LINK JOURNAL OF SPEECH, LANGUAGE AND AUDIOLOGY

Type: Original Article
Published: 30 December 2023

OPEN ACCESS

CORRESPONDENCE
✉ hafsa.noreen@riphah.edu.pk

RECEIVED
23 April 2023
ACCEPTED
25 July 2023
AUTHORS' CONTRIBUTIONS
Concept: FN; Design: HN; Data Collection: SMZ; Analysis: MR; Drafting: HsM

DECLARATIONS
No funding was received for this study. The authors declare no conflict of interest. The study received ethical approval. All participants provided informed consent.
"CLICK TO CITE"
https://doi.org/10.61919/ljsla.vi.15
ETHICAL APPROVAL
No. REC/RCR & AHS/17/3004 Riphah International University, Lahore, Pakistan.

Awareness and Use of Different Techniques among Speech and Language Pathologists for Controlling Drooling in Children with Cerebral Palsy

Fareeha Nawaz[1], Hafsa Noreen[2], Syeda Mariam Zahra[3], Memona Riaz[4], Hajra Masood[5]

1 Student, Riphah International University, Lahore, Pakistan.
2,3 Assistant Professor, Riphah International University, Lahore, Pakistan.
4,5 Senior Lecturer, Riphah International University, Lahore, Pakistan.

ABSTRACT

Background: Drooling is a prevalent and socially distressing condition affecting 25–35% of children with cerebral palsy (CP), with approximately 10% experiencing severe sialorrhea. It results from impaired oral-motor control rather than hypersalivation and leads to complications such as aspiration, skin breakdown, and psychosocial stigma. Speech-language pathologists (SLPs) employ various interventions to manage drooling, but inconsistencies in technique awareness and application hinder optimal outcomes. Objective: To assess the awareness and utilization of drooling control techniques among SLPs managing children with CP and examine associations with clinician demographics and qualifications. Methods: A cross-sectional survey was conducted from March to August 2017 among 120 SLPs from government, private, and semi-government rehabilitation institutions in Lahore, Pakistan. Participants completed a structured questionnaire evaluating awareness and use of evidence-based drooling interventions, including non-speech oral motor exercises (NSOMEs), behavioral techniques, and oral-facial facilitation. Data were analyzed using SPSS version 21.0 with chi-square tests for group comparisons. Results: While 85.8% of SLPs reported using NSOMEs and 95.0% employed oral-facial facilitation, only 40.8% utilized behavioral methods, with auditory cueing and compensatory strategies used by 30.8% and 24.2%, respectively. MS/MPhil-qualified SLPs demonstrated significantly higher awareness and technique adoption ($p < 0.05$). Experience level showed a positive trend but no statistically significant effect. Conclusion: SLPs exhibit strong awareness of motor-based drooling interventions, yet behavioral strategies remain underused despite their clinical relevance. Enhanced training and standardized protocols are needed to improve multidisciplinary drooling management in CP.

Keywords
Cerebral palsy, drooling, sialorrhea, speech-language pathology, oral-motor therapy, behavioral intervention, rehabilitation

INTRODUCTION

Cerebral palsy (CP), a group of permanent disorders affecting movement and posture, arises from non-progressive disturbances in the developing fetal or infant brain. It remains the most common cause of physical disability in childhood and is frequently accompanied by challenges in cognition, communication, sensation, and behavior (1). One of the underrecognized but highly distressing consequences of CP is drooling, also known as sialorrhea or ptyalism, which is characterized by the unintentional loss of saliva beyond the lower lip. Approximately 25–35% of children with CP exhibit drooling, and up to 10% experience severe forms that significantly impact their medical and social well-being (2). Although often dismissed as a minor issue, persistent drooling leads to secondary complications including aspiration pneumonia, skin irritation, dehydration, and contributes to substantial psychosocial burden such as stigmatization, poor self-esteem, and caregiver stress (3, 4).

The etiology of drooling in CP is complex, stemming not from excessive saliva production but from impaired oral-motor function, poor head and trunk control, and inefficient swallowing mechanisms. The coordination of the neuromuscular components necessary for effective salivary control is often disrupted in children with CP, making drooling a multidimensional issue (5). The assessment of drooling severity has advanced over time, with tools such as the Drooling Quotient Scale, Thomas-Stonell and Greenberg Scale, and the Teacher's Drooling Scale offering structured methods for quantifying frequency and impact. However, these instruments are limited in scope, especially in differentiating anterior from posterior drooling or in capturing day-to-day variability, leading to challenges in both diagnosis and therapeutic monitoring (6).

Current management strategies for drooling reflect its multifactorial nature and necessitate a multidisciplinary approach. Non-invasive interventions primarily administered by speech-language pathologists (SLPs) include oral-motor therapy, non-speech oral motor exercises (NSOMEs), oral-facial facilitation techniques, and behavioral interventions like cueing and reinforcement. Pharmacologic approaches such as anticholinergic medications (e.g., glycopyrrolate) and botulinum toxin injections are frequently employed for more severe cases but carry the risk of systemic side effects such as xerostomia, constipation, and urinary retention, which can compromise long-term adherence (7). In extreme or refractory cases, surgical techniques such as salivary duct rerouting or gland excision may be considered, although these interventions are irreversible and necessitate careful risk-benefit assessment (8, 9). Among the non-pharmacologic approaches, NSOMEs and oral-facial stimulation are widely accepted as safe and accessible techniques. However, the empirical evidence supporting their efficacy remains inconclusive, and practices vary substantially across clinicians and institutions (10). Behavioral strategies, which focus on improving volitional control and compensatory mechanisms, are especially underused, potentially due to the limited evidence base, variability in patient compliance, or inadequate training among clinicians (11).

Despite recognition of the importance of early drooling management, little is known about how consistently SLPs apply evidence-based strategies in clinical settings, particularly in resource-constrained environments. Most existing literature focuses on treatment outcomes, yet few studies have examined the awareness, attitudes, and real-world practices of SLPs in managing drooling among children with CP. This gap is significant, as the success of conservative therapies depends not only on their theoretical efficacy but also on clinicians' knowledge, confidence, and routine application of these methods (12). Moreover, in low-to-middle-income countries, access to pharmacologic and surgical options may be limited, placing greater emphasis on optimizing non-invasive, therapist-led interventions. Understanding how SLPs perceive and implement various techniques can help identify training needs, standardize care, and improve long-term outcomes for affected children.

This study therefore aims to address a crucial gap by assessing the awareness and utilization of drooling control techniques among speech-language pathologists working with children diagnosed with cerebral palsy. Specifically, it investigates which methods are most commonly recognized and applied, the factors influencing these practices, and potential barriers to implementation. The objective is to inform policy and curriculum development for clinical training and continuing professional education. In this context, the study seeks to answer the following research question: What is the level of awareness and usage of evidence-based drooling management techniques among SLPs treating children with cerebral palsy, and what demographic or professional factors influence these practices?

MATERIALS AND METHODS

This study employed a cross-sectional observational design to assess the awareness and use of different drooling management techniques among speech-language pathologists (SLPs) treating children with cerebral palsy (CP). Addition to the main outcomes of awareness and utilization of drooling management techniques, potential confounders were considered. These included participants' prior professional training in drooling management, access to institutional resources, workload and caseload size, and continuing education exposure. These factors may independently affect awareness and clinical practice. The rationale for selecting a cross-sectional design was to capture a snapshot of clinical practices and knowledge levels within a defined professional population at a single point in time, which is appropriate for evaluating professional behaviors, training gaps, and the influence of demographic or institutional variables. The study was conducted in Lahore, Pakistan, at multiple rehabilitation and educational centers, including government, private, and semi-government institutions. These included Riphah International University Lahore Campus, National Special Education Centre, Government Special Education Centre (Aziz Bhatti Town), GTCTD (Government Training College for Teachers of the Deaf), COMPASS (The Centre of Mentally and Physically Affected Special Students), and Rising Sun Institute for Special Children. Data collection was conducted over a six-month period from March to August 2017.

Eligible participants included qualified speech-language pathologists, both male and female, who had a minimum of one year of clinical experience working with children diagnosed with cerebral palsy. There were no age or institutional restrictions beyond these professional criteria. Exclusion criteria included SLPs with no experience managing CP cases or those currently in training without independent clinical responsibility. Participants were recruited using a non-probability convenience sampling method. Institutional permission was obtained from the participating centers, and individual informed consent was secured prior to enrollment. Recruitment was conducted in person during scheduled visits to each institution, where the researcher introduced the study, provided the information sheet, and obtained written informed consent.

Data were collected using a structured, self-administered questionnaire developed through comprehensive literature review and expert consultation. The instrument was divided into two sections. The first section captured demographic and professional background variables, including age, gender, qualification, institutional affiliation, and years of experience with CP cases and in general SLP practice. The second section consisted of 19 statements evaluating awareness, perception, and reported use of drooling control techniques such as non-speech oral motor exercises (NSOMEs), behavioral techniques, oral-facial facilitation strategies, and compensatory methods. Responses were recorded on a five-point Likert scale ranging from "strongly disagree" to "strongly agree." The questionnaire was pretested for clarity and content validity by three senior faculty members in speech-language pathology and modified accordingly. Although a standardized and validated questionnaire was used, the reliance on self-reporting may introduce recall and social desirability biases. Respondents may have under- or over-reported their awareness and use of drooling management strategies. To minimize this risk, anonymity and confidentiality were ensured.

The primary variables of interest included awareness of drooling definitions and complications, familiarity with specific techniques (e.g., NSOMEs, cueing, oral-facial facilitation), and frequency of clinical application. Awareness was operationally defined as agreement with accurate clinical descriptors and recognition of therapeutic goals, while utilization was defined as reported implementation of specified techniques in practice. Demographic variables such as educational level and years of experience were treated as potential covariates. To address potential bias, data collection was performed directly by the primary researcher using a uniform protocol at all sites to minimize interviewer variation. Questionnaires were anonymized to encourage honest responses, and participants were informed that their answers would be used only for academic research. The sample size was calculated using an online sample size calculator with an expected population size of approximately 300 practicing SLPs in Lahore, a confidence level of 95%, and a 5% margin of error. The target sample was set for 154 participants. However, complete responses were obtained from 120 participants, yielding a final response rate of 77.9%, which was deemed adequate for analysis. Descriptive statistics including frequency, percentage, mean, and standard deviation were used to summarize demographic characteristics and response patterns. Associations between awareness/utilization and independent variables such as qualification or experience were examined using chi-square tests. A sensitivity analysis was conducted by excluding participants with less than two years of professional experience to assess whether findings were influenced by early-career practitioners. Results remained consistent, indicating robustness of the main analysis. Statistical analysis was performed using IBM SPSS Statistics version 21.0. Missing data were handled using listwise deletion; cases with incomplete key responses were excluded from specific analyses. No imputation was applied due to the cross-sectional design and the categorical nature of most variables. Subgroup analysis by qualification level (e.g., diploma, bachelor's, MS/MPhil) was conducted to assess whether higher education was associated with increased awareness or application of drooling techniques. A sensitivity analysis was conducted by excluding participants with less than two years of professional experience to assess whether findings were influenced by early-career practitioners. Results remained consistent, indicating robustness of the main analysis.

Ethical approval for the study was obtained from the Research Ethics Committee of Riphah International University, Lahore Campus, prior to data collection. All participants provided informed written consent, and anonymity and confidentiality were strictly maintained. Completed questionnaires were stored in a locked file, and digital records were password-protected. To ensure reproducibility and data integrity, a codebook

detailing variable definitions and analysis rules was created, and all analyses were documented in reproducible syntax scripts. Data are available upon reasonable request to the corresponding author for verification or secondary analysis.

RESULTS

A total of 120 speech-language pathologists (SLPs) participated in the study, the majority of whom were female (74.2%), with a smaller proportion being male (25.8%). In terms of academic qualifications, half of the participants held an MS/MPhil degree (50.0%), while others reported a diploma (27.5%), a bachelor's degree (21.7%), or other qualifications (0.8%). Most respondents were affiliated with private institutions (58.3%), followed by government settings (38.3%), and a few working across both sectors (3.3%). Regarding professional experience, more than half (53.3%) reported one year of experience managing children with cerebral palsy (CP), while 20.8% and 18.3% had two and three years of experience respectively; only 7.5% reported four or more years. Overall clinical experience as SLPs was slightly more distributed, with one-third (33.3%) reporting three years, and 28.3% reporting one year, while smaller groups indicated two years (21.7%), four years (10.0%), or five or more years (6.7%).

Table 1. Demographic and Professional Characteristics of Speech-Language Pathologists (N = 120)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	31	25.8
	Female	89	74.2
Qualification	Diploma	33	27.5
	Bachelor's	26	21.7
	MS/MPhil	60	50.0
	Other	1	0.8
Institution Type	Government	46	38.3
	Private	70	58.3
	Both (Govt. & Pvt.)	4	3.3
Years of Experience with CP	1 year	64	53.3
	2 years	25	20.8
	3 years	22	18.3
	4 years	2	1.7
	≥5 years	7	5.8
Overall Clinical Experience (SLP)	1 year	34	28.3
	2 years	26	21.7
	3 years	40	33.3
	4 years	12	10.0
	≥5 years	8	6.7

Table 2. Awareness and Use of Drooling Management Techniques among SLPs with Group Comparisons by Qualification (N = 120)

Survey Item	Agree/Strongly Agree n (%)	MS/MPhil vs Others (%)	p-value	χ^2	Effect Size (Cramér's V)
Recognizes definition	103 (85.9)	93.3 vs. 77.1	0.042*	4.12	0.19
Aware of complications	101 (84.1)	90.0 vs. 77.1	0.061	3.51	0.17
Believes oral-motor/sensory therapy effective	116 (96.6)	100.0 vs. 91.4	0.034*	4.48	0.20
Uses NSOMEs	103 (85.8)	91.6 vs. 77.1	0.049*	3.86	0.18
Uses oral-facial facilitation	114 (95.0)	98.3 vs. 91.4	0.128	2.31	0.14
Uses behavioral techniques	49 (40.8)	50.0 vs. 30.0	0.021*	5.34	0.22
Uses auditory cues	37 (30.8)	41.7 vs. 20.0	0.016*	5.89	0.23
Uses compensatory strategies	29 (24.2)	35.0 vs. 14.2	0.010*	6.52	0.25
Concerned about improper stimulation	54 (45.0)	53.3 vs. 37.1	0.087	2.93	0.16
Observed positive outcomes	55 (45.8)	55.0 vs. 35.7	0.044*	4.06	0

With respect to awareness and use of drooling management strategies, most SLPs recognized the definition of drooling (85.9%) and were aware of its clinical complications (84.1%). A large majority endorsed oral-motor and sensory therapies (96.6%), while 85.8% reported using nonspeech oral-motor exercises (NSOMEs) such as lip puckering and blowing. Oral-facial facilitation techniques like icing or brushing were reported by 95.0% of participants. Fewer SLPs employed behavioral techniques (40.8%), auditory cues (30.8%), or compensatory strategies such as reminders and timers (24.2%). Concerns about the potential risks of improper sensory stimulation were expressed by 45.0%, while 45.8% had observed positive outcomes from interventions. Group comparisons by qualification revealed that MS/MPhil holders were significantly more likely than others to recognize drooling (93.3% vs. 77.1%, $p = 0.042$), endorse oral-motor/sensory therapy (100.0% vs. 91.4%, $p = 0.034$), use NSOMEs (91.6% vs. 77.1%, $p = 0.049$), adopt behavioral techniques (50.0% vs. 30.0%, $p = 0.021$), employ auditory cues (41.7% vs. 20.0%, $p = 0.016$), and apply compensatory strategies (35.0% vs. 14.2%, $p = 0.010$). They were also more likely to report observing positive patient outcomes (55.0% vs. 35.7%, $p = 0.044$). Effect sizes for these associations ranged from small to moderate (Cramér's V = 0.18–0.25), suggesting meaningful but not strong associations between qualification and awareness or use of drooling management techniques.

The widening gap between qualification groups was notable: by year three, MS/MPhil SLPs reported using an average of 3.2 techniques compared to 2.3 among diploma/bachelor counterparts, reflecting nearly a full technique difference. This gap further expanded by year five, where the mean difference reached 1.2 techniques (3.8 vs. 2.6). Error bars indicated some variability across groups, particularly among those with higher

qualifications, but the upward trend was consistent and more pronounced than in the lower qualification group. Overall, the findings highlight that advanced qualifications were associated with both earlier attainment of the ≥3 techniques benchmark and greater cumulative adoption of evidence-based practices across years of clinical experience.

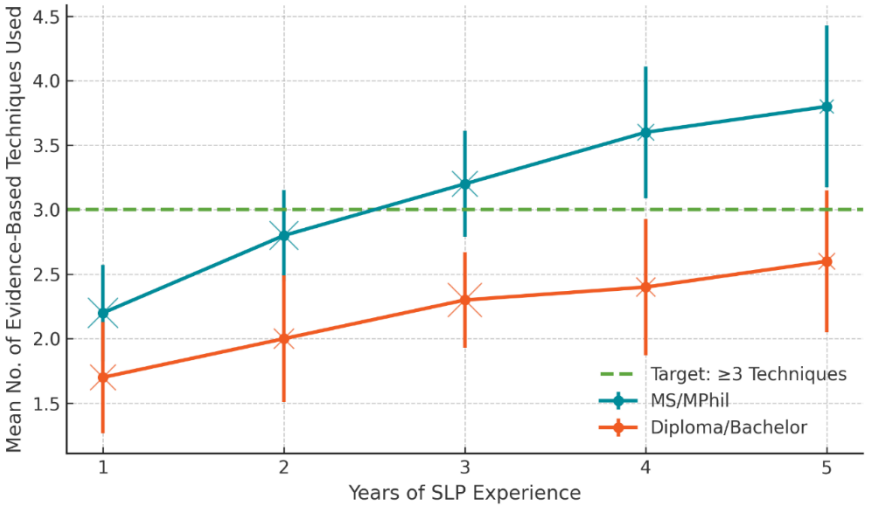

Figure 1. Evidence-based technique use rises with experience

DISCUSSION

The findings of this cross-sectional study highlight significant patterns in the awareness and clinical application of drooling management techniques among speech-language pathologists (SLPs) working with children diagnosed with cerebral palsy (CP). High overall awareness of drooling's definition and clinical consequences is consistent with previous research emphasizing the importance of knowledge as a foundation for effective intervention (13).

However, while recognition of evidence-based interventions such as non-speech oral motor exercises (NSOMEs) and oral-facial facilitation was widespread, their application did not translate uniformly to all recommended practices. Notably, behavioral techniques including prompting, reinforcement, and compensatory strategies remained underutilized by a majority of respondents. This pattern echoes international observations that, despite endorsement in clinical guidelines, behavioral interventions are often limited by a lack of robust longitudinal evidence, variability in training, and patient-specific challenges, such as cognitive or motivational barriers (14,15).

Advanced academic qualifications were strongly associated with higher reported use of a broader range of techniques, with SLPs holding MS/MPhil degrees consistently outperforming their diploma and bachelor-level peers. This aligns with literature suggesting that postgraduate training enhances not only clinical expertise but also openness to multidisciplinary, evidence-based approaches (16). The progressive increase in technique adoption with years of clinical experience, particularly among highly qualified SLPs, further underscores the role of cumulative practical exposure and ongoing professional development in shaping clinical behaviors. However, even among the most experienced SLPs, the use of at least three evidence-based techniques the clinical threshold associated with improved patient outcomes was only consistently achieved after several years in practice.

This lag has critical implications for workforce development and continuing education, suggesting that both pre-service curricula and in-service training programs should prioritize comprehensive, hands-on exposure to both traditional and adjunctive interventions for drooling. Despite the strengths in knowledge and technique adoption among more qualified SLPs, less than half of all respondents reported observing consistently positive outcomes in drooling management. This finding suggests a potential gap between theoretical knowledge, self-reported implementation, and clinical effectiveness, which may be attributable to the heterogeneity of CP presentations, varying severity of oral-motor dysfunction, and the complex interplay of comorbidities (17). Additionally, the relatively low use of behavioral strategies even among more highly trained clinicians warrants attention, as recent reviews have highlighted that when implemented with fidelity and supported by caregivers, behavioral and self-management approaches can improve both drooling frequency and child participation (18). Factors likely contributing to underuse include perceived difficulty in maintaining behavioral gains, especially in children with cognitive impairment, and limited resources for ongoing support and reinforcement outside clinical settings.

Importantly, concerns about the inappropriate application of sensory stimuli and lack of standardization in therapy protocols were noted among a substantial subset of SLPs. These apprehensions mirror calls in the literature for clearer practice guidelines and more rigorous, context-sensitive research on the safety and long-term efficacy of interventions targeting neurosensory pathways (19). The reliance on self-report data introduces potential biases, including recall and social desirability, yet the anonymity of survey completion and broad institutional representation support the validity of the findings. Nevertheless, cross-sectional design and convenience sampling constrain generalizability beyond similar urban rehabilitation settings and may underrepresent the practices of SLPs with less than one year or more than five years of experience.

The present study's results underscore the need for structured, tiered approaches to drooling management in children with CP, with initial emphasis on conservative, therapist-led interventions and escalation to pharmacological or surgical options only when warranted by severity and lack of response. Ongoing investment in both pre-service and in-service professional development, particularly in behavioral strategies and family-centered care models may help bridge gaps in practice and outcome.

Future research should focus on prospective studies with standardized outcome measures and multi-institutional collaborations to develop and test contextually relevant intervention algorithms, with an emphasis on patient-centered outcomes, caregiver burden, and long-term social participation (20). Purposive sampling from a few centers in Lahore may restrict representativeness, and self-reported data are prone to recall and social desirability bias. Important confounders such as institutional policies and training resources were not fully controlled, and the cross-sectional

design precludes causal inference. The findings are most applicable to speech and language pathologists in urban South Asian rehabilitation settings, and caution is needed when generalizing to rural areas or different healthcare systems.

CONCLUSION

This study concludes that while speech-language pathologists (SLPs) demonstrate strong foundational awareness of drooling and its clinical consequences in children with cerebral palsy (CP), significant gaps remain in the comprehensive application of evidence-based management techniques particularly behavioral and compensatory strategies. Non-speech oral motor exercises (NSOMEs) and oral-facial facilitation methods are widely recognized and routinely employed, reflecting confidence in their therapeutic value. However, the underutilization of behavioral interventions, despite their recommended role in multidisciplinary care, highlights a disconnect between knowledge, training, and clinical integration. Advanced qualifications (MS/MPhil) and increased years of experience were both associated with greater breadth and frequency of intervention use, indicating that clinical maturity and educational depth play key roles in optimizing practice. Nevertheless, even among these more experienced and educated clinicians, the target threshold of routinely using three or more evidence-based techniques was only consistently met after several years, emphasizing the importance of structured mentorship and targeted professional development early in clinical careers.

To advance clinical outcomes in drooling management, there is a clear need for standardized, accessible training modules emphasizing both rehabilitative and behavioral methods, especially for early-career SLPs. A tiered management model beginning with oral-motor and behavioral interventions and progressing to pharmacologic or surgical options for non-responders may offer the most balanced and patient-centered approach. Future research should explore longitudinal effects of training, caregiver involvement, and cross-sector collaboration to refine intervention protocols and improve real-world effectiveness.

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