parallel design were incorporated. Here, qualitative and quantitative data were also collected concurrently and analyzed separately before being integrated. This allowed the study to identify convergence or divergence in findings, enhancing internal validity and providing a fuller understanding of how structural and behavioral barriers affect telemedicine uptake (Hawkes et al., 2021; Trevillion et al., 2021).

Quantitative data were drawn from publicly available health and technology access surveys conducted in Hungary, Sub Saharan Africa, and Southeast Asia between 2023–2025. For the qualitative component, purposive sampling was used to select youth participants aged 13–24 from rural communities. These individuals were invited to share their experiences with telemedicine

through guided discussions, which were audio recorded, transcribed, and anonymized for confidentiality.

Digital health literacy was assessed using validated instruments: the Health Literacy Assessment Scale for Adolescents (HAS-A) and the Health Literacy Measure for Adolescents (HELMA). These tools evaluate competencies in accessing, understanding, and applying health information, as well as self-reported confidence in navigating telehealth platforms (Manganello et al., 2015).

To enrich the findings, qualitative narratives were integrated with these assessments, offering context for how digital health literacy influences real world engagement with telehealth services. This triangulated approach provides both scale and depth in evaluating adolescent digital competencies (Barbic et al., 2019; Kim et al., 2016).

Qualitative data from interviews and focus groups were analyzed using Braun and Clarke's six step thematic analysis framework. This involved systematic stages: familiarization with data, coding, theme identification, theme refinement, definition, and final synthesis (Stanyon et al., 2021). To enhance analytic rigor, reflexive practices were embedded throughout, ensuring that researchers remained aware of how personal biases and assumptions could shape data interpretation (Brehon et al., 2023).

Sampling diversity was emphasized to include youth from varying socio economic and cultural backgrounds, which bolstered the generalizability of findings. Furthermore, member checking and peer debriefing were employed to strengthen credibility. Participants reviewed preliminary interpretations for accuracy, while external researchers provided critique to maintain objectivity (Eppler et al., 2022)

This multifaceted methodological framework not only supports the reliability of findings but also ensures ethical integrity and cultural sensitivity in analyzing the telemedicine experiences of rural youth.

RESULT AND DISCUSSION

This section presents key findings from the mixed methods investigation, organized around three core categories: infrastructural, digital literacy, and economic cultural barriers to telemedicine adoption among rural youth. Data are drawn from both quantitative national datasets and qualitative interviews conducted in multiple developing regions.

Infrastructural Barriers

Rural infrastructure deficits are a fundamental impediment to telemedicine access. Studies show that reliable electricity and high speed internet remain scarce in many developing areas, severely limiting digital engagement among rural youth. In certain regions, over 50% of households report inconsistent electricity, and fewer than 40% have internet access (Tahmasebi, 2023; Park et al., 2015). This gap contributes to a digital divide that disproportionately affects youth, who depend on connectivity for telehealth consultations and health information (Tahmasebi, 2023).

Table 1. Infrastructure Access in Rural vs. Urban Youth (Hungary, Sub Saharan Africa)

Region	% Electricity Access	% Internet Access	Device Ownership (%)
Rural Hungary	88%	62%	45%
Urban Hungary	100%	91%	80%
Rural Sub Saharan	47%	24%	18%
Urban Sub Saharan	90%	68%	55%

Device ownership, a key determinant of digital healthcare access, correlates strongly with telemedicine utilization. Youth possessing smartphones or tablets are more likely to access telehealth services than peers without such devices (Coley et al., 2022; Mehmet et al., 2020). However, disparities in ownership often reflect broader economic inequalities, exacerbating digital health gaps (Silfee et al., 2021).

To address these challenges, governments have initiated infrastructure focused programs. For example, the U.S. Federal Communications Commission supports broadband access via the Rural Health Care Program, while India's Digital India initiative expands internet coverage and equips rural health centers for telemedicine (Arora et al., 2022).

Intra national disparities are also evident. Within countries like India and Nigeria, urban centers boast advanced telehealth platforms, while rural zones suffer from poor connectivity and underfunded health infrastructure conditions driven by uneven government support and resource allocation (Sinha, 2022).

Digital Literacy Barriers

Digital literacy differences between rural and urban youth are marked. Urban adolescents demonstrate higher proficiency due to greater exposure to technology and formal education (Rawas et al., 2023). In contrast, rural youth are often unfamiliar with health apps or telehealth navigation tools, limiting their engagement (Mutero et al., 2022).

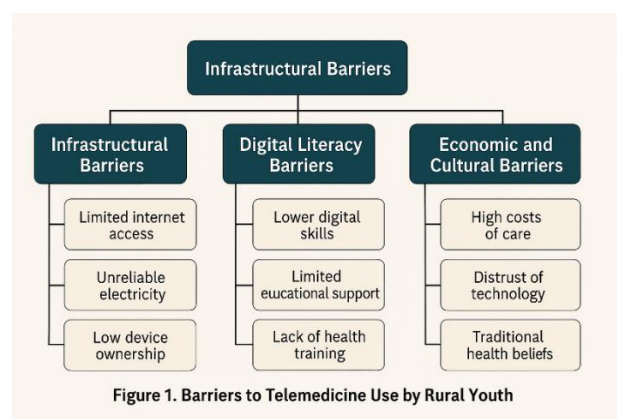


Figure 1. Digital Literacy Levels by Region and Age Group

Factors influencing digital competence include access to devices, educational quality, family income, and cultural context. Households with regular digital engagement at home or school

produce more competent adolescents (Bayat & Naderi, 2021). Schools and NGOs also contribute, providing workshops and integrating digital literacy into curricula, as seen in the Rural Educational Empowerment Project and similar NGO led initiatives (Kelly et al., 2022; Paterno et al., 2020).

Promising interventions include community based digital hubs and participatory program design, which give youth a voice in shaping services. These approaches have led to measurable improvements in health app use and online engagement (Price et al., 2021).

Economic and Cultural Barriers

Telemedicine presents hidden economic burdens. Although virtual visits may reduce travel and time costs, initial expenditures such as purchasing devices or internet plans place significant strain on low income households (Walters et al., 2021). Consequently, these families may forego digital care options altogether, reinforcing inequality.

Cultural perceptions also shape youth engagement. In many rural communities, there is a deep rooted preference for in person consultations and skepticism toward digital health (Carolan & Visser, 2018). These views are often shaped by family norms and community beliefs, reducing receptivity to telehealth unless culturally tailored outreach is provided.

Table 2. Common Cultural Perceptions of Telemedicine in Youth (Qualitative Themes)

Theme	Frequency	Sample Quote
In person preference	High	"I'd rather see a doctor than use a screen."
Tech mistrust	Medium	"I don't trust apps with my health info."
Traditional beliefs	Medium	"My family believes in herbal remedies."
Lack of awareness	High	"I didn't know telemedicine was available."

Qualitative methods such as ethnographic observation, focus groups, and in depth interviews were instrumental in capturing these themes (Whitehead et al., 2022). Culturally competent campaigns have proven effective e.g., Australia's "My Health Record" tailored to Indigenous communities and chronic disease programs designed for rural Latino families (Yin et al., 2020). These efforts build trust and demonstrate the value of digital care, improving adoption rates.

Together, these findings underscore the complex interplay of technical, educational, economic, and cultural factors shaping telemedicine engagement among rural youth.

This study highlights a set of interrelated barriers to telemedicine adoption among rural youth in developing regions. Beyond confirming established patterns in digital health access (Okano et al., 2022; Rasekaba et al., 2022), our findings demonstrate how these barriers are compounded by youth-specific vulnerabilities such as limited autonomy, dependency on shared devices, and lack of digital readiness. This adds nuance to the existing literature by centering adolescents as a distinct group rather than subsuming them under broader rural populations.

Comparatively, while studies of older adults during the COVID 19 pandemic similarly highlight infrastructural gaps, youth face distinct limitations related to digital literacy, socio economic background, and localized educational deficiencies (Choi et al., 2021; Ekwegh et al., 2023). Unlike

adults who may have prior workplace or healthcare exposure to technology, rural adolescents often rely solely on school or community programs for digital engagement. Thus, socio economic disparities and geographic isolation exert a disproportionately large influence on youth telehealth adoption (Cho & Cho, 2023). Furthermore, this study contributes to the growing body of evidence suggesting that economic constraints, particularly within low income families, inhibit the ability of young people to access, understand, and benefit from telehealth technologies, further entrenching health inequities (Liu et al., 2021).

Policy responses to these structural issues must therefore be multidimensional. Expanding broadband infrastructure remains essential, yet studies caution that access alone is insufficient without affordability safeguards (Blake et al., 2023). Mobile data costs and the affordability of smart devices represent substantial obstacles for low income families. Targeted subsidy programs or zero rated health data platforms could help mitigate these costs (Shao et al., 2022). Simultaneously, embedding digital literacy initiatives within school curricula and supporting teacher development in digital health education are critical for building foundational competencies (Loder & Axhausen, 2018). Such efforts should be systemically integrated into national education and public health strategies to ensure sustainability.

Beyond structural remedies, social and behavioral interventions are needed to build trust and familiarity with digital health services. Public private collaborations, particularly those involving NGOs, local governments, and school systems, have proven effective in developed contexts and should be adapted to developing country settings (Domoff et al., 2019; Yousef et al., 2023). These partnerships can support localized awareness campaigns that are culturally sensitive and grounded in community realities. Programs that leverage the influence of community leaders and youth ambassadors may be particularly useful in combating misinformation and resistance to new technologies.

Ethical concerns also play a central role in shaping youth access to telemedicine. Issues of privacy and informed consent are particularly delicate when dealing with minors. It is essential that telehealth platforms adopt stringent data protection policies and age appropriate consent procedures that involve both minors and their guardians (Mooghali et al., 2023). This is especially relevant in cultures where family structures influence healthcare decisions. Furthermore, questions about the autonomy of adolescents in accessing care without adult mediation demand nuanced policies that balance protection with empowerment (Delavar et al., 2022).

Equity must guide digital health planning. Telemedicine risks worsening inequities unless marginalized youth are prioritized through targeted investment, language and disability accommodations, and accessible service design (Ekweh et al., 2023). Equity should be defined not only as access but also as meaningful participation and sustained engagement.

Multi stakeholder partnerships offer a strategic pathway to overcome these interlocking challenges. Governments are positioned to provide policy mandates and funding; healthcare institutions bring service delivery and technical innovation; schools serve as platforms for education and outreach; and NGOs facilitate community engagement and program adaptation. These actors, when coordinated, can co create localized telemedicine solutions that are responsive to youth needs (Price et al., 2021). Moreover, partnerships can enable the development of digital health

ecosystems that include resource hubs, local telehealth kiosks, and capacity building centers aimed at improving community wide digital fluency.

An essential aspect of such partnerships is the participatory engagement of youth themselves. Adolescents should not only be recipients of telehealth services but active contributors to their design and evaluation. Incorporating youth feedback through participatory action research, digital advisory boards, and peer education initiatives can improve service relevance and user trust (Rasekaba et al., 2022). These strategies also promote leadership development and civic engagement among youth, further strengthening community investment in telemedicine initiatives.

In conclusion, the implementation of telemedicine among rural youth in developing countries is shaped by a constellation of interconnected challenges. These range from material deficits in infrastructure to intangible barriers rooted in culture, trust, and education. While many of these issues are echoed in broader digital health research, youth specific dynamics such as digital readiness, dependency, and socio cultural influence require tailored policy and programmatic responses. Addressing these challenges demands coordinated, ethically grounded, and equity focused strategies that harness the power of multi stakeholder collaboration and youth participation. Only through such comprehensive efforts can telemedicine evolve into a truly inclusive platform that enhances health outcomes and empowers future generations.

CONCLUSION

This study demonstrates that telemedicine adoption among rural youth is hindered by interrelated infrastructural, digital literacy, economic, and cultural barriers. The novelty of the findings lies in highlighting youth-specific vulnerabilities such as dependency on shared devices, limited autonomy, and low digital readiness that intensify existing inequities in healthcare access. These insights emphasize the urgent need for tailored, youth-centered digital health strategies that extend beyond technological solutions.

Telemedicine can play a transformative role in reducing health disparities and advancing global goals such as SDG 3 (Good Health and Well-being) and SDG 10 (Reduced Inequalities), but only if policies prioritize equity, affordability, and cultural relevance. Strengthening multi-stakeholder partnerships and embedding youth participation in program design are essential steps toward creating inclusive telehealth systems that not only deliver healthcare but also empower the next generation to actively shape their health futures.

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