International Journal of Contemporary Pediatrics
Prasanna P et al. Int J Contemp Pediatr. 2025 Oct;12(10):1647-1652
http://www.ijpediatrics.com

pISSN 2349-3283 | eISSN 2349-3291

DOI: https://dx.doi.org/10.18203/2349-3291.ijcp20252960

Original Research Article

Effectiveness of augmentative alternative communication therapy in children with cerebral palsy with expressive speech delay

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Received: 07 June 2025
Revised: 18 August 2025
Accepted: 09 September 2025

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ABSTRACT

Background: The objectives of the study were to determine the effectiveness of augmentative alternative communication therapy (AAC) in children with cerebral palsy (CP) and to correlate the outcome of AAC therapy with the communication function classification system (CFCS) and gross motor function system classification (GMFCS) levels.

Methods: This is a prospective interventional study. Among the children satisfying the inclusion criteria, CFCS and GMFCS scoring, and the family impact of assistive technology scale AAC scoring (FIATS AAC) were taken. AAC therapy was administered based on the patient's baseline communication skills, utilizing both aided and unaided techniques on a weekly follow-up basis. The outcome was assessed at 6 months following therapy by both the investigator and the speech therapist using the FIATS-AAC questionnaire.

Results: All cohorts (n=101) had a predominant expressive language delay. Among 101 cohorts, 43.5% belonged to level 3 GMFCS, and 42.5% belonged to level 3 CFCS classification. 93.06% (n=94) used low-tech AAC, and 6.94% (n=7) used high-tech AAC. The correlation between baseline and follow-up FIATS AAC scores showed a significant improvement in the score, with a $p<0.01$.

Conclusion: Children with expressive speech delay could benefit from AAC as it aids in communication with family and social interaction. Additionally, this study correlates the association between GMFCS and CFCS with AAC therapy.

Keywords: Cerebral palsy, Perisylvian syndrome, Augmentative alternative communication therapy

INTRODUCTION

Cerebral palsy (CP) describes a group of disorders of the movement and posture, causing activity limitation, that are attributed to non-progressive disturbances that occur in the developing fetal or infant brain.[1] The motor disorders of CP are often accompanied by disturbances of sensation, cognition, communication, perception, and behavior, and or by a seizure disorder. Children presenting with CP who have minimal or no functional speech can have major barriers to communicating with others.[2]

The current prevalence of CP in India is about 3 in 1000 live births. Speech and language development disorders are more common in the perisylvian syndrome, a subtype of CP. Perisylvian syndrome is a neurological disease with infrequent occurrence, presenting with predominant delay in language milestones secondary to damage to the sylvian fissure (lateral sulcus). The main symptoms are difficulty in chewing and swallowing, low muscle tone in the face and tongue, and speech and language developmental delay. These symptoms may also be accompanied by difficulties with mobility and intellectual disabilities.[3]

The Communication Function Classification System (CFCS) focuses on activity and participation levels as described in the World Health Organization's (WHO) International Classification of Functioning, Disability, and

Health (ICF). CFCS grading is as follows: grade 1-effective sender and receiver with unfamiliar and familiar partners, grade 2-effective but slower paced sender and/or receiver with unfamiliar and/or familiar partners, grade 3-effective sender and receiver with familiar partners, grade 4-inconsistent sender and/or receiver with familiar partners, and grade 5-seldom effective sender and receiver even with familiar partners.[4]

Augmentative alternative communication (AAC) therapy is used to express thoughts, needs, and ideas to support spoken or written communication in children with severe disorders of expression or reception of speech. AAC is classified as manual signs and symbols. Production of hand shapes and movements, body positioning, facial expression, and formal sign languages are classified under manual signs, whereas graphic or object representations of language are included under symbols. Symbols are organized on high-technique and low-technique communication aids. High-tech symbols include electronic devices that produce synthetic voice output. Low-tech symbols are paper-based books or charts of pictures, photographs, graphic symbols, and words.[5]

According to studies, AAC therapy plays a significant role in developing communication and speech skills. Very few studies have been done regarding the role of AAC therapy in CP. Hence, the present study aims to study the role of AAC therapy in CP in India.

METHODS

The main objective of this study is to determine the effectiveness of augmentative alternative communication therapy in children with cerebral palsy using the FIATS-AAC score and to correlate the outcome of augmentative alternative communication therapy with CFCS and GMFCS levels. This is a hospital-based prospective interventional study done in Bangalore from January 2021 to June 2022. A sample size of 101 provided a significant power to get a correlation for the outcome of AAC therapy (r=0.97), which was calculated in reference to Ryan et al. The study group included children with CP between the ages of 5 to 18 years attending neurology outpatient clinics. Children between 5-18 years with a diagnosis of CP with expressive language delay, with guardian consent, were included in the study. Children with other learning disabilities like deaf-mutism, autism spectrum disorders, neurodegenerative disorders, and other systemic and chronic illnesses were excluded.

Parents completed a demographic form designed for the study. The interview form collected descriptive information regarding antenatal and postnatal events. Parents also reported on their children's everyday functional communication and handling of objects using two standardized classification systems: CFCS and gross motor function classification system (GMFCS). The demographic data provided a detailed description of the study sample.

FIATS-AAC scoring is an emerging parent-reported outcome measure configured to detect the functional outcome effects of AAC interventions. It includes 13 dimensions to assess the effectiveness of AAC: behavior of the child, contentment, control of the child while doing activities, education, face-to-face communication, self-reliance, social versatility, caregiver relief, energy, family roles, finances, security, and supervision. Informed consent was taken from the parents of children before undertaking the study.

As this study focused on the assessment of communication skills and the role of AAC speech therapy in CP, the expressive and receptive language skills were assessed at baseline. AAC speech therapy was given based on baseline communication skills using both aided and unaided techniques on a weekly follow-up basis. Results were assessed in follow-up at 3 months (follow-up 1) and 6 months (follow-up 2) following therapy by both the investigator and speech therapist using the FIATS-AAC questionnaire filled by the parents or guardians of the cohorts. A comparison of baseline and follow-up assessment scores was made.

RESULTS

A total of 101 children with cerebral palsy satisfying the inclusion criteria were enrolled in the study. The most common age group presented was between 4-7 years (75.3%), when most of the guardians face a significant issue in communicating with children. Among study groups, 65.34% (n=66) were males and 34.65% (n=35) were females (Table 1 and Figure 1).

Table 1: Gender wise distribution of cohorts.

Sex category	Frequency (n=101)	Percent
Male	72	64.9
Female	39	35.1

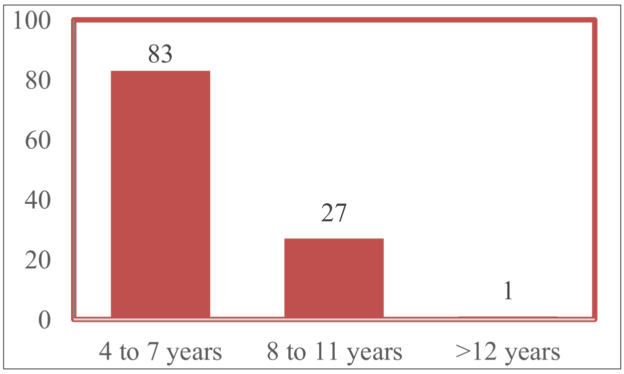

Figure 1: Age-wise distribution of cohorts.

All cohorts had developmental delay, with a predominant language delay of 69.3% (n=70). The most common associated symptoms were seizures in 27.72% (n=28), and excessive drooling of saliva in 15.84% (n=16). The most common subtype was spastic CP 59.4% (n=60, 37), followed by dystonic CP 62% (n=38), and mixed CP 2.9% (n=3). MRI changes observed were correlating with the clinical subtype, and showed periventricular hyperintensities in 39.6% (n=40), putamen hyperintensities in 18.8% (n=19), bilateral perisylvian hyperintensities in 16.8% (n=17), and basal ganglia with perisylvian hyperintensities in 7.9% (n=8).

Different variables, including GMFCS and CFCS, were correlated with the outcome using an independent t-test. Functional classification revealed that most children had moderate-to-severe motor impairment, with predominantly GMFCS levels 3 (43.5%; n=44) and 4 (36.6%; n=37). Communication function, however, was comparatively poorer, with the majority classified as CFCS levels 4 (42.5%; n=43) and levels 5 (39.6%; n=40). This discrepancy underscores the disproportionate communication challenges in cerebral palsy, even among children with relatively preserved gross motor ability. Correlation analyses revealed that CFCS grade was a strong predictor of AAC outcomes (p<0.001), whereas GMFCS grade showed no significant association (p=0.352). This finding reinforces the notion that baseline communication ability, rather than gross motor function, is the more critical determinant of AAC therapy response.

AAC interventions were widely implemented, with low-tech AAC systems (communication boards, picture cards) utilized in 93.07% (n=94) of cases, reflecting both cost-effectiveness and ease of adaptation in resource-limited settings. Only 6.9% (n=7) used high-tech AAC (e.g., AVAZ application), which may offer further benefits in selected candidates with adequate motor and cognitive prerequisites.

FIATS-AAC total scores can range from 13 to 91, with higher scores indicating greater overall functioning concerned to communication. The minimum FIATS-AAC score observed was 30, and the maximum was 75 in the current study. Since the FIATS-AAC score was a continuous variable, a one-way ANOVA test was used. AAC therapy showed a statistically significant improvement in functional communication over the 6-month follow-up period, as evidenced by a rise in mean FIATS-AAC scores from 38.63 to 43.79 (r=0.97, p<0.001). The magnitude of improvement did not differ significantly between spastic, dystonic, and mixed CP subtypes (p=0.12), suggesting that AAC benefits are not restricted by motor phenotype (Table 2).

Overall, these results highlight the high prevalence of expressive language impairment in cerebral palsy, the importance of early and individualized communication interventions, and the utility of AAC, particularly low-tech formats, in enhancing functional communication irrespective of motor subtype. Importantly, communication function classification should guide AAC planning and prognostication more than motor severity scales.

Table 2: Correlation of GMFCS, CFCS, AND FIATS -AAC score with outcome (n=101).

Variables and class	Frequency	Mean (SD)	P value
GMFCS			
2	16	37.71 (9.955)	0.352
3	44	38.83 (9.864)	
4	37	39.71 (9.731)	
5	4	32.17 (8.976)	
CFCS			
3	18	54.68 (3.637)	<0.01
4	43	40.47 (5.170)	
5	40	29.93 (3.810)	
FIATS-AAC score			
Baseline	38.62	r=0.97 (9.79)	<0.001
Follow up	43.78	r=0.97 (9.95)	

GMFCS-gross motor function classification system, CFCS-communication function classification system, FIATS-AAC-family impact of assistive technology scale-augmentative alternative communication

DISCUSSION

In the present cohort of 101 children with cerebral palsy, the majority were in the early school-age range, with a mean age of 6.91±1.9 years and a predominant cluster between 4–7 years (75.3%, n=76). This age distribution reflects the period when functional and communication impairments become more evident and when families actively seek rehabilitative intervention. According to Pennington et al, children with CP faced a major communication barrier at 8-13 years of age.[3] Whereas in Smith et.al and Ryan et al the most common study groups were of 2 years and 7-10 years, respectively.[6,7] In a study by Patil et al, the mean age of diagnosis of Worster-Drought syndrome (WDS) was 7.3 years. A male predominance of 65.34% (n=66) was observed, in keeping with epidemiological evidence that suggests increased susceptibility of male infants to perinatal hypoxic–ischemic injury. This nearly correlates to Patil et al which showed an M: F ratio of 52:31.[8]

The current study mainly focused on children with cerebral palsy and its subtypes, excluding ASD, Neurodegenerative conditions, and deaf mutism. The majority of the cases belonged to the spastic subtype, followed by dystonic and mixed CP, a distribution consistent with earlier Indian and international series. The relatively higher proportion of dystonic CP in this cohort may reflect a tertiary care referral bias, with more complex motor phenotypes being referred for specialist evaluation. Whereas in Ryan et al children with CP and other complex communication needs like ASD, Down's syndrome, and acquired brain injury were also included in the study.[7]

In our study, a global developmental delay with a predominant expressive language delay was observed. Cohorts with expressive language delay significantly outnumbered cohorts with receptive language delay. This is in correlation with Patil et al where all cohorts had developmental delay with expressive language delay.[8] This pattern has also been reported by Hustad et al who found that children with CP often retain comprehension skills despite substantial expressive limitations, underscoring the role of motor speech impairment rather than primary language comprehension deficits.[9]

In the present study, 27.7% (n=28) had seizures and 15.84% (n=16) had excessive drooling of saliva, illustrating the multi-system nature of CP and the need for multidisciplinary management, and upholds the importance of oro-facial muscles required for the generation of speech and communication. On the other hand, it also illustrates the association of drooling of saliva with perisylvian syndrome, as stated in Sharma et al.[10] Hidecker et al stated that children with CP associated with other co-morbidities like seizures had an increased risk of communication problems.[4] Patil et al showed that children with WDS had drooling of saliva in 79.51%, prolonged feeding time in 50.60%, seizures in 52.01% and reflex seizures while feeding in 34%.[8]

MRI brain findings were concordant with motor subtype: periventricular white matter hyper-intensities predominated in spastic cases, consistent with periventricular leukomalacia as a common neuropathological substrate, while basal ganglia and putaminal involvement were more frequently seen in dystonic CP, in line with prior neuroimaging correlations reported by Krägeloh-Mann and colleagues.[11] Bilateral perisylvian abnormalities, identified in over 12% of participants, may explain oromotor dysfunction and severe speech–language impairment in this subgroup. MRI findings in our study are comparable to Hidecker et al which showed that periventricular lesions were associated with speech and more functional CFCS levels, while cortical/sub-cortical and basal ganglia lesions were associated with an absence of speech and lower CFCS levels.[4] Patil et al stated that among 83 cohorts who underwent neuroimaging, 80 of them showed bilateral perisylvian gliosis, 3 cases showed bilateral perisylvian polymicrogyria, and 70 of them were associated with occipital lobe enhancement.[8] It was observed that CP with perisylvian hyper-intensities in the MRI brain has better outcomes with AAC therapy in the current study, which underlines the predominance of expressive language delay in CP and its response to AAC.

Cohorts were classified into different levels using the GMFCS and CFCS classification. Functional classification revealed a moderate-to-severe motor impairment profile (GMFCS levels 3–4) but an even greater burden of communication disability (CFCS levels 4–5) in the majority. This discrepancy reinforces previous observations that communication limitations in CP may not parallel motor severity and highlights the importance of independent assessment of communication function in clinical practice. In our study, 42.5% (n=43) belonged to grade 4, 39.6% (n=40) belonged to grade 5, and 17.82% (n=18) belonged to grade 3 CFCS classification in line with Ryan et al where majority of cohorts belonged to grade 3 (n=33) CFCS, followed by grade 4 (n=13) and grade 2 (n=4).[7]

According to Smith et al, 27 study cohorts were divided into children who were not yet talking (n=12), emerging talkers (n=11), and established talkers (n=4).[6] Ryan et al classified cohorts into emerging communicator (n=10), content-dependent communicator (n=38), and independent communicator (n=2).[7] In Hustad and Miles et al study, 22 children with CP who had a communication disorder were classified based on the need for communication and speech goals. Among 22 cases, 21 (95%) were identified as needing some form of AAC, while one child (5%) was able to meet all communication needs using speech alone. In addition, 4 children (18%) used AAC as a backup strategy for natural speech (category B), 9 (41%) used AAC to supplement or support speech (category C), and 8 (36%) required AAC for all communication (category D).[11] Whereas, current study mainly focused on classifying cohorts using functional classification, which is more objective than other methods of classification.

According to Ryan et al most of the cohorts communicated using gestures/sounds/words with all partners, about two-thirds used communication books/boards/cards with family members and paid professionals, and only a few of them used speech-generating devices.[7] In Hemsley et al study, 10 parents with children born with CP were interviewed for the need of AAC in hospital settings and mentioned that children used a varied range of communication methods involving speech generating devices (n=6), communication boards and cards (n=3), and other non-verbal gestures (n=7).[12] Brill et al studied on need for AAC in 60 Canadian children with CP and demonstrated that more than 75% required AAC, but only 38% used it and the majority of them used high-tech methods.[13] In Anderson et al study, among 560 cases, children with either significant speech problems or no speech, 54% (n=197) used AAC in any form. Among them, 64 of 197 (33%) used hand signs, 110 (56%) used indistinct hand signs.[14] In the current study, 93.06% (n=94) used aided AAC in the form of symbols, picture or letter cards, and 6.94% (n=7) of them used speech-generating devices in the form of mobile phone applications. However, the predominance of low-tech AAC usage reflects local resource constraints and may limit generalizability to settings with greater access to high-tech solutions (Table 3).

The outcome of AAC therapy was measured by the FIATS-AAC score done at the baseline visit and a follow-up visit after 6 months of therapy. AAC therapy produced significant functional communication gains over six months, with improvements observed across all CP motor subtypes. The predominance of low-tech AAC use in this cohort reflects cost-effectiveness, ease of training, and accessibility in low-resource settings, consistent with usage trends reported in other developing countries. High-tech AAC, though less utilized, remains an important option for select children with adequate motor control and cognitive capacity, and may offer greater adaptability and engagement when accessible. Watson et al demonstrated that AAC helped children with CP to initiate conversation fluently, access vocabulary, and improve narrative performance after 6 -12 weeks of therapy.[15] Fox et al showed significant improvement in communication following the use of Lee Silverman voice therapy (LSVT).[16]

Table 3: Comparison of the present study with different studies.

Study	Ryan et al (n=50)	Smith et al (n=26)	Current study (n=101)
Duration	12 months	2 years	6 months
Type of study	Observational	Longitudinal	Prospective interventional
Age group	3-17 years	24-29 months	4-18 years
Sex (M:F)	2.7:1	1:1	1.8:1
Etiology	ASD-38%, CP-16%, developmental delay-16%, Rett syndrome-13%, Down syndrome-11%, genetic syndrome-4%, acquired brain injury-2%	Cerebral palsy	Spastic CP-59.4%, dystonic CP-37.6%, mixed CP-2.9%
Speech problem	Emerging-20%, context-dependent-76%, independent-4%	Not yet talking-46%, emerging talking-42%, established talking-15%	Predominant expressive language delay-100%
GMFCS grade			
1	13	6	0
2	21	3	16
3	4	3	44
4	6	5	37
5	6	9	4
CFCS grade			
2	4		0
3	33		18
4	13		43
5	0		40
Outcome measurement	Expressive and receptive language age	MLUm and PLS-4 score	FIATS-AAC score

ASD-Autism spectrum disorder, CP-cerebral palsy, GMFCS-gross motor function classification system, communication function classification system, FIATS-AAC-family impact of assistive technology scale-augmentative alternative communication, MLUm-mean length of utterance in morphemes, PLS-preschool language scale

The current study showed improvement in the child's communication at follow-up with an increase in FIATS-AAC score from baseline (M=38.63, SD=9.801) to follow-up (M=43.79, SD=9.95), with a mean difference of 0.97, which is statistically significant, $p<0.01$. These results correlated very well with Ryan et al, there was a significant mean difference in FIATS-AAC score from baseline 2 (M=51.2, SD=8.3) to follow-up 2 (M=53.5, SD=8.3) which was statistically significant showing $t(34)=3.24$, $p=0.003$, with an effect size of 0.55.[7] In Smith et al study, the outcome was measured with MLUm and PLS-4 scores and compared among children who were not yet talking, emerging talkers, and established talkers. Therefore, the observation showed 0 SD and 7.45 SD among non-talking groups for MLUm and PLS-4 scores, respectively, 0.16 SD and 6.79 SD among emerging takers, and 0.45 SD and 2.06SD among established talkers for MLUm and PLS-4 scores.[6]

This study also correlates the outcome of AAC therapy with GMFCS and CFCS scores. It showed a significant improvement in children with CP with a higher CFCS score ($p<0.01$). The absence of a significant association between GMFCS level and AAC outcome suggests that gross motor severity is not a limiting factor for communication improvement. In contrast, the CFCS level was strongly predictive of AAC benefit, indicating that baseline communication ability, rather than motor capacity, should guide prognostication and intervention planning. This finding is in agreement with Binger and Light's recommendations that AAC implementation should be tailored to the communication function rather than motor function alone.[17]

Few studies in India showed the use of AAC therapy and its outcome. This study seeds future research to evaluate the responsiveness of the FIATS-AAC as an outcome measure for routine clinical use. Thus, it provides the ability to detect functional change within individuals and groups of children following an AAC intervention if change is present. With suitable measurement tools such as the FIATS-AAC, clinicians will have the ability to make shared decisions and assess the effectiveness of AAC interventions designed to enhance functional communication, which will ultimately improve outcomes for children with complex communication needs.

CONCLUSIONS

The children with cerebral palsy with perisylvian phenotype with predominant speech delay could potentially benefit from AAC, as it aids in communication with family and society. The inclusion of both GMFCS and CFCS classifications allowed for a nuanced understanding of functional profiles, and the use of standardized FIATS AAC scoring enabled objective measurement of therapy impact. This study also reinforces the importance of CFCS classification in the assessment of AAC therapy response. Also, this study emphasizes the importance of parents' participation in the care of children with CP by involving the FIATS-AAC score for assessment of the efficacy of AAC therapy.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Prasanna P, Gowda VK, Shivappa SK, Hegde S. Effectiveness of augmentative alternative communication (AAC) therapy in children with cerebral palsy (CP) with expressive speech delay. Int J Contemp Pediatr 2025;12:1647-52.