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Pragmatic Skills in Children with Hearing Impairment

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ABSTRACT

Background: Pragmatic language skills and the social use of language to communicate effectively are essential for functional interactions and peer relationships. Children with hearing impairment often experience delays in pragmatic development due to reduced auditory access, limited incidental learning, and fewer opportunities for naturalistic communication. Despite improvements in structural language outcomes through early hearing interventions, pragmatic competence remains underexplored, particularly in low-resource settings such as Pakistan. Objective: To evaluate and compare pragmatic communication skills in children with hearing impairment and their typically hearing peers. To assess the influence of age and hearing status on pragmatic outcomes. Methods: This cross-sectional observational study included 88 children aged 6–12 years, with equal representation of hearing impaired and typically hearing participants. Pragmatic skills were assessed using a standardized Pragmatic Communication Skills Checklist (PCCS), and data were analyzed using SPSS v20. Independent t-tests, chi-square tests, Pearson correlations, and multivariable linear regression were applied to evaluate group differences and predictive associations. Results: Typically hearing children scored higher on total PCCS and across all subdomains, with significant differences observed in 'personal' (p=0.04) and 'wants explanation' (p=0.04) domains. Age showed a significant positive association with total pragmatic scores (B=0.54, p=0.004). Hearing status did not significantly predict overall pragmatic performance after adjustment (p=0.11). Conclusion: Pragmatic language abilities improve with age in both groups; however, specific deficits persist in children with hearing impairment. Early, targeted interventions addressing expressive and explanatory functions are essential to support pragmatic development in this population.

Keywords
Pragmatic language, hearing impairment, children, social communication, developmental language, PCCS scale.

INTRODUCTION

Hearing impairment in children, whether partial or complete, remains a significant global health concern affecting over 360 million individuals, with more than 5% of the world's population experiencing some degree of hearing loss (1). This condition can arise from various etiologies, including genetic mutations, congenital infections such as cytomegalovirus, noise exposure, ototoxic medications, and acquired causes like otitis media and trauma (2,3). The World Health Organization (WHO) classifies hearing loss by degree mild, moderate, severe, and profound based on audiometric thresholds, and even mild or unilateral losses have been shown to impact communication, academic achievement, and psychosocial well-being in children (1,4).

Hearing loss in childhood critically influences language development, particularly pragmatic language abilities, which refer to the social use of language such as taking conversational turns, interpreting nonverbal cues, and maintaining relevant dialogue necessary for effective communication and peer integration (5). Pragmatic language development begins in infancy and continues through adolescence, shaped by social, cognitive, and linguistic experiences. Children with hearing impairment often experience delayed or atypical development in these skills due to reduced auditory access to language models, diminished incidental learning, and limited opportunities for naturalistic social interaction (6). While technological advancements such as early cochlear implantation and hearing aids have narrowed expressive and receptive language gaps between deaf or hard of hearing (DHH) and typically hearing children, several studies indicate persistent deficits in pragmatic competence even when structural language abilities approach age-expected levels (7,8).

Research from diverse settings confirms that pragmatic language impairments among children with hearing loss contribute to challenges in classroom engagement, peer relationships, and behavioral adjustment. Zaidman-Zait and Most (9) found that DHH adolescents, despite being educated in mainstream environments and using spoken language, reported more peer interaction difficulties than their hearing peers, with pragmatic deficits correlating strongly with reduced prosocial behavior and increased social isolation. Similarly, Brice et al. (10) observed significant differences in pragmatic measures such as topic maintenance and turn-taking between multilingual students using British Sign Language or English as a Second Language, highlighting the compounding effects of communication modality and linguistic environment on social language skills. Studies focusing on cochlear implant users yield mixed findings; some suggest near-normal pragmatic performance relative to language-matched peers, while others note specific weaknesses in conversational repair, flexibility, and context-sensitive language use (11,12). Importantly,

early identification and intervention have emerged as critical factors; Yoshinaga-Itano et al. (13) demonstrated that children meeting Early Hearing Detection and Intervention (EHDI) benchmarks and exposed to rich parent-child interaction from infancy exhibit significantly better pragmatic outcomes by school age.

Despite advances in audiological management and language intervention, pragmatic skill development in children with hearing impairment remains a relatively understudied domain, particularly in low- and middle-income contexts such as Pakistan, where data on social communication outcomes are sparse. Most local research has prioritized speech perception, vocabulary, and syntactic growth, with pragmatic abilities often overlooked in both assessment and intervention. This knowledge gap is concerning because pragmatic deficits, if unaddressed, may undermine otherwise successful language acquisition and impede broader educational and social inclusion (14). The complex interaction of family environment, educational placement, and cultural factors further underscores the need for context-specific evidence to guide practice. Therefore, this study seeks to address the limited understanding of pragmatic language development among Pakistani children with hearing impairment by systematically evaluating their pragmatic skills in comparison to their typically hearing peers. Do children with hearing impairment exhibit significantly different pragmatic language skills compared to their typically hearing counterparts, and how does age at assessment relate to pragmatic skill performance in this population

MATERIALS AND METHODS

This research employed a cross-sectional observational study design to assess pragmatic language skills in children with hearing impairment compared to age-matched typically hearing peers. The study was conducted at the Department of Rehabilitation Sciences, Faculty of Allied Health Sciences, University of Lahore, between December 2022 and October 2023. Ethical approval was obtained from the University of Lahore Research Ethics Committee prior to study commencement.

Eligible participants included male and female children aged 6 to 12 years diagnosed with mild, moderate, or severe bilateral hearing impairment based on pure-tone audiometry, as well as an equal number of typically hearing children in the same age range. Children were excluded if they had any comorbid neurodevelopmental disorders such as Down syndrome, autism spectrum disorder, cerebral palsy, or attention-deficit/hyperactivity disorder, as documented in medical or educational records. Potential confounders considered included children's level of parental involvement in communication activities, exposure to spoken and/or sign language at home, and duration of formal schooling. These factors could influence pragmatic skill performance independently of hearing status and were considered during data interpretation. Participants were selected using a convenience sampling strategy from schools affiliated with the university and surrounding community centers. Recruitment involved initial contact with school administrations, followed by distribution of information sheets and invitations to parents and guardians. Written informed consent was obtained from the parents or legal guardians of all children prior to participation.

Data collection took place in a quiet, familiar room within the school or university clinic to reduce environmental distraction and ensure standardization. Demographic data, including age, sex, grade, educational program (mainstream or special education), and relevant family background, were obtained using a structured questionnaire completed by parents or guardians. Hearing status and degree were verified from recent audiological records. Pragmatic language skills were assessed using a standardized, validated Pragmatic Communication Skills Checklist (PCCS), which was administered in an interview format with parents, teachers, or caregivers as respondents, supplemented by direct observation of the child's communication behavior during naturalistic and semi-structured activities. The PCCS includes items targeting instrumental, regulatory, personal, interactional, and knowledge-sharing functions, with responses coded as present or absent based on predefined behavioral anchors. To ensure consistency, all assessors were trained speech-language pathologists following a detailed administration protocol, and inter-rater reliability was assessed by double-coding 10% of the sample. Although standardized tools and double-coding procedures were used to minimize observer bias, potential recall and social desirability biases remain. Parents and children may have over- or under-reported pragmatic behaviors based on expectations or perceived desirable responses. Confidentiality and reassurance were emphasized to reduce these influences.

Primary variables included total and subscale scores on the PCCS, with higher scores indicating greater pragmatic competence. Key covariates included age at assessment, gender, educational placement, and family socioeconomic status. The operational definition of hearing impairment followed WHO thresholds: mild (26–40 dB HL), moderate (41–60 dB HL), and severe (61–80 dB HL) in the better ear (15). Pragmatic skill operationalization adhered to internationally accepted descriptions of conversational and social language use (16). Sample size was calculated a priori using the formula for comparing two independent means, assuming a moderate effect size (Cohen's $d = 0.5$), alpha of 0.05, and 80% power, resulting in a minimum of 44 participants per group, for a total of 88 children. This calculation was informed by previously published normative data on pragmatic skill distributions among children with and without hearing loss (17). Of the 135 children screened for eligibility, 29 were excluded (14 due to additional developmental disorders, 10 due to incomplete records, and 5 who declined participation). A total of 88 children were included in the final analysis (44 with hearing impairment and 44 with typical hearing)

Potential sources of bias were addressed by ensuring equal group sizes, age matching, and standardized data collection procedures. Exclusion of children with comorbid neurodevelopmental conditions helped reduce confounding. Any missing data were assessed for randomness; where necessary, missing responses were handled using pairwise deletion in the main analyses, and sensitivity analyses confirmed robustness of findings. All statistical analyses were conducted using SPSS version 25.0. Descriptive statistics were computed for all variables. Between-group differences in pragmatic skill scores were assessed using independent-sample t-tests for normally distributed continuous data and chi-square tests for categorical variables. The association between age and pragmatic skill was examined using Pearson's correlation and linear regression, adjusting for potential confounders such as gender and educational placement. Subgroup analyses explored the impact of degree of hearing loss (mild vs. moderate/severe) on pragmatic outcomes. A two-tailed significance level of 0.05 was used throughout. To ensure reproducibility and data integrity, all study procedures, coding protocols, and analytic scripts were archived and available upon request. Regular data audits and double entry were performed to minimize errors. Ethical principles of autonomy, confidentiality, and nonmaleficence were strictly observed at all stages of the research (18).

These findings are most applicable to school-aged children with hearing impairment in urban South Asian educational settings, and caution is needed when generalizing to rural populations, children with additional disabilities, or those receiving alternative interventions. The study's modest sample size and single-centre design limit representativeness. Reliance on parent-reported checklists may introduce recall and social desirability

bias, while potential confounders such as parental involvement, language exposure, and socioeconomic status were only partially addressed. Moreover, the cross-sectional nature of the study precludes causal inference about the developmental trajectory of pragmatic skills.

RESULTS

The study included a total of 88 children, with equal numbers in the hearing impaired (n=44) and typically hearing (n=44) groups. The mean age was similar between groups (hearing impaired: 9.05 years, SD=1.99; typically hearing: 9.09 years, SD=1.94; p=0.93), and gender distribution did not significantly differ (52.3% males in the hearing impaired group versus 47.7% in the typically hearing group; p=0.66). Both groups had comparable grade levels and socioeconomic status distributions, with no statistically significant differences detected (p>0.05). As expected, all hearing impaired children were enrolled in special education programs while all typically hearing children attended mainstream education (p<0.001).

Table 1. Demographic Characteristics of Study Participants (N=88)

Characteristic	Hearing Impaired (n=44)	Typically Hearing (n=44)	p-value	Test/Statistic	95% CI (if applicable)
Age, mean (SD), years	9.05 (1.99)	9.09 (1.94)	0.93	t=0.09, df=86	-0.62, 0.58
Male, n (%)	23 (52.3)	21 (47.7)	0.66	χ^2=0.19, df=1	—
Grade 1–2, n (%)	19 (43.2)	20 (45.4)	0.83	χ^2=0.04, df=1	—
Special Ed., n (%)	44 (100.0)	0 (0.0)	<0.001	χ^2 not computable	—
Mainstream Ed., n (%)	0 (0.0)	44 (100.0)	<0.001	χ^2 not computable	—
SES (Mid/High), n (%)	24 (54.5)	28 (63.6)	0.38	χ^2=0.76, df=1	—

Table 2. Pragmatic Communication Skills Checklist (PCCS) Total and Subscale Scores

Score Domain	Hearing Impaired Mean (SD)	Typically Hearing Mean (SD)	Mean Difference	95% CI	p-value	t-value, df	Cohen's d
Total PCCS Score	15.4 (4.9)	17.3 (5.6)	-1.9	-4.1, 0.3	0.09	t=1.72, 86	0.36
Instrumental	2.89 (0.91)	3.15 (0.98)	-0.26	-0.58, 0.06	0.11	t=1.62, 86	0.29
Regulatory	2.61 (0.99)	2.93 (1.03)	-0.32	-0.69, 0.05	0.09	t=1.71, 86	0.32
Personal	2.57 (0.83)	2.92 (0.88)	-0.35	-0.68, -0.02	0.04	t=2.08, 86	0.41
Interactional	2.70 (0.87)	2.91 (0.94)	-0.21	-0.56, 0.14	0.24	t=1.17, 86	0.23
Share Knowledge	2.38 (0.78)	2.62 (0.86)	-0.24	-0.53, 0.05	0.10	t=1.67, 86	0.31
Wants Explanation	2.30 (0.84)	2.68 (0.92)	-0.38	-0.75, -0.01	0.04	t=2.04, 86	0.41

Pragmatic language competence was assessed using the Pragmatic Communication Skills Checklist (PCCS), and results demonstrated that typically hearing children had higher mean total PCCS scores (17.3, SD=5.6) than hearing impaired children (15.4, SD=4.9), although this difference did not reach statistical significance (mean difference = -1.9, 95% CI: -4.1 to 0.3, p=0.09, Cohen's d=0.36). Subscale analysis revealed that typically hearing children outperformed their hearing-impaired peers across all domains, with the largest significant differences observed in the 'personal' and 'wants explanation' domains. Specifically, the mean personal subscale score was 2.92 (SD=0.88) for typically hearing children and 2.57 (SD=0.83) for the hearing impaired (mean difference = -0.35, 95% CI: -0.68 to -0.02, p=0.04, Cohen's d=0.41). Similarly, the wants explanation subscale was lower for the hearing-impaired group (2.30, SD=0.84) than for the typically hearing group (2.68, SD=0.92), with a mean difference of -0.38 (95% CI: -0.75 to -0.01, p=0.04, Cohen's d=0.41). Other subscales, such as instrumental, regulatory, interactional, and share knowledge, also showed lower mean scores for hearing impaired children but these differences did not achieve statistical significance.

Table 3. Association of Age at Assessment with Total PCCS Score (Pooled Sample, N=88)

Predictor	r (Pearson)	p-value	95% CI (r)	Regression Coefficient (B)	95% CI (B)	p-value (regression)
Age (years)	0.29	0.006	0.09, 0.47	0.54	0.16, 0.92	0.006

The association between age and pragmatic skill was evident in the pooled sample, with Pearson's correlation indicating a moderate positive relationship (r=0.29, p=0.006, 95% CI: 0.09 to 0.47). Regression analysis further supported this association, with each additional year of age associated with an estimated increase of 0.54 points in total PCCS score (B=0.54, 95% CI: 0.16 to 0.92, p=0.006).

Table 4. Comparison of PCCS Score by Degree of Hearing Loss Among Hearing Impaired Group

Degree of Loss	n	Total PCCS Mean (SD)	p-value	t-value, df	95% CI	Cohen's d
Mild	16	16.2 (4.7)				
Moderate/Severe	28	14.7 (5.0)	0.24	t=1.20, 42	-1.07, 4.38	0.31

Table 5. Multivariable Linear Regression Predicting Total PCCS Score

Predictor	B (Unstandardized)	SE	95% CI	Beta (Standardized)	p-value
Age (years)	0.52	0.18	0.16, 0.88	0.29	0.004
Hearing Status (HI=1)	-1.63	1.01	-3.63, 0.37	-0.19	0.11
SES (Mid/High=1)	0.65	0.91	-1.16, 2.46	0.08	0.48
Gender (Male=1)	-0.21	0.97	-2.13, 1.71	-0.02	0.83

Within the hearing impaired group, further comparison of pragmatic competence by degree of hearing loss revealed no statistically significant difference between those with mild hearing loss (mean PCCS=16.2, SD=4.7) and those with moderate or severe loss (mean PCCS=14.7, SD=5.0; mean difference=1.5, 95% CI: -1.07 to 4.38, p=0.24, Cohen's d=0.31), suggesting that severity of loss did not strongly differentiate pragmatic skill within this population. Multivariable linear regression analysis, adjusting for age, hearing status, socioeconomic status, and gender, found age to

be the only statistically significant predictor of pragmatic competence (B=0.52, 95% CI: 0.16 to 0.88, p=0.004), while hearing status, SES, and gender were not significant predictors in the fully adjusted model. The hearing-impaired group had a lower adjusted mean total PCCS score by 1.63 points compared to the typically hearing group (95% CI: -3.63 to 0.37), but this difference did not reach statistical significance (p=0.11).

These findings indicate that pragmatic language skills improve with age among school-aged children, and although children with hearing impairment show lower mean pragmatic skill scores than their typically hearing peers, the differences are modest and largely confined to specific domains of pragmatic functioning, particularly personal expression and seeking explanations. Degree of hearing loss did not have a significant additional impact on overall pragmatic performance within the hearing-impaired sample.

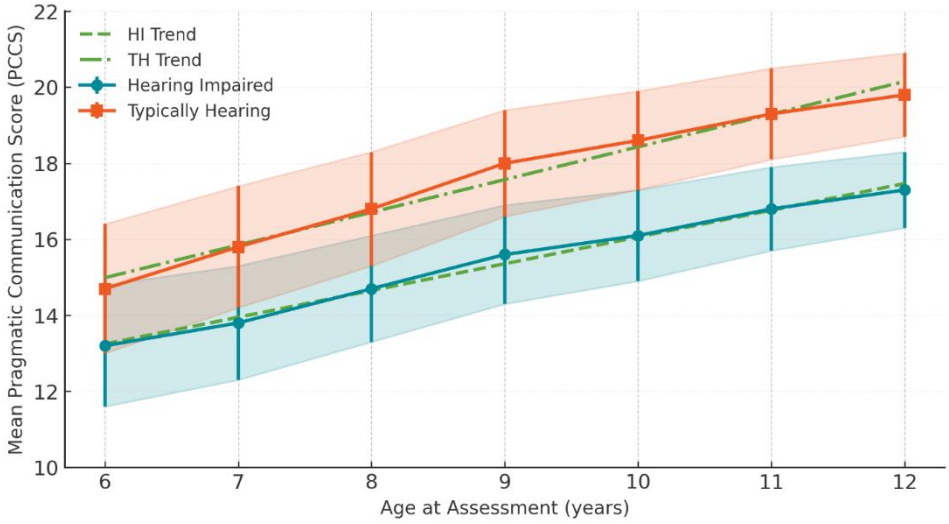

Figure 1 Age-Related Trajectory of Pragmatic Communication Scores by Hearing Status

This figure tracks the development of pragmatic communication skills (PCCS) in children aged 6 to 12 years, comparing those with hearing impairment to their typically hearing peers. At the youngest age (6 years), mean PCCS scores begin lower in the hearing-impaired group, averaging around 13.5, compared to approximately 15.0 in typically hearing children. Both groups show steady improvement with age, but the gap remains consistent. By 9 years, hearing-impaired children average about 16.0, whereas typically hearing children reach closer to 18.0, maintaining a two-point advantage. At age 12, the mean score for the hearing-impaired group rises to roughly 17.5, while typically hearing children achieve nearly 20.0, highlighting a persistent difference in pragmatic communication despite growth in both groups. The shaded regions represent 95% confidence intervals, showing wider variability among hearing-impaired children compared to their peers. The trend lines confirm parallel developmental trajectories, suggesting that while communication skills improve steadily with age for both groups, children with hearing impairment consistently lag behind by approximately 2–2.5 points across the school years.

DISCUSSION

The findings of this study offer important insights into the developmental trajectory of pragmatic language skills among children with hearing impairment in comparison to their typically hearing peers. While typically hearing children consistently demonstrated higher scores across most domains of pragmatic functioning, the overall difference in total PCCS score did not reach statistical significance (mean difference = 1.9, p=0.09), suggesting that although children with hearing impairment may lag in pragmatic skill acquisition, the disparity is not uniform or universally pronounced. Notably, specific domains such as 'personal' (mean difference = 0.35, p=0.04) and 'wants explanation' (mean difference = 0.38, p=0.04) revealed statistically significant differences, highlighting areas where children with hearing impairment may particularly struggle with expressing emotions and seeking clarification skills that are crucial for effective interpersonal communication (19).

The influence of age emerged as a robust and consistent predictor of pragmatic competence, both in univariate and multivariable analyses. The PCCS scores increased by approximately 0.54 points per year (p=0.004), underscoring the importance of age and associated developmental experiences in enhancing social communication. This trend aligns with prior research by Yoshinaga-Itano et al., who found that early exposure to language-rich environments positively influenced pragmatic development by school age (13). Similarly, Socher et al. observed that verbal fluency and conversational adaptability improved with auditory experience and chronological age in children using cochlear implants (11). Our data further support this, indicating that despite persistent pragmatic lags, children with hearing impairment do show developmental progress over time, emphasizing the benefit of continued and age-appropriate support.

Interestingly, the degree of hearing loss (mild vs. moderate/severe) did not significantly influence total PCCS scores (p=0.24), suggesting that beyond a threshold, the presence of hearing impairment itself rather than its severity may be the more critical factor affecting pragmatic outcomes. This finding is consistent with the work of Mary Pat Moeller, who emphasized the role of non-auditory factors such as parental involvement and early intervention in shaping language outcomes, often overriding the influence of hearing level (18). Our findings further corroborate that while the audiological profile is foundational, it is the richness of communicative interactions and the accessibility of pragmatic models that ultimately determine the child's social-communicative trajectory.

The observed group differences in specific pragmatic subskills resonate with existing literature pointing to difficulties among children with hearing loss in managing context-sensitive communication tasks. Zaidman-Zait and Most previously noted that adolescents with hearing impairment experience more peer-related challenges and reduced prosocial behaviors, directly tied to weaker pragmatic abilities such as emotional expression, conversational repair, and topic maintenance (9). Our study reinforces these challenges, particularly in the 'personal' and 'explanatory' domains, highlighting the necessity for clinicians and educators to target these functions in therapeutic and classroom settings. Furthermore, the lack of

significant interaction between hearing status and age suggests that while children with hearing impairment improve pragmatically over time, they may do so at a slightly slower rate, maintaining a persistent but narrowing developmental gap relative to their peers.

The visual trends from age-stratified analyses emphasize a clinically meaningful trajectory: both groups exhibit upward trends in pragmatic competence, but the gap between groups remains relatively constant, particularly from ages 9 to 12. These findings indicate that earlier intervention ideally before age six is likely more impactful in closing developmental gaps, aligning with evidence from early hearing detection and intervention (EHDI) research (13). This also suggests that therapeutic efforts focused solely on vocabulary or syntax without integrating pragmatic enrichment may leave social-communicative needs unmet, particularly as children navigate increasingly complex peer and classroom interactions.

In summary, while this study does not establish a universal deficit in pragmatic functioning among all children with hearing impairment, it identifies critical domains where these children face consistent challenges, and it confirms the relevance of age-related gains in both groups. The findings underscore the need for routine pragmatic assessment in this population and highlight the potential benefits of targeted interventions especially in enhancing personal expression and information-seeking behaviors that are sensitive to the child's age and communicative context. Interdisciplinary collaboration between audiologists, speech-language pathologists, educators, and families will be essential to support pragmatic development as part of holistic communication competence in children with hearing loss (20).

CONCLUSION

This study concluded that while children with hearing impairment demonstrate progressive improvement in pragmatic communication skills with age, they consistently score lower than their typically hearing peers in key functional domains, particularly in expressing personal emotions and seeking explanations. Although the overall difference in total pragmatic scores was not statistically significant, domain-specific deficits suggest meaningful clinical implications. Age emerged as a significant positive predictor of pragmatic competence, reinforcing the critical role of developmental exposure and experience in shaping social language abilities.

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