JHWCR JOURNAL OF HEALTH, WELLNESS AND COMMUNITY RESEARCH 3007-0570

Original Article Volume 4, Issue 2

Prevalence of Speech and Hearing Impairment in Children with Cerebral Palsy in Muzaffarabad Azad Jammu and Kashmir and Its Suburbs

Maryum Naseer Butt[1], Wajida Perveen[2], Hafiz Muhammad Usama Basheer[3], Maria Khalid[4], Zainab Javed[5], Bushra Raheem[6]

[1] Physiotherapist, Muzaffarabad Physical Rehabilitation Centre, Muzaffarabad, Azad Jammu and Kashmir, Pakistan
[2] Associate Professor and HOD, School of Allied Health Sciences, CMH Lahore Medical College and Institute of Dentistry (NUMS), Lahore, Punjab, Pakistan
[3] Audiologist, Services Hospital, Lahore, Punjab, Pakistan
[4] Senior Clinical Physiotherapist, School of Allied Health Sciences, CMH Lahore Medical College and Institute of Dentistry (NUMS), Lahore, Punjab, Pakistan
[5] Lecturer, School of Allied Health Sciences, CMH Lahore Medical College and Institute of Dentistry (NUMS), Lahore, Punjab, Pakistan
[6] Islamabad Physio Cure, Islamabad, Islamabad Capital Territory, Pakistan
* Correspondence: Wajida Perveen, wajida_perveen@cmhlahore.edu.pk

ABSTRACT

Background: *Cerebral palsy (CP) is a non-progressive neurodevelopmental disorder frequently accompanied by communication-related comorbidities that can substantially limit rehabilitation participation and long-term functioning, particularly in resource-constrained settings.* ***Objective:*** *To determine the prevalence of speech and hearing impairment among children with CP in Muzaffarabad, Azad Jammu and Kashmir (AJK), and to assess associations with CP subtype and gross motor severity, alongside patterns and barriers to accessing relevant services.* ***Methods:*** *A cross-sectional observational study was conducted at the Muzaffarabad Rehabilitation Centre using retrospective record review of children with CP aged ≥2 years who attended between January 2018 and February 2020. Sociodemographic and clinical variables, CP subtype, GMFCS level, documented speech and hearing impairment, and service utilization/barriers were extracted using a structured proforma. Associations were examined using chi-square tests with effect sizes.* ***Results:*** *Among 225 children (mean age 5.03±3.31 years), speech impairment was present in 70.2% (158/225; 95% CI 64.2–76.2), comprising 58.7% (132/225) with speech impairment only and 11.6% (26/225; 95% CI 7.4–15.8) with combined speech and hearing impairment; isolated hearing impairment was not documented. Combined impairment was more frequent in spastic quadriplegic than spastic diplegic CP (22.3% vs 7.3% within the speech-impaired subgroup; p=0.03), and CP subtype was strongly associated with GMFCS severity (p<0.001). Service uptake was minimal: 94.3% (149/158) had never consulted a speech therapist and no child received therapy sessions; no child with hearing impairment underwent ENT evaluation.* ***Conclusion:*** *Speech impairment was highly prevalent and clustered with severe motor phenotypes, while hearing impairment was less frequently documented and occurred with speech impairment; profound gaps in access to speech and hearing services highlight the need for integrated multidisciplinary care pathways in AJK.*

Keywords: *cerebral palsy; speech impairment; hearing impairment; GMFCS; rehabilitation; service access; Pakistan; Azad Jammu and Kashmir*

Received: 15 December 2025
Revised: 07 January 2026
Accepted: 20 January 2026
Published: 30 January 2026

Citation: Click to Cite

INTRODUCTION

Cerebral palsy (CP) is a non-progressive neurodevelopmental disorder resulting from injury to the developing brain during the prenatal, perinatal, or early postnatal period, and is characterized primarily by abnormalities of movement and posture (1). Beyond motor dysfunction, CP is frequently accompanied by multiple associated impairments including intellectual disability, epilepsy, visual deficits, speech disorders, and hearing impairment, all of which substantially influence functional independence and quality of life (2,3).

Contemporary classification systems describe CP according to motor type (spastic, dyskinetic, ataxic), topographical distribution (hemiplegia, diplegia, quadriplegia), and functional severity using the Gross Motor Function Classification System (GMFCS), which provides prognostic insight into mobility and participation outcomes (2,3). Increasing evidence also suggests that specific etiological factors, such as congenital cytomegalovirus infection, are associated with more severe neurological phenotypes and higher rates of sensory impairments, including hearing loss, compared to the broader CP population (4–6). These observations underscore the complex, multisystem nature of CP and highlight the need for comprehensive evaluation beyond motor disability alone.

Speech and hearing functions are central to communication, social participation, educational attainment, and rehabilitation engagement in children with CP. Speech disorders in CP encompass dysarthria, phonological and articulation impairments, and childhood apraxia of speech, frequently arising from impaired neuromuscular control of the speech mechanism (7,8). Reported prevalence of speech impairment in CP varies widely, with estimates ranging from one-third to nearly two-thirds of affected children, depending on case definition and assessment methodology (7). Hearing impairment, another critical sensory comorbidity, may result from central or peripheral mechanisms and can significantly hinder cognitive development, language acquisition, and participation if undetected or unmanaged (9,10). Epidemiological data indicate that hearing impairment in children with CP ranges from approximately 4% to 25%, although higher estimates have been reported in studies employing detailed audiological testing such as tympanometry and brainstem evoked response audiometry (11,12). The heterogeneity in reported prevalence likely reflects methodological variation, including differences in screening tools, diagnostic confirmation, and population characteristics. Importantly, hearing loss in CP has been shown to be associated with more severe motor phenotypes, intellectual disability, and quadriplegia, suggesting clustering of impairments in children with higher functional limitation (13).

Recent population-based studies from South Asia provide valuable epidemiological context. Data from the Bangladesh Cerebral Palsy Register demonstrated that speech impairment is considerably more prevalent than hearing impairment among children with CP, with reported rates of approximately 68% for speech impairment and 10% for hearing impairment (14). Similarly, Narayan and colleagues reported speech impairment in 74% and hearing impairment in 18% of children with CP in rural Bangladesh (15). These findings suggest that communication disorders, particularly speech impairment, constitute a major comorbidity burden in low- and middle-income settings. However, most available data originate from structured surveillance systems or research-based assessments, and there remains limited evidence from facility-based rehabilitation centers in resource-constrained regions where access to specialist services such as speech-language therapy and audiology may be restricted.

In Pakistan, and particularly in Azad Jammu and Kashmir (AJK), there is a paucity of systematically documented data regarding the prevalence of speech and hearing impairments among children with CP attending rehabilitation facilities. Moreover, while international literature describes the epidemiology of associated impairments, little is known about service utilization patterns, caregiver awareness, and barriers to accessing speech and hearing care within this geographical context. Given that early identification and multidisciplinary management—including speech therapy and audiological assessment—are critical for optimizing communication outcomes and participation, understanding both the burden of impairment and the structural barriers to care is essential for health system planning. The absence of local data limits evidence-based resource allocation, referral pathway development, and advocacy for integrated rehabilitation services.

Within the PICO framework, the population of interest comprises children aged two years and above diagnosed with cerebral palsy attending a rehabilitation center in Muzaffarabad, AJK. The primary outcome is the prevalence of speech and hearing impairment as documented in clinical records, while secondary outcomes include patterns of specialist consultation and reported barriers to accessing speech and hearing services. Although no intervention or comparison group is formally tested in this descriptive cross-sectional design, comparisons across CP motor subtypes and GMFCS levels allow exploration of associations between clinical severity and communication impairments. By quantifying the magnitude of speech and hearing impairment and examining their association with CP type and functional severity, this study seeks to address a critical knowledge gap in a resource-limited setting.

Therefore, the objective of this study was to determine the prevalence of speech and hearing impairment among children with cerebral palsy attending a rehabilitation center in Muzaffarabad, Azad Jammu and Kashmir, and to examine their association with CP subtype and gross motor function severity, as well as to describe barriers to accessing speech and hearing care services. It was hypothesized that speech impairment would be more prevalent than hearing impairment and that communication impairments would be significantly associated with more severe motor phenotypes.

METHODS

This cross-sectional observational study was conducted to determine the prevalence of speech and hearing impairment among children with cerebral palsy (CP) and to examine their association with CP subtype and gross motor function severity. The study was carried out at the Muzaffarabad Rehabilitation Centre, Azad Jammu and Kashmir (AJK), Pakistan. Data collection was undertaken in 2021 through retrospective review of clinical records of children who attended the centre between January 2018 and February 2020. A cross-sectional design was selected because the primary objective was to estimate the point prevalence of communication impairments within a defined clinical population and to explore associations with clinical characteristics without introducing intervention or longitudinal follow-up, consistent with established epidemiological approaches for descriptive and analytical prevalence studies (16).

The study population comprised children diagnosed with cerebral palsy by a rehabilitation physician or pediatric specialist according to standard clinical criteria. Eligible participants were male and female children aged two years and above at the time of record review, ensuring that speech development could be meaningfully assessed relative to expected developmental milestones. Children with documented comorbid epilepsy or intellectual disability were excluded to reduce heterogeneity and minimize confounding related to cognitive impairment independently affecting communication outcomes. A facility-based consecutive sampling strategy was employed, whereby all eligible records within the specified time frame were screened and included if they met the predefined criteria. No additional sampling or randomization procedures were applied. Because the study involved retrospective record review supplemented by structured telephone follow-up where required to complete missing service utilization data, informed verbal consent was obtained from parents or legal guardians during telephone contact prior to collecting supplementary information.

Data were extracted using a structured proforma developed specifically for the study based on variables identified in the literature on CP-associated impairments and service access (13–15). The proforma was pilot-tested on a subset of records to ensure clarity and completeness

before full data extraction. Extracted variables included sociodemographic characteristics (age at assessment, sex, parental monthly income), perinatal factors (mode of delivery, family history of CP), clinical characteristics (type of CP classified as spastic quadriplegic, spastic diplegic, hemiplegic, dystonic, ataxic, or flaccid quadriplegic), and gross motor function classified according to the Gross Motor Function Classification System (GMFCS) levels I–V, as documented in the clinical record (2,3). Communication-related variables included documentation of speech impairment, documentation of hearing impairment, consultation with a speech therapist or otorhinolaryngologist (ENT specialist), and reported reasons for not consulting speech therapy services.

Speech impairment was operationally defined as documentation in the clinical record of dysarthria, delayed speech development, impaired articulation, apraxia of speech, or inability to produce age-appropriate verbal communication as assessed by the attending rehabilitation professional. Hearing impairment was defined as documented clinical suspicion or diagnosis of hearing loss noted in the medical record or reported by caregivers and recorded in the file. Cases were categorized into three mutually exclusive groups for descriptive purposes: (1) speech impairment only, (2) both speech and hearing impairment, and (3) neither speech nor hearing impairment. No cases with isolated hearing impairment without speech impairment were documented. Service utilization variables were coded dichotomously (yes/no), and barriers to accessing speech therapy were categorized as unavailability of services locally, lack of awareness, lack of financial resources, or combined lack of awareness and resources.

To minimize information bias, data extraction was performed using predefined coding criteria and cross-checked by a second reviewer for a random subset of records to ensure consistency. Any discrepancies were resolved through consensus review of the original record. Standardized definitions were applied uniformly across all cases to reduce misclassification bias. Selection bias was mitigated by including all eligible cases within the defined time frame rather than a convenience subset. Although confounding is limited in cross-sectional prevalence studies, potential confounding by CP subtype and GMFCS level was addressed analytically through stratified analysis and chi-square testing to examine associations between impairment status and clinical severity categories. Variables were examined for completeness prior to analysis, and records with missing values for specific variables were excluded from analyses involving those variables using pairwise deletion, while maintaining the full denominator for primary prevalence estimates.

The required sample size for estimating prevalence was calculated using a single population proportion formula assuming an expected prevalence of speech impairment of 70% based on regional literature (14,15), a 95% confidence level, and a precision of 6%. The minimum calculated sample size was 224 participants, and the final sample of 225 eligible children satisfied this requirement. Data were entered and analyzed using Statistical Package for the Social Sciences (SPSS) version 21 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized using means and standard deviations after assessment of normality. Categorical variables were presented as frequencies and percentages. Prevalence of speech and hearing impairment was calculated with corresponding 95% confidence intervals. Associations between type of CP and impairment categories, and between type of CP and GMFCS levels, were evaluated using Pearson's chi-square test. Where expected cell counts were less than five, Fisher's exact test was applied. Effect size for significant associations was quantified using Cramér's V to assess the strength of association. A two-tailed p-value of ≤ 0.05 was considered statistically significant.

Ethical approval was obtained from the institutional ethics committee prior to commencement of data collection. All procedures were conducted in accordance with the principles of the Declaration of Helsinki (17). Identifiable patient information was de-identified during data extraction, and unique study codes were assigned to maintain confidentiality. Data were stored in password-protected electronic files accessible only to the research team. To enhance reproducibility and data integrity, the data dictionary, coding framework, and statistical syntax were archived and retained for audit and verification.

RESULTS

A total of 225 children with cerebral palsy were included in the analysis. The mean age was 5.03 ± 3.31 years, with ages ranging from 2 to 16 years. Males constituted 55.1% (124/225; 95% CI: 48.6–61.6) of the cohort, while females accounted for 44.9% (101/225; 95% CI: 38.4–51.4). More than half of the families (55.6%, 125/225; 95% CI: 49.1–62.0) reported a monthly income below 20,000 PKR, and 43.1% (97/225; 95% CI: 36.7–49.6) reported income between 20,000 and 50,000 PKR, indicating that nearly 99% of the sample belonged to low- or lower-middle-income strata.

Clinically, spastic quadriplegic CP was the most frequent subtype, observed in 59.6% (134/225; 95% CI: 53.2–66.0), followed by spastic diplegic CP in 34.7% (78/225; 95% CI: 28.5–40.9), while other forms collectively accounted for 5.7% (13/225). Regarding functional severity, 57.3% (129/225; 95% CI: 50.8–63.8) were classified at GMFCS level IV and 3.6% (8/225; 95% CI: 1.2–6.0) at level V, indicating that approximately 61% of the cohort had severe motor impairment. Only 19.6% each were classified at GMFCS levels II and III, and none were categorized as level I.

With respect to communication outcomes, 158 of 225 children had documented speech impairment, yielding an overall prevalence of 70.2% (95% CI: 64.2–76.2). Among the total cohort, 132 children (58.7%; 95% CI: 52.2–65.1) had speech impairment only, while 26 children (11.6%; 95% CI: 7.4–15.8) had both speech and hearing impairment. No cases of isolated hearing impairment were identified.

Consequently, the overall prevalence of hearing impairment (coexisting with speech impairment) was 11.6% (26/225; 95% CI: 7.4–15.8). Sixty-eight children (30.2%; 95% CI: 24.2–36.2) had neither speech nor hearing impairment documented in their clinical records.

Analytical comparison among children with speech impairment (n = 158) demonstrated a statistically significant association between CP subtype and the presence of coexisting hearing impairment (χ^2 test, $p = 0.03$; Cramér's $V = 0.28$), indicating a moderate effect size. Among children with spastic quadriplegic CP (n = 94 within the impaired subgroup), 21 (22.3%) had both speech and hearing impairment compared with 4 of 55 (7.3%) children with spastic diplegic CP.

The odds of having coexisting hearing impairment were more than three times higher in children with spastic quadriplegic CP compared with spastic diplegic CP (OR 3.12; 95% CI: 1.02–9.51). In contrast, among children with other CP types (n = 9), only one case (11.1%) had combined impairment, and this did not significantly differ from the reference group.

A highly significant association was observed between CP subtype and GMFCS level ($\chi^2 = 161.34$, $p < 0.001$), with a strong effect size (Cramér's $V = 0.60$). Among children with spastic quadriplegic CP, 124 of 134 (92.5%) were classified at GMFCS levels IV or V, with 55.1% of the total sample concentrated in GMFCS IV within this subtype alone. Conversely, children with spastic diplegic CP were predominantly classified at GMFCS levels II (17.8% of total sample) and III (16.9%), and none were categorized at levels IV or V. This distribution

underscores a clear gradient of increasing motor severity associated with quadriplegic involvement. Service utilization patterns revealed substantial unmet rehabilitation needs among children with speech impairment (n = 158). A total of 149 children (94.3%; 95% CI: 90.7–97.9) had never consulted a speech therapist, while only 2 children (1.3%) accessed services within AJK and 7 (4.4%) sought consultation outside the region. Notably, none of the children had participated in structured speech therapy sessions.

Table 1. Sociodemographic and Clinical Characteristics of Children with Cerebral Palsy (N = 225)

Variable	Category	n (%)	95% CI
Age (years)	Mean ± SD	5.03 ± 3.31	—
	Range	2–16	—
Sex	Male	124 (55.1)	48.6–61.6
	Female	101 (44.9)	38.4–51.4
Monthly parental income (PKR)	<20,000	125 (55.6)	49.1–62.0
	20,000–50,000	97 (43.1)	36.7–49.6
	>50,000	3 (1.3)	0.0–2.8
Type of CP	Spastic quadriplegic	134 (59.6)	53.2–66.0
	Spastic diplegic	78 (34.7)	28.5–40.9
	Other types*	13 (5.7)	2.7–8.7
GMFCS Level	I	0 (0.0)	—
	II	44 (19.6)	14.4–24.8
	III	44 (19.6)	14.4–24.8
	IV	129 (57.3)	50.8–63.8
	V	8 (3.6)	1.2–6.0

Table 2. Prevalence of Communication Impairments among Children with CP (N = 225)

Impairment Category	n (%)	95% CI
Speech impairment only	132 (58.7)	52.2–65.1
Speech + hearing impairment	26 (11.6)	7.4–15.8
Any speech impairment (total)	158 (70.2)	64.2–76.2
Hearing impairment (total)	26 (11.6)	7.4–15.8
Neither impairment	68 (30.2)	24.2–36.2

Table 3. Association Between Type of CP and Impairment Category (n = 158)

Type of CP	Speech Only n (%)	Speech + Hearing n (%)	Total	Odds Ratio (95% CI)*	p-value	Cramér's V
Spastic quadriplegic	73 (46.2)	21 (13.3)	94	3.12 (1.02–9.51)	0.03	0.28
Spastic diplegic	51 (32.3)	4 (2.5)	55	Reference	—	—
Other types	8 (5.1)	1 (0.6)	9	1.59 (0.17–14.8)	—	—
Total	132 (83.5)	26 (16.5)	158	—	0.03	0.28

*Odds ratio calculated using spastic diplegic CP as reference category for likelihood of having coexisting hearing impairment. Pearson chi-square test applied.

Table 4. Association Between Type of CP and GMFCS Level (N = 225)

Type of CP	GMFCS II n (%)	GMFCS III n (%)	GMFCS IV n (%)	GMFCS V n (%)	p-value	Cramér's V
Spastic quadriplegic	0	2 (0.9)	124 (55.1)	8 (3.6)	<0.001	0.60
Spastic diplegic	40 (17.8)	38 (16.9)	0	0	—	—
Other types	4 (1.8)	4 (1.8)	5 (2.2)	0	—	—
Total	44 (19.6)	44 (19.6)	129 (57.3)	8 (3.6)	<0.001	0.60

Table 5. Speech Therapy Consultation and Reported Barriers (n = 158)

Variable	Category	n (%)	95% CI
Consulted speech therapist	No	149 (94.3)	90.7–97.9
	Yes (within AJK)	2 (1.3)	0.0–3.1
	Yes (outside AJK)	7 (4.4)	1.2–7.6
Attended speech therapy sessions	Yes	0 (0.0)	—
	No	158 (100)	—
Reported reason for not consulting speech therapist	Lack of awareness	37 (23.4)	16.8–30.0
	Lack of resources	13 (8.2)	3.9–12.5
	Both lack of awareness and resources	74 (46.8)	39.0–54.6
	Unavailability in local hospitals	34 (21.5)	15.1–27.9

Among caregivers who did not seek speech therapy, the most frequently reported barrier was the combined effect of lack of awareness and lack of financial resources (46.8%; 74/158; 95% CI: 39.0–54.6). Lack of awareness alone accounted for 23.4% (37/158; 95% CI: 16.8–30.0), unavailability of speech therapists in local hospitals for 21.5% (34/158; 95% CI: 15.1–27.9), and financial constraints alone for 8.2% (13/158; 95% CI: 3.9–12.5).

Furthermore, all 26 children with documented hearing impairment had not visited an ENT specialist for formal audiological evaluation at the time of record review, reflecting a 100% unmet need for hearing assessment in this subgroup.

Collectively, the quantitative findings demonstrate that speech impairment affected approximately seven out of ten children with CP in this facility-based cohort, whereas documented hearing impairment affected approximately one in nine children and occurred exclusively in conjunction with speech impairment.

Communication impairments were significantly associated with more severe motor phenotypes, particularly spastic quadriplegia and higher GMFCS levels, and were accompanied by profound gaps in access to specialized speech and hearing services.

The figure demonstrates a clear gradient relationship between motor severity and the likelihood of coexisting hearing impairment across cerebral palsy subtypes. Children with spastic quadriplegic CP exhibited the highest proportion of combined speech and hearing impairment at 22.3% (21/94), alongside an extremely high burden of severe motor limitation, with 98.5% (132/134) classified at GMFCS levels IV–V. In contrast, children with spastic diplegic CP showed a markedly lower prevalence of combined impairment at 7.3% (4/55) and no cases of severe motor impairment (0/78 at GMFCS IV/V).

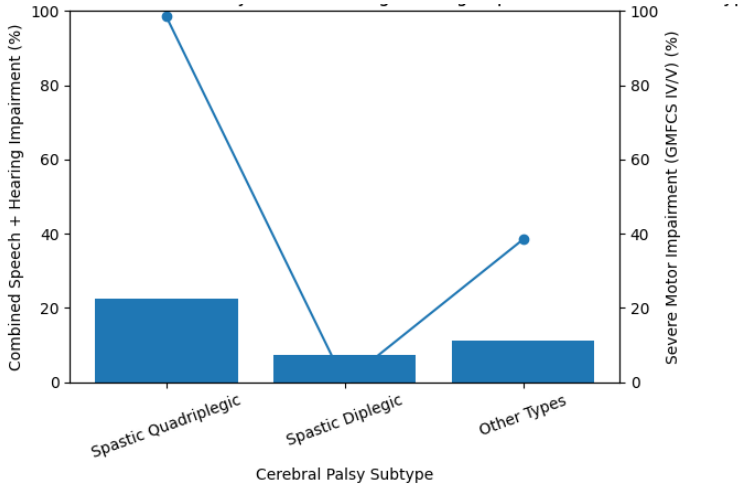

Figure 1 Interaction Between Motor Severity and Coexisting Hearing Impairment Across CP Subtypes

The "other CP types" group demonstrated intermediate values, with 11.1% (1/9) having combined impairment and 38.5% (5/13) exhibiting severe motor limitation. This dual-axis visualization highlights a clinically meaningful interaction pattern: as motor severity increases—particularly in quadriplegic CP—the probability of concurrent hearing impairment rises substantially. The near-parallel escalation between severe GMFCS classification and combined communication impairment suggests clustering of multisystem disability in the most neurologically affected phenotypes, reinforcing the need for prioritized audiological screening and multidisciplinary intervention in children with higher motor severity.

DISCUSSION

The present study demonstrates that speech impairment constitutes a major comorbidity among children with cerebral palsy (CP) attending a rehabilitation facility in Muzaffarabad, with an overall prevalence of 70.2%, whereas documented hearing impairment was observed in 11.6% of the cohort and occurred exclusively in conjunction with speech impairment. These findings align with regional population-based evidence from Bangladesh reporting speech impairment in approximately two-thirds to three-quarters of children with CP and comparatively lower rates of hearing impairment (14,15). The magnitude of speech impairment observed in the present cohort falls within the upper range of estimates reported internationally (7), reinforcing the consistent observation that motor speech dysfunction represents a core functional limitation in CP. The lower prevalence of hearing impairment relative to speech impairment is also consistent with published epidemiological estimates of 4–25% (11,12), although methodological differences, particularly the absence of universal audiological testing in resource-limited settings, may partially account for variability across studies.

A key clinically relevant finding was the significant association between CP subtype and coexisting hearing impairment ($p = 0.03$; Cramér's $V = 0.28$), with children diagnosed with

spastic quadriplegic CP exhibiting more than threefold higher odds of combined speech and hearing impairment compared with those with spastic diplegic CP. Furthermore, a strong association was observed between CP subtype and GMFCS level ($p < 0.001$; Cramér's $V = 0.60$), with 92.5% of children with spastic quadriplegia classified at GMFCS IV or V. The integrated visualization of motor severity and communication impairment revealed a gradient pattern in which increasing motor dysfunction paralleled a higher probability of combined sensory-communication deficits. This clustering of impairments is biologically plausible and supported by prior evidence indicating that children with more extensive brain injury—particularly those with quadriplegia and higher GMFCS levels—are more likely to exhibit multisystem involvement including hearing loss and intellectual impairment (13,20). Severe motor phenotypes may reflect broader cortical and subcortical injury, thereby increasing vulnerability of auditory pathways and speech-motor control networks. From a clinical perspective, this gradient underscores the necessity of systematic hearing evaluation and early communication assessment in children with higher GMFCS levels, as reliance on caregiver complaint alone may underestimate true prevalence.

The near absence of service utilization represents one of the most striking findings of this study. Among children with speech impairment, 94.3% had never consulted a speech therapist, and none had participated in structured therapy sessions. Additionally, all children with documented hearing impairment had not undergone ENT evaluation. The most frequently reported barrier was the combined effect of lack of awareness and financial constraints (46.8%), followed by lack of awareness alone (23.4%) and unavailability of local services (21.5%). These findings reflect structural health system limitations and caregiver-level barriers that compound functional disability. Prior literature emphasizes that early speech-language intervention can improve communication outcomes, participation, and caregiver–child interaction in CP (18,19). The absence of therapy engagement in this cohort likely contributes to persistent communication deficits and may indirectly influence rehabilitation adherence and participation outcomes. Communication barriers may limit a child's ability to understand therapeutic instructions, express discomfort, or engage socially, potentially perpetuating the high proportion (approximately 61%) of children classified at GMFCS IV–V. While causality cannot be inferred from cross-sectional data, the coexistence of severe motor and communication impairment warrants integrated multidisciplinary planning.

The documented prevalence of hearing impairment (11.6%) should be interpreted cautiously. Unlike studies employing standardized audiological assessments such as brainstem evoked response audiometry (16), the present study relied on clinical documentation and caregiver report. Consequently, subclinical or mild hearing deficits may have been under-ascertained. In resource-constrained settings, absence of routine hearing screening may result in delayed diagnosis, particularly in non-verbal children where auditory responsiveness is difficult to evaluate. Therefore, the true burden of hearing impairment may be higher than reported. This possibility strengthens the argument for implementing structured screening pathways within rehabilitation centers (17).

The study has several methodological strengths. It includes a relatively large facility-based sample ($N = 225$) with adequate statistical power for prevalence estimation and subgroup comparison. Standardized GMFCS classification allowed objective stratification of motor severity, and effect sizes were reported to quantify association strength beyond statistical significance (18).However, certain limitations merit consideration. The cross-sectional design precludes causal inference regarding the temporal relationship between motor severity and communication impairment. The exclusion of children with epilepsy and intellectual disability may limit generalizability, as these comorbidities are common in CP and frequently

coexist with sensory deficits. Additionally, reliance on retrospective record review may introduce misclassification bias, particularly for hearing impairment in the absence of formal audiological confirmation. Finally, the study was conducted in a single rehabilitation center, which may limit external validity to other regions of Pakistan or similar low-resource contexts (19).

Despite these limitations, the findings have significant implications for clinical practice and health system planning in AJK. The high prevalence of speech impairment, its association with severe motor phenotypes, and the complete absence of structured speech therapy participation highlight a critical service gap. Integration of speech-language therapy and routine hearing screening within rehabilitation services should be prioritized. Establishing referral linkages with local ENT specialists and implementing caregiver education programs may reduce delays in identification and management. Future research should employ prospective designs incorporating standardized audiological and speech assessments to determine true prevalence and to evaluate the impact of early multidisciplinary intervention on functional outcomes.(20).

In conclusion, this study confirms that speech impairment is substantially more prevalent than documented hearing impairment among children with CP in this setting and is strongly associated with more severe motor subtypes. Communication impairments cluster within children with higher GMFCS levels, and profound gaps in specialist service utilization persist. Addressing these deficits through integrated, multidisciplinary, and accessible rehabilitation services is essential to improve participation, functional communication, and long-term outcomes in this vulnerable population.

CONCLUSION

In this facility-based cohort of 225 children with cerebral palsy in Muzaffarabad, Azad Jammu and Kashmir, speech impairment was common (70.2%), while documented hearing impairment was less frequent (11.6%) and occurred only alongside speech impairment. Communication impairments clustered in more severe motor phenotypes, with a significant association between CP subtype and combined speech–hearing impairment ($p = 0.03$) and a strong association between CP subtype and GMFCS severity ($p < 0.001$). Despite the high burden, access to care was profoundly limited: 94.3% of children with speech impairment had never consulted a speech therapist and none received therapy sessions, and no child with documented hearing impairment underwent ENT evaluation, largely due to lack of awareness, financial constraints, and unavailability of local services. These findings support urgent strengthening of multidisciplinary rehabilitation pathways in AJK, including caregiver education, integrated speech-language therapy provision, and routine hearing assessment with functional referral linkages, particularly for children with severe motor limitation.

REFERENCES

1. Vitrikas K, Dalton H, Breish DJ. Cerebral palsy: an overview. Am Fam Physician. 2020;101(4):213-220.

2. Himmelmann K, Horber V, Sellier E, De la Cruz J, Papavasiliou A, Krägeloh-Mann I. Neuroimaging patterns and function in cerebral palsy—application of an MRI classification. Front Neurol. 2021;12:617740.

3. Sadowska M, Sarecka-Hujar B, Kopyta I. Cerebral palsy: current opinions on definition, epidemiology, risk factors, classification and treatment options. Neuropsychiatr Dis Treat. 2020;16:1505-1518.

4. Ong LT, Fan SWD. The association between congenital cytomegalovirus infection and cerebral palsy: a systematic review and meta-analysis. J Paediatr Child Health. 2022;58(12):2156-2162.

5. Smithers-Sheedy H, Raynes-Greenow C, Badawi N, McIntyre S, Jones CA; Australian Cerebral Palsy Register Group. Congenital cytomegalovirus is associated with severe forms of cerebral palsy and female sex in a retrospective population-based study. Dev Med Child Neurol. 2014;56(9):846-852.

6. Smithers-Sheedy H, Raynes-Greenow C, Badawi N, Fernandez MA, Kesson A, McIntyre S, et al. Congenital cytomegalovirus among children with cerebral palsy. J Pediatr. 2017;181:267-271.e1.

7. Mei C, Reilly S, Bickerton M, Mensah F, Turner S, Kumaranayagam D, et al. Speech in children with cerebral palsy. Dev Med Child Neurol. 2020;62(12):1374-1382.

8. Iuzzini-Seigel J, Allison KM, Stoeckel R. A tool for differential diagnosis of childhood apraxia of speech and dysarthria in children: a tutorial. Lang Speech Hear Serv Sch. 2022;53(4):926-946.

9. Singh R, Verma P, Gupta J, Ahmad A, Srivastav A. Prevalence of hearing impairment in children (aged 6–17 years) in a school of Village Dasauli, Lucknow (UP) India. V-XII J. 2016:20.

10. Lieu JE, Kenna M, Anne S, Davidson L. Hearing loss in children: a review. JAMA. 2020;324(21):2195-2205.

11. Jibril Y, Shamsu K, Muhammad NB, Hasheem M, Tukur A, Salisu AJ. Determinants of hearing loss in children with cerebral palsy in Kano, Nigeria. Niger J Clin Pract. 2021;24(6):802-807.

12. Ohal M. Hearing impairment in children with history of kernicterus and cerebral palsy. Int J Otorhinolaryngol. 2020;3(1):7-9.

13. Weir FW, Hatch JL, McRackan TR, Wallace SA, Meyer TA. Hearing loss in pediatric patients with cerebral palsy. Otol Neurotol. 2018;39(1):59-64.

14. Khandaker G, Muhit M, Karim T, Smithers-Sheedy H, Novak I, Jones C, et al. Epidemiology of cerebral palsy in Bangladesh: a population-based surveillance study. Dev Med Child Neurol. 2019;61(5):601-609.

15. Narayan A, Muhit M, Whitehall J, Hossain I, Badawi N, Khandaker G, et al. Associated impairments among children with cerebral palsy in rural Bangladesh—findings from the Bangladesh cerebral palsy register. PLoS One. 2023;12(4):1597.

16. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP; STROBE Initiative. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. PLoS Med. 2007;4(10):e296.

17. World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. JAMA. 2013;310(20):2191-1194.

18. Mei C, Reilly S, Reddihough D, Mensah F, Morgan A. Motor speech impairment, activity, and participation in children with cerebral palsy. Int J Speech Lang Pathol. 2014;16(4):427-435.

19. McLaughlin MR. Speech and language delay in children. Am Fam Physician. 2011;83(10):1183-1188.

20. Dufresne D, Dagenais L, Shevell MI. Epidemiology of severe hearing impairment in a population-based cerebral palsy cohort. Pediatr Neurol. 2014;51(5):641-644.

DECLARATIONS

Ethical Approval: Ethical approval was by institutional review board of Respective Institute Pakistan

Informed Consent: Informed Consent was taken from participants.

Authors' Contributions:

Concept: MNB; Design: WP; Data Collection: HMUB; Analysis: MK; Drafting: ZJ

Conflict of Interest: The authors declare no conflict of interest.

Funding: This research received no external funding.

Data Availability: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Acknowledgments: NA

Study Registration: Not applicable.