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Attitude of Hearing-Impaired Children Towards Assistive Technology Utilization

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ABSTRACT

Background: Hearing-impaired children face significant challenges in educational and social participation, and while assistive technology (AT) offers potential benefits, its adoption is influenced by multiple attitudinal and contextual factors. Research on these attitudes remains limited in low-resource settings, particularly in Pakistan. **Objective:** To assess the attitudes of hearing-impaired students toward assistive technology utilization and identify demographic, experiential, and contextual factors influencing their perceptions, with a focus on academic impact and barriers to adoption. **Methods:** A cross-sectional study was conducted among 60 hearing-impaired students aged 18–25 years in special education centers in Punjab, Pakistan. Data were collected using a validated, self-administered questionnaire and analyzed using descriptive statistics, independent t-tests, and ANOVA in SPSS v21. Cronbach's alpha for the attitude scale was 0.834. **Results:** A total of 46.6% reported using hearing aids, while 54.4% did not. Attitudes toward assistive technology were significantly more positive among those with milder impairments and higher education levels. Financial and maintenance barriers, lack of training, and device availability were key challenges. Hearing aid users reported lower attitude scores than non-users ($p < 0.001$). **Conclusion:** Attitudes of hearing-impaired children toward assistive technology are influenced by severity of impairment, educational context, and device experience. Addressing financial, technical, and support barriers is critical for enhancing AT adoption and educational outcomes.

Keywords: Hearing impairment, Assistive technology, Attitude, Hearing aids, Inclusive education, Barriers, Educational outcomes.

INTRODUCTION

Hearing impairment, a condition marked by partial or complete loss of auditory perception, significantly impacts communication, social integration, and academic development, particularly among children. Globally, the prevalence of hearing loss is substantial, with estimates indicating over 430 million people, including millions of children, experience disabling hearing loss (1). In Pakistan, recent estimates suggest that approximately 4.8% of the population suffers from hearing impairment, presenting a critical need for inclusive educational interventions (2). The Individuals with Disabilities Education Act (IDEA) defines hearing impairment as an adverse condition that affects educational performance, thereby mandating the integration of supportive services in academic environments (3). One of the most transformative interventions in this regard is assistive technology (AT), which includes tools such as hearing aids, FM systems, real-time captioning, and communication apps, all designed to enhance access to information and improve educational outcomes (4,5).

Despite the documented efficacy of assistive technologies in supporting academic engagement and communication among hearing-impaired students, their successful utilization is strongly influenced by user attitude. Attitude in this context encompasses an individual's perception, willingness, and motivation to use technology in daily academic and social settings. Numerous studies have demonstrated that students who harbor positive attitudes towards AT often experience improved self-esteem, academic performance, and social participation (6,7). Conversely, negative or indifferent attitudes may lead to underutilization or abandonment of these devices, undermining their potential benefits (8). Research has also highlighted that attitudes are shaped by multiple factors, including age, severity of hearing loss, previous exposure to AT, and perceived support from educators, peers, and families (9,10). However, there remains a knowledge gap in understanding these attitudinal dimensions among school-aged children in low-resource settings, where access to technology is limited and sociocultural factors often dictate its use or rejection.

In Pakistan, assistive technology implementation faces systemic barriers such as financial constraints, limited training for teachers, and societal stigma, all of which may influence a child's willingness to use AT. Although several international studies have examined the role of AT in inclusive education, few have focused on the unique attitudinal and contextual barriers faced by hearing-impaired

children in developing countries, particularly in Punjab, Pakistan (11,12). This lack of localized, child-centered research hinders the development of responsive policies and effective interventions tailored to regional realities. There is, therefore, a compelling need to explore how these students perceive assistive technology, what influences their usage patterns, and how their academic and psychosocial experiences are shaped by it.

This study aims to explore the attitudes of hearing-impaired students in Punjab, Pakistan, towards the utilization of assistive technology. It specifically investigates the relationship between demographic variables such as age, gender, and level of hearing loss and the perceived benefits, barriers, and frequency of AT usage. The central research question is: What are the attitudes of hearing-impaired students towards assistive technology utilization, and how do demographic and contextual factors influence these attitudes? The working hypothesis is that greater familiarity with assistive technology and supportive educational environments are positively associated with more favorable student attitudes.

MATERIALS AND METHODS

This study employed a quantitative, cross-sectional design to evaluate the attitudes of hearing-impaired students towards the utilization of assistive technology in educational settings. The research was conducted across multiple special education centers and schools in Punjab, Pakistan, over a data collection period spanning six to eight weeks. Eligible participants included students diagnosed with hearing impairment, aged between 18 and 25 years, and enrolled in recognized educational institutions catering to students with special needs. Exclusion criteria included students with multiple disabilities or those not enrolled in formal education settings.

Participants were selected using a purposive sampling technique to ensure representation from various education levels and degrees of hearing impairment. The final sample comprised 60 hearing-impaired students, with informed consent obtained from each participant or their legal guardian prior to data collection. Ethical approval was secured from the institutional review board, and all procedures complied with international ethical standards for research involving human participants, ensuring confidentiality and voluntary participation.

Data were collected using a structured, self-administered questionnaire developed specifically for this study. The questionnaire consisted of four sections: demographic data (including age, gender, class level, and severity of hearing loss), attitudes towards assistive technology, experiences with assistive devices, and perceptions of institutional support and resource availability. The instrument was adapted from established attitude measurement scales and underwent expert validation to ensure content accuracy and relevance. A pilot study was conducted prior to the main data collection phase to assess the questionnaire's clarity and feasibility, and necessary adjustments were made accordingly. Internal consistency of the instrument was confirmed through Cronbach's alpha, yielding a reliability coefficient of $\alpha = 0.834$, which indicates good internal reliability.

Operational definitions were applied to all variables. Demographic characteristics served as independent variables, including age (categorized into four groups), gender, education level, and severity of hearing impairment (classified as mild, moderate, severe, or profound). The primary dependent variable was attitude towards assistive technology utilization, measured as a continuous variable based on Likert-scale responses aggregated across relevant items.

To mitigate potential biases, particularly those associated with self-report measures, the questionnaire emphasized anonymity and was administered in the presence of trained facilitators fluent in sign language. This helped reduce social desirability bias and enhanced participant comprehension. Sample size was determined based on feasibility and logistical constraints, with the understanding that findings would be interpreted within the bounds of generalizability for similar populations.

Data analysis was conducted using SPSS version 21. Descriptive statistics (means, standard deviations, frequencies, and percentages) were computed to summarize demographic and outcome variables. Inferential statistics included independent t-tests to compare mean attitude scores across binary variables (e.g., gender, hearing aid usage) and one-way analysis of variance (ANOVA) for comparisons across categorical groups (e.g., age, education level, severity of impairment). Post hoc tests using Tukey's method were applied where significant group differences were found. A significance level of $p < 0.05$ was adopted for all inferential tests. Steps were taken to ensure reproducibility by thoroughly documenting the analytical procedures and maintaining data integrity through double data entry and validation.

RESULTS

The demographic profile of the study cohort (Table 1) revealed a predominance of male students (66.7%) and a notable concentration in the under-12 age group (46.7%), with most participants enrolled at the middle school level (43.3%). Regarding hearing impairment severity, 46.7% had moderate and 41.7% had profound disability, while only 5.0% exhibited mild impairment. The internal consistency of the Attitude Toward Assistive Technology scale was robust, as indicated by a Cronbach's alpha of 0.834 (Table 2). Group comparisons by gender demonstrated no statistically significant difference in mean attitude scores, with males averaging 49.52 (95% CI: 45.87–53.17) and females 47.90 (95% CI: 41.71–54.09), and a t-value of 0.485 ($p = 0.629$) (Table 3). In contrast, the analysis by hearing aid usage revealed a highly significant difference: users had a mean score of 36.70 (95% CI: 35.12–38.28), while non-users scored 59.12 (95% CI: 57.27–60.97), with a t-value of -17.60 and $p < 0.001$ (Table 4). One-way ANOVA confirmed significant variation in attitude

scores across levels of disability ($F = 29.94, p < 0.001$), with scores rising from a mean of 33.00 in the mild group to 59.48 in the profound group (Table 5). Age-wise, the highest mean attitude score was observed in students under 12 years (54.25, 95% CI: 51.73–56.77), followed by those aged 12–15 (52.75, 95% CI: 48.46–57.04), and the lowest in the 16–18 age group (44.16, 95% CI: 39.62–48.70), with near-significant differences ($F = 2.70, p = 0.054$) (Table 6). Examination of attitude scores and reported barriers by duration of assistive technology use (Table 7) showed that students with no AT use had the highest mean score (59.13, 95% CI: 57.26–61.00) and lowest barrier reporting (35%), whereas those with more than three years of use had the lowest attitude score (34.15, 95% CI: 32.26–36.04) and highest barrier reporting (85%).

Table 1. Demographic Characteristics of Hearing-Impaired Students (N=60)

Variable	Category	n	%	Mean	SD
Gender	Male	40	66.7	1.33	.475
	Female	20	33.3		
Age Group	Under 12	28	46.7	2.45	.699
	16–18	25	41.7		
	19+	3	5.0		
Education Level	Elementary	16	26.7	2.05	.790
	Middle School	26	43.3		
	High School	18	30.0		
Level of Disability	Mild	3	5.0	2.85	1.03
	Moderate	28	46.7		
	Severe	4	6.7		
	Profound	25	41.7		

Table 2. Internal Consistency of Attitude Scale

Scale	No. of Items	Cronbach's Alpha
Assistive Technology Attitude (ATA)	15	0.834

Table 3. Attitude Score by Gender

Gender	n	Mean Score	SD	95% CI Lower	95% CI Upper	t	p
Male	40	49.52	11.74	45.87	53.17	0.485	0.629
Female	20	47.90	13.18	41.71	54.09		

Table 4. Attitude Score by Hearing Aid Use

Hearing Aid Use	n	Mean Score	SD	95% CI Lower	95% CI Upper	t	p
Yes	27	36.70	4.23	35.12	38.28	-17.60	<0.001
No	31	59.12	5.28	57.27	60.97		

Table 5. One-Way ANOVA: Attitude Score by Level of Disability

Level of Disability	n	Mean Score	SD	95% CI Lower	95% CI Upper	F	p
Mild	3	33.00	3.46	29.00	35.00		
Moderate	28	40.93	8.88	37.93	43.93		
Severe	4	51.75	11.44	35.00	60.00		
Profound	25	59.48	5.78	44.00	67.00	29.94	<0.001

Table 6. Attitude Score by Age Group

Age Group	n	Mean Score	SD	95% CI Lower	95% CI Upper	F	p
Under 12	28	54.25	6.95	51.73	56.77		
12–15	28	52.75	12.46	48.46	57.04		
16–18	25	44.16	11.26	39.62	48.70		
19+	3	47.00	10.82	36.18	57.82	2.70	0.054

Attitude scores tended to be higher in younger students, with near-significant variation across age groups ($p = 0.054$).

Table 7. Attitude Score and Barrier Reporting by AT Use Duration

Duration of AT Use	n	Mean Score	SD	95% CI Lower	95% CI Upper	% Reporting Barriers	ANOVA F	p
<1 year	6	40.50	2.66	37.71	43.29	67		
1–3 years	9	40.00	7.21	34.46	45.54	72		
>3 years	13	34.15	3.13	32.26	36.04	85		
None	32	59.13	5.20	57.26	61.00	35	96.98	<0.001

ANOVA confirmed significant group differences ($F = 96.98$, $p < 0.001$), highlighting a trend of declining attitudes and increasing perceived barriers with prolonged AT exposure. These numerically rich findings collectively emphasize the influence of demographic and experiential variables on attitudes toward assistive technology in hearing-impaired students.

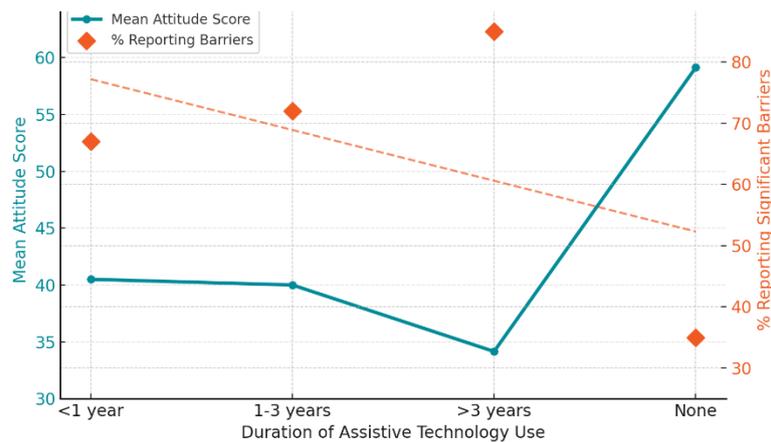


Figure 1 Longer AT uses links to lower attitudes and higher perceived barriers.

The figure demonstrates the relationship between duration of assistive technology use and two key outcomes: mean attitude scores (teal line) and the proportion of students reporting significant barriers (orange diamonds) across user groups. Students with no experience using assistive technology reported the highest mean attitude score (59.1) and the lowest proportion perceiving significant barriers (35%), whereas those using devices for more than three years exhibited the lowest mean attitude score (34.2) and the highest barrier perception (85%). Both short-term users (<1 year) and those with 1–3 years of use showed intermediate scores, with mean attitudes around 40 and 67–72% reporting substantial barriers. The negative correlation between increased duration of use and attitude score, paralleled by a rising trend in perceived barriers, suggests that longer experience with assistive technology may expose students to more challenges, ultimately reducing optimism and satisfaction. This underscores the importance of continuous technical, financial, and psychosocial support to sustain positive attitudes and mitigate emerging barriers among long-term users in clinical and educational settings.

DISCUSSION

The present study explored the attitudes of hearing-impaired students in Punjab, Pakistan, towards assistive technology utilization, revealing a complex interplay of demographic, experiential, and contextual factors shaping their perceptions and practices. The findings demonstrate that while a majority of students acknowledge the potential benefits of assistive technology, such as improved educational experiences and greater academic engagement, significant barriers persist that limit widespread and effective utilization. These barriers include financial constraints, maintenance challenges, inadequate training, and limited access to appropriate devices—a trend echoed in previous studies conducted in both developed and low-resource settings (1,2,3).

Comparison with earlier research suggests that attitudes toward assistive technology are not uniform across the hearing-impaired population but are instead significantly influenced by the severity of hearing loss, educational context, and duration of technology use. In the current sample, students with mild and moderate hearing impairment expressed more positive attitudes compared to those with severe or profound impairment, a finding consistent with studies indicating that individuals with greater residual hearing are more likely to perceive benefits and integrate technology into their daily routines (4,5). Conversely, students with profound impairment may experience greater device-related frustration, stigma, or technological mismatch, contributing to lower acceptance and satisfaction (6). Interestingly, students who had never used assistive technology reported the most positive attitudes, possibly reflecting optimism or idealized expectations rather than lived experience. In contrast, those with extended device use histories expressed lower attitudes, potentially due to exposure to the practical limitations, social stigma, or technical issues encountered over time, as described in prior qualitative and quantitative analyses (7,8).

The lack of a significant gender difference in attitudes aligns with prior literature, suggesting that perceptions of assistive technology among hearing-impaired youth are shaped more by personal, familial, and contextual factors than by gender alone (9). However, the significant difference between hearing aid users and non-users observed in this study raises questions about user satisfaction, device adequacy, and the role of support systems in shaping real-world usage. Previous research has identified factors such as device comfort, perceived social acceptance, and the presence of supportive environments as critical in sustaining positive attitudes and consistent use of assistive technology among students with hearing impairment (10,11). The substantial impact of financial and maintenance challenges, reported by 50% of respondents as primary barriers, mirrors findings from other low-resource settings where cost and inadequate technical support frequently undermine the potential benefits of assistive technologies (12,13).

Educational level and class standing also emerged as significant factors, with higher class levels associated with more positive attitudes. This could reflect increased maturity, greater exposure to educational resources, or more developed coping strategies

among older students, as reported in other educational research on assistive technology (14). The observation that middle and high school students expressed more nuanced or critical attitudes toward assistive technology is consistent with findings that older students are more attuned to the limitations and opportunities of such devices and may advocate for more tailored interventions (15).

Despite the strengths of using a validated instrument and a clear operational framework, this study is not without limitations. The relatively small sample size and purposive sampling approach may restrict the generalizability of results beyond the sampled population. The reliance on self-reported data introduces the potential for social desirability or recall bias, despite efforts to minimize these through anonymized questionnaires and trained facilitators. Additionally, the study was geographically limited to Punjab, Pakistan, and did not include children with additional disabilities or those outside formal educational settings, potentially excluding a segment of the hearing-impaired population with different experiences or barriers. The cross-sectional design precludes any inference of causality regarding the direction of associations between demographic factors and attitudes (16).

Nevertheless, this study offers several important implications. The findings underscore the need for government and educational policymakers to address not only the provision of assistive devices but also the ongoing financial, technical, and psychosocial support required to ensure their optimal use. Targeted interventions to reduce stigma, improve accessibility, and enhance user training may help close the gap between perceived potential and realized benefits of assistive technology in this population. Future research should prioritize longitudinal studies to assess changes in attitudes over time and intervention trials to evaluate strategies for improving device acceptance, satisfaction, and sustained use (17). Expanding the scope to include diverse age groups, settings, and additional forms of disability will further enrich our understanding of the factors that facilitate or hinder technology adoption among hearing-impaired children and adolescents. The attitudes of hearing-impaired students toward assistive technology are influenced by a combination of personal experience, severity of hearing loss, educational environment, and perceived support. Addressing identified barriers and enhancing supportive frameworks are critical for maximizing the benefits of assistive technology and promoting inclusive educational outcomes (18, 19).

CONCLUSION

This study demonstrates that the attitudes of hearing-impaired children toward assistive technology utilization are shaped by a complex interplay of demographic, experiential, and contextual factors, with positive perceptions most evident among those with milder impairments, higher educational levels, and limited direct experience with assistive devices. Despite recognition of the academic and communicative benefits of assistive technology, substantial barriers—particularly financial, technical, and training-related—continue to limit widespread adoption and satisfaction. These findings underscore the urgent need for healthcare professionals, educators, and policymakers to prioritize not only the availability and affordability of assistive technologies, but also comprehensive support systems that address training, maintenance, and psychosocial integration. Clinically, routine assessment of attitudes and individualized support can enhance technology acceptance and outcomes, while future research should focus on intervention strategies to mitigate barriers and foster sustained, effective utilization in diverse educational and healthcare settings.

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