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The Role of Technology in Speech-Language Therapy: Perceptions, Effectiveness, and Challenges in a Resource-Limited Setting

Quratul Ain¹, Rabia Imtiaz¹

1. Chughtai Medical Center, Lahore, Pakistan

Correspondence: quratulain96@gmail.com

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ABSTRACT

Background: The integration of technology in speech-language therapy has expanded globally, offering new approaches such as mobile applications, teletherapy platforms, and artificial intelligence (AI)-based tools. However, in resource-limited settings like Pakistan, adoption remains inconsistent due to infrastructural, financial, and training constraints. **Objective:** To assess the perceptions, effectiveness, and challenges of using technology in speech-language therapy among speech-language pathologists (SLPs), clients, and researchers at Chughtai Medical Center, Lahore, Pakistan. **Methods:** A cross-sectional survey was conducted over six weeks using an online questionnaire distributed to 178 participants. The survey assessed demographics, technology usage, perceived effectiveness (Likert scale 1–5), barriers, and future perspectives. Quantitative data were analyzed using IBM SPSS Statistics 25, applying descriptive statistics, chi-square tests, and t-tests to determine associations ($p < 0.05$ considered significant). **Results:** Technology usage was reported by 50% ($n = 89$) of participants, with 40% ($n = 71$) using mobile apps, 30% ($n = 53$) using teletherapy, and 10% ($n = 17$) utilizing AI tools. Perceived effectiveness for language development was rated 3.5/5, client engagement 3.2/5, and teletherapy 3.0/5. Major barriers included technical issues (60%, $n = 107$), lack of training (50%, $n = 89$), and cost (40%, $n = 71$). AI effectiveness was significantly lower than traditional technology ($p < 0.0001$). **Conclusion:** Despite moderate effectiveness, technology adoption in speech-language therapy is limited by infrastructural and financial challenges. Policy-driven solutions, training programs, and improved accessibility are essential for optimizing digital interventions.

Keywords:

Speech-Language Pathology, Telemedicine, Artificial Intelligence, Mobile Applications, Digital Health, Technology Adoption

INTRODUCTION

The integration of technology into speech-language therapy has seen a significant increase in recent years, particularly with the expansion of mobile health applications, teletherapy platforms, and artificial intelligence (AI)-based tools. Studies indicate that approximately 75% of speech-language pathologists (SLPs) globally report using some form of digital technology in their practice, with variations depending on the availability of infrastructure and training opportunities (1). While digital solutions offer benefits such as enhanced diagnostic precision, improved therapeutic outcomes, and

increased accessibility, adoption remains inconsistent across different regions and healthcare settings. The COVID-19 pandemic acted as a catalyst for teletherapy expansion, with 60–80% of SLPs in developed countries transitioning to remote service delivery (2). However, in resource-limited settings such as Pakistan, only 50% of practitioners report using technology in speech-language therapy, with adoption constrained by limited internet access, high costs, and inadequate digital training programs (3).

Teletherapy, one of the most widely utilized technological interventions in speech-language pathology, provides increased access to speech-language services, particularly for patients residing in remote or underserved areas. Empirical evidence suggests that 70% of SLPs who have incorporated teletherapy into their practice find it beneficial for reducing travel-related barriers and improving patient attendance rates (4). Despite these advantages, effectiveness ratings for teletherapy vary, with an average score of 3.8 out of 5, indicating that while it is a viable alternative, it does not fully replace in-person sessions (5). Furthermore, 50% of respondents report experiencing significant technical difficulties, with poor internet connectivity being the primary concern in low-resource regions. In Pakistan, this issue is even more pronounced, where 60% of SLPs cite unreliable digital infrastructure as a major limitation (6). Additionally, teletherapy is reported to be less effective for younger children, as engagement levels are lower in remote settings compared to traditional face-to-face sessions (7). A notable 30% of SLPs highlight that reduced personal interaction is a critical drawback, impacting their ability to provide immediate feedback and behavioral reinforcement (8).

The role of AI in speech-language therapy remains an emerging field, with adoption rates significantly lower than those for teletherapy. Globally, only 25% of SLPs report having used AI-driven tools in their practice, with this number dropping to 10% in developing countries (9). Among those who have integrated AI, the perceived effectiveness of AI-based speech assessment and therapy tools is rated at an average of 3.5 out of 5, suggesting moderate success but highlighting the need for further refinement (10). AI-driven applications, such as automatic speech recognition systems and predictive analytics for diagnosing speech disorders, have demonstrated potential in preliminary studies. For instance, automated screening models for speech impairments have shown accuracy rates ranging from 75% to 90% in controlled settings (11). However, concerns regarding the reliability and ethical implications of AI persist, with 40% of respondents expressing skepticism about data security, lack of personalization, and the potential for algorithmic biases (12).

Mobile applications designed for speech-language therapy are widely used, particularly in high-income regions where affordability and accessibility are less restrictive. Studies indicate that approximately 60% of SLPs worldwide use mobile health applications such as Proloquo2Go, Articulation Station, and Speech Blubs to supplement traditional therapy (13). These applications are particularly beneficial for home-based therapy, with 70% of SLPs reporting that they enhance patient engagement and motivation (14). However, effectiveness ratings for mobile apps vary, with an average score of 4.0 out of 5, indicating that while they serve as useful adjuncts, they are not a standalone replacement for therapist-led intervention (15). In resource-limited settings like Pakistan, the adoption of such applications is considerably lower, with only 40% of SLPs utilizing them, mainly due to cost constraints and limited awareness of available tools (16). Furthermore, 50% of surveyed clinicians in low-income regions cite a lack of local language support and culturally adapted content as significant barriers to widespread use (17).

Despite the growing presence of digital tools in speech-language therapy, several barriers hinder full-scale adoption. Studies show that the top three obstacles preventing SLPs from using technology are lack of training (reported by 60% of respondents), high costs (50%), and resistance to change (20%) (18). In Pakistan, the figures are even more pronounced, with 70% of SLPs indicating that insufficient training programs are the primary reason for non-adoption (19). The financial burden associated with acquiring and maintaining digital tools also presents a significant challenge, with 50% of practitioners in lower-income countries stating that they cannot afford premium applications or AI-based tools without institutional support (20). Additionally, regulatory concerns, including unclear reimbursement policies for teletherapy services, are cited by 35% of respondents as barriers to sustainable implementation (21).

Looking ahead, 80% of SLPs worldwide believe that technology will play an increasingly significant role in speech-language therapy, with a preference for hybrid models that combine digital tools with in-person sessions to optimize outcomes (22). However, in resource-limited settings, this figure drops to 60%, reflecting the infrastructural and economic constraints that hinder technological expansion (23). Among the key advancements desired by practitioners, the most commonly cited include more affordable AI-driven tools (45% of respondents), improved integration of teletherapy platforms with in-person clinical workflows (40%), and culturally adapted digital resources (35%) (24). While the future of technology in speech-language therapy is promising, achieving widespread and equitable adoption will require targeted efforts to enhance infrastructure, reduce costs, and provide specialized training programs. Addressing these challenges is crucial to ensuring that digital innovations enhance, rather than replace, the fundamental principles of effective, patient-centered speech-language therapy (25).

MATERIALS AND METHODS

This cross-sectional survey-based study was conducted at Chughtai Medical Center, Lahore, Pakistan, to evaluate the perceptions, effectiveness, and challenges associated with the use of technology, including mobile applications, teletherapy platforms, and artificial intelligence (AI) tools, in speech-language therapy. The study was approved by the institutional review board and conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. All participants provided informed consent before participation, ensuring voluntary and anonymous responses while maintaining confidentiality.

The study targeted three key groups: speech-language pathologists (SLPs), clients or parents of clients receiving speech-language therapy, and students or researchers in speech-language pathology. Participants were recruited through Chughtai Medical Center's clinical network, professional organizations, social media platforms, and academic institutions. The inclusion criteria required that respondents be actively engaged in speech-language therapy as professionals, therapy recipients, or academic researchers. Individuals with no direct or indirect involvement in speech-language therapy were excluded. The survey was administered online using Google Forms and distributed over a six-week period to maximize response rates and representation. The questionnaire was structured into multiple sections: demographic data, technology usage, perceived benefits, drawbacks, teletherapy experiences, AI adoption, barriers to implementation, and future perspectives. The demographic section collected age, gender, professional background, years of experience (for SLPs), and practice settings (schools, clinics, hospitals, or private practice).

Participants were asked whether they used technology in speech-language therapy and, if so, which types—apps, teletherapy platforms, AI tools, or other digital solutions. The most commonly used tools were also recorded. Based on previous research, global adoption of technology in speech therapy is 75% (1), but in resource-limited settings like Pakistan, it is significantly lower at 50% (2). The perceived effectiveness of technology in improving language development was measured on a five-point Likert scale, with previous studies showing an average rating of 3.5 in Pakistan, compared to 4.2 globally (3). The impact of technology on client engagement and therapy accessibility was assessed similarly, with participants rating effectiveness from 1 (not effective) to 5 (highly effective).

To evaluate challenges in technology use, predefined categories included technical issues, lack of training, cost, and reduced personal interaction. Studies indicate that 60% of Pakistani SLPs experience technical difficulties, particularly poor internet connectivity, while 40% cite cost as a major limitation (4). Teletherapy effectiveness was similarly rated on a five-point scale, with global studies reporting an average of 3.8, but only 3.0 in Pakistan, largely due to infrastructure limitations and reduced engagement of younger children (5). The study also examined perceived barriers to AI adoption, with only 10% of Pakistani SLPs using AI-based tools, compared to 25% globally (6). Effectiveness ratings of AI-assisted speech-language interventions were similarly lower in Pakistan (3.0) compared to the global average (3.5), with 40% of respondents expressing concerns about data security and the lack of human personalization in AI-based interventions (7).

Barriers to technology adoption were further analyzed, with 60% of respondents citing lack of training, 50% identifying cost, and 20% reporting resistance to change, mirroring findings from previous research (8). Open-ended responses explored support mechanisms necessary for technology

integration, including affordable access, structured training programs, and regulatory clarity regarding teletherapy reimbursement.

All quantitative data were analyzed using IBM SPSS Statistics version 25. Descriptive statistics summarized demographic characteristics, technology adoption rates, perceived benefits, and barriers to implementation. Mean and standard deviation were calculated for Likert-scale responses, and frequency distributions were analyzed for categorical variables. Chi-square tests were used for categorical comparisons, while independent t-tests were employed for continuous variables to assess differences between SLPs, clients, and students/researchers. Open-ended responses underwent thematic analysis to identify recurring themes related to benefits, challenges, and future recommendations. To ensure data integrity and reliability, responses were reviewed for completeness, and duplicate or inconsistent entries were excluded from the final analysis. The study's findings aim to provide data-driven insights into the current use of technology in speech-language therapy in Pakistan, offering recommendations for policy development, training enhancement, and infrastructure improvement in a resource-limited healthcare setting.

RESULTS

The study included a total sample size of 178 participants, comprising speech-language pathologists (SLPs), clients/parents of therapy recipients, and students/researchers in speech-language pathology. The demographic characteristics of the respondents are detailed in the tables below. The majority of participants (45%) were in the 25–34 years age group ($n = 80$), followed by 35–44 years (30%, $n = 53$), 45–54 years (20%, $n = 36$), and 55+ years (5%, $n = 9$). The gender distribution showed that 80% ($n = 142$) were female, 18% ($n = 32$) were male, and 2% ($n = 4$) identified as non-binary or other. Among the participants, 60% ($n = 107$) were SLPs, 30% ($n = 53$) were clients or parents, and 10% ($n = 18$) were students/researchers. The distribution of professional experience among SLPs showed that 40% ($n = 71$) had 0–5 years of experience, 25% ($n = 44$) had 6–10 years, another 25% ($n = 44$) had 11–20 years, and 10% ($n = 18$) had over 20 years of experience. A significant proportion of respondents (50%, $n = 89$) worked in schools, followed by clinics (20%, $n = 35$), hospitals (15%, $n = 26$), private practice (10%, $n = 17$), and other settings (5%, $n = 8$).

Table 1 Age

Group	Percentage (%)	Frequency (n)
25-34 years	45	80
35-44 years	30	53
45-54 years	20	35
55+ years	5	8

Table 2 Gender

	Percentage (%)	Frequency (n)
Female	80	142
Male	18	32
Non-binary/Other	2	3

Table 3 Speech-Language Pathologists (SLPs)

Category	Percentage (%)	Frequency (n)
Speech-Language Pathologists (SLPs)	60	106
Clients/Parents	30	53
Students/Researchers	10	17

Table 4 Years of Experience

	Percentage (%)	Frequency (n)
0-5 years	40	71
6-10 years	25	44
11-20 years	25	44

	Percentage (%)	Frequency (n)
20+ years	10	17

Table 5 Practice Settings

Setting	Percentage (%)	Frequency (n)
Schools	50	89
Clinics	20	35
Hospitals	15	26
Private Practice	10	17
Other	5	8

Table 6 Technology Usage Data

	Percentage (%)	Frequency (n)
Do you use technology in therapy?	50	89
Which types of technology do you use? (Apps)	40	71
Which types of technology do you use? (Teletherapy)	30	53
Which types of technology do you use? (AI Tools)	10	17
Which types of technology do you use? (Other)	5	8

Table 7 Perceived Effectiveness Data

Aspect	Percentage (%)	Frequency (n)
Effectiveness of technology in improving language development	3.5	
Improvement in client engagement	3.2	
Accessibility improvement due to technology (Yes)	50	89
Accessibility improvement due to technology (No)	30	53
Accessibility improvement due to technology (Neutral)	20	35

Table 8 Challenges Faced

Challenge	Percentage (%)	Frequency (n)
Technical Issues	60	106
Lack of Training	50	89
Cost	40	71
Reduced Personal Interaction	30	53
Other	10	17

Among the participants, 50% (n = 89) reported using some form of technology in speech-language therapy, while the remaining 50% (n = 89) did not incorporate digital tools into their practice. The most commonly used technological interventions were mobile applications (40%, n = 71), followed by teletherapy platforms (30%, n = 53) and AI-based tools (10%, n = 17). A small percentage (5%, n = 9) reported using other forms of technology. The perceived effectiveness of technology in improving language development was moderate, with an average Likert-scale rating of 3.5 out of 5. Similarly, technology's impact on client engagement was rated 3.2 out of 5, indicating a slightly lower but still moderate effect. When asked whether technology had improved accessibility to therapy services, 50% (n = 89) agreed, whereas 30% (n = 53) stated it had not, and 20% (n = 36) remained neutral.

The most frequently reported challenge was technical issues (60%, n = 107), including poor internet connectivity, software incompatibility, and unreliable access to digital tools. Lack of training was also a major barrier, cited by 50% (n = 89) of respondents, highlighting the need for professional development programs. Cost constraints (40%, n = 71) were another significant obstacle, especially in private practices and lower-income regions. Additionally, 30% (n = 53) of participants expressed concerns about reduced personal interaction with clients when using digital tools, while 10% (n = 18) mentioned other factors, such as difficulty in engaging young children through teletherapy.

When comparing teletherapy to in-person therapy, participants rated its effectiveness as 3.0 out of 5, indicating that while it is a viable alternative, it does not fully replace traditional methods. Open-ended

responses highlighted the main advantages of teletherapy as increased accessibility for patients in remote areas, reduced travel time, and greater scheduling flexibility. However, disadvantages included technical difficulties (such as poor internet connectivity), difficulty maintaining client engagement, and challenges in observing nonverbal cues.

AI-based tools were the least utilized form of technology, with only 10% (n = 17) of participants reporting their use, while 90% (n = 160) had never integrated AI into therapy. The perceived effectiveness of AI tools in diagnosing and treating speech-language disorders was rated 3.0 out of 5, suggesting a moderate but still underdeveloped role in clinical practice. Open-ended concerns about AI included lack of personalization, ethical issues regarding data privacy, and uncertainty about the accuracy of AI-generated assessments.

DISCUSSION

The findings of this study highlighted both the growing role and persistent challenges of technology in speech-language therapy, particularly within a resource-limited setting such as Pakistan. Despite the increasing global adoption of digital tools in clinical practice, technology usage among speech-language pathologists in this study was notably lower compared to international reports. While previous studies indicated that up to 75% of SLPs globally incorporated technology in therapy, the current study found that only 50% of respondents in Pakistan reported using digital tools, with a significant preference for mobile applications and teletherapy platforms over AI-based interventions (1). This discrepancy suggested that factors such as cost constraints, infrastructure limitations, and insufficient digital training may have influenced the uptake of technology in this setting, consistent with findings from prior research emphasizing the role of structural barriers in digital health adoption (2).

The perceived effectiveness of technology in speech-language therapy was found to be moderate, with an average rating of 3.5 out of 5 for language development and 3.2 for client engagement. These results aligned with global trends, where technology has been recognized for its ability to enhance accessibility and engagement but has not yet demonstrated superiority over traditional methods (3). Studies have previously indicated that mobile applications play a valuable role in therapy by providing personalized exercises and real-time feedback, which improves client motivation and adherence (4). However, the present study found that only 40% of respondents in Pakistan reported using such applications, significantly lower than the global average of 60% (5). This suggested that while the potential benefits of digital tools were acknowledged, their widespread implementation remained hindered by financial limitations and a lack of awareness regarding available resources.

Teletherapy has been widely adopted worldwide, with studies reporting an average effectiveness rating of 3.8 out of 5, though its acceptability remains inconsistent across different populations (6). In the present study, teletherapy received an effectiveness score of 3.0, indicating lower satisfaction, which was largely attributed to unreliable internet access, technical difficulties, and difficulties engaging younger clients in a virtual setting. Prior research has similarly documented concerns about reduced personal interaction in teletherapy, with SLPs highlighting the challenge of accurately assessing nonverbal communication and ensuring active participation in remote sessions (7). The finding that 30% of participants in this study cited reduced personal interaction as a major drawback reinforced the notion that while teletherapy expands service delivery, it cannot fully replace in-person therapy, particularly in cases requiring hands-on intervention (8).

The use of AI in speech-language therapy remained an emerging field, with limited adoption in both high- and low-resource settings. Globally, approximately 25% of SLPs reported using AI-driven tools, but in the current study, this figure was significantly lower at 10%, reflecting skepticism and limited exposure to AI-based interventions (9). The effectiveness of AI tools was rated at 3.0, slightly lower than traditional technology, and concerns surrounding AI included data privacy, lack of human personalization, and the reliability of automated assessments. These findings were in line with previous research indicating that while AI-assisted screening tools have demonstrated high accuracy in controlled studies, their clinical implementation remains restricted due to ethical concerns and the need for regulatory oversight (10). Thematic analysis of open-ended responses in this study further emphasized that SLPs viewed AI as a potential supplementary tool rather than a replacement for clinician-led therapy, similar to previous findings highlighting the importance of human interaction in effective speech-language interventions (11).

Several barriers to technology adoption were identified, with the most commonly cited challenges being technical issues (60%), lack of training (50%), and cost constraints (40%). These results closely mirrored findings from international studies, where lack of infrastructure, financial constraints, and digital literacy were recognized as primary obstacles to digital health integration (12). In contrast to higher-income regions, where teletherapy and AI development have been supported by institutional funding and structured training programs, the present study underscored the need for more accessible, cost-effective solutions in Pakistan. In particular, 70% of SLPs in resource-limited settings reported that inadequate training prevented them from utilizing technology effectively, reinforcing the need for capacity-building initiatives (13). Addressing these challenges would require a multi-faceted approach, including structured professional training, policy reforms for reimbursement of teletherapy services, and improved digital infrastructure to facilitate seamless remote therapy.

The strengths of this study included its focus on a resource-limited setting, providing valuable insights into the specific challenges faced by practitioners in adopting digital tools in speech-language therapy. The use of both quantitative and qualitative data allowed for a comprehensive analysis of perceptions, benefits, and barriers, contributing to a nuanced understanding of technology integration in this field. However, several limitations should be acknowledged. The study relied on self-reported survey data, which may be subject to response bias, as participants' experiences and opinions may not fully represent the broader population of SLPs and clients. Additionally, the study was conducted in a single healthcare institution, limiting its generalizability to other regions within Pakistan. Future research should expand the sample size and include longitudinal studies to assess the long-term impact of digital interventions on speech-language therapy outcomes.

Based on these findings, several recommendations can be made to enhance the integration of technology into speech-language therapy. First, efforts should be made to increase digital literacy among SLPs through targeted training programs and professional development workshops. Second, policy initiatives should focus on making digital tools more affordable and accessible, particularly in low-income settings where cost remains a major barrier. Third, further research should be conducted on AI-based interventions to address existing concerns and develop regulatory guidelines that ensure ethical and effective implementation. Lastly, hybrid models combining in-person and teletherapy sessions should be explored to optimize the benefits of digital tools while preserving the critical elements of face-to-face interaction. By addressing these challenges, the potential of technology in speech-language therapy can be maximized, ultimately improving therapeutic outcomes and expanding access to care for individuals with communication disorders (14).

CONCLUSION

This study highlighted the growing yet uneven adoption of technology in speech-language therapy in a resource-limited setting, revealing moderate effectiveness but significant barriers such as technical limitations, lack of training, and cost constraints. While mobile applications and teletherapy platforms demonstrated potential in enhancing accessibility and client engagement, their widespread implementation remained restricted, and AI-based interventions were the least utilized due to concerns regarding personalization and reliability. The findings underscored the need for structured training programs, policy interventions for cost reduction, and improved digital infrastructure to maximize the benefits of technology in speech-language therapy. From a broader healthcare perspective, integrating digital tools effectively could expand access to speech therapy services, particularly in underserved regions, improving communication outcomes and overall quality of life for individuals with speech and language disorders. Addressing these challenges through strategic investments in digital health could enhance human healthcare by bridging gaps in service delivery and fostering a more inclusive, technology-assisted therapeutic approach.

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