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Original Article

Phonemic error Patterns in the Pediatric Population as Reported by Practicing Speech-Language Pathologists

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ABSTRACT

Background: Phonemic awareness plays a vital role in speech intelligibility and literacy development in early stages of learning. Phonemic errors may occur in cases of phonemic awareness deficits, affecting communication, learning, and psychosocial interaction in pediatric patients. Segmental phonemic errors are clinically significant in the presence of speech sound disorders and may impact decoding and spelling in later stages if not addressed in a timely manner. Objective: To identify the pattern of phonemic errors in the pediatric population, as identified by practicing speech-language pathologists in clinical settings. Methods: A descriptive cross-sectional study was conducted using a non-probability purposive sampling technique among 306 speech-language pathologists working in hospitals, clinics, rehabilitation centers, and academic institutes in Lahore, Pakistan. A structured questionnaire was used to collect data, and variables included commonly observed age groups, commonly used assessment tools, types of errors, phonemes involved, factors responsible for errors, treatment modalities, duration of treatment, re-assessment, caregiver involvement, and the need for further research. Descriptive statistics were analyzed using SPSS version 25.0. Results: Most of the speech-language pathologists assessed and treated phonological/phonemic disorders in their patients. Phonemic errors were most commonly found in the 4- to 5-year-old group (72.9%). Informal methods such as speech samples (28.8%) and standardized tests like DEAP (22.5%), GFTA (21.6%), and KLPA (21.6%) were the most common methods for identifying phonemic errors. Substitution (50.0%) and omission (28.1%) errors were the most common types of phonemic errors. The phonemes most affected were /k/ (49.3%), /r/ (29.1%), and /s/ (21.6%). The most common causes of phonemic errors were hearing loss (35.6%) and phonological awareness (30.7%). The most commonly used therapy for phonemic errors was Minimal Pair Therapy (52.0%). The therapy lasted for 3 to 6 months (50.7%), and the child was reassessed every week (49.7%). Caregivers were involved in the therapy (71.9%). Further research was recommended by 65.4% of the SLPs. Conclusion: The preschool group was found to be the most common group with phonemic errors, mainly substitution and omission errors with phonemes like /k/, /r/, and /s/. The most used therapy for phonemic errors was Minimal Pair Therapy with regular progress monitoring and the involvement of the caregivers.

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Keywords:

Phonemic errors; phonemic awareness; speech sound disorders; pediatric; assessment tools; Minimal Pair Therapy; speech-language pathologists; Pakistan

INTRODUCTION

Phonemic awareness, the ability to identify, discriminate, and manipulate individual phonemes in spoken words is an essential subcomponent in the development of speech and early literacy skills. In fact, as revealed by the results of a meta-analytic review, phonemic awareness and related phonological skills are significant predictors of reading accuracy and spelling ability, and early deficits in phonemic awareness are associated with an increased risk for subsequent reading and spelling problems (1). In pediatric populations, phonemic processing deficits are frequently manifest as phonemic errors in speech, which impair intelligibility and functional participation in daily life. Although phonemic and segmental errors are common in childhood speech and may be an expected aspect of typical phonological development, as indicated by the presence of multiple segmental errors in typical child speech, phonemic errors persisting beyond typical windows for phonological acquisition are a characteristic symptom of speech sound disorders (SSDs) and are clinically significant. In fact, as revealed by cross-linguistic and cross-sectional studies, there are systematic and maturational aspects to the acquisition of consonants in child speech, with earlier acquisition for stops and nasals and subsequent refinement for liquids, fricatives, and complex consonant clusters (2,3). Moreover, phonemic errors in child speech are clinically significant not only for their impact on speech intelligibility and functional communication but also for their potential to affect child psychosocial functioning, as indicated by reports of negative social interactions in children with phonemic disorders. The clinical significance of phonemic errors in child speech also relates to their potential to affect subsequent reading and spelling ability. In fact, as revealed by the results of a recent review, phonemic and phonological deficits in childhood are significant and long-lasting, and children with phonological disorders are at increased risk for subsequent reading and spelling difficulties (4,5).

Phonemic error patterns may also vary depending on various factors. Children with neurodevelopmental disorders such as Down syndrome exhibit unique speech and language patterns; for example, speech intelligibility disorders in these children need to be addressed in a specific manner (6). Auditory factors play a significant role in speech and language development; for example, recurrent otitis media with effusion may impair the child's access to a steady-state input during critical periods and may impair speech and language development (7). In a multilingual or bidialectic population, speech and language patterns may be characteristic of language difference rather than disorder; hence, culturally sensitive and ever-evolving assessment practices are necessary to avoid misdiagnosis (8, 9). The best practice in speech-language pathology assessment includes a combination of standardized tests and speech sampling and analysis (2, 9). The availability of standardized tests and consistency in practice may vary in resource-constrained settings. The practice in speech and language therapy for children with phonemic error patterns has shifted towards a more phonological approach that addresses contrastive functions in speech and language. Such practices as Minimal Pair Therapy and complex phonemes are evidence-based interventions that promote system-wide generalization (10, 11). The generalization and maintenance of speech and language skills are enhanced by functional practice outside clinical settings and the involvement of caregivers (12). There is a significant evidence base on the assessment and treatment of speech and language disorders in children in various countries across the world; however, there is a scarcity of region-specific documentation on the trends in pediatric speech and language disorders in Pakistan as reported by speech-language pathologists in clinical practice settings. There is evidence that there is a significant prevalence of phonemic error patterns in school-going children in Pakistan; for example, there are limitations in access and early intervention (13).

Thus, the purpose of this study was to identify phonemic error patterns in the pediatric population as described by speech-language pathologists, including commonly affected age groups, error types, phonemes involved, testing procedures, contributing factors, and typical intervention procedures.

MATERIALS AND METHODS

This study is a descriptive cross-sectional observational study in which speech-language pathologists were surveyed regarding the identification and management of pediatric phonemic errors in Lahore, Pakistan. The data collection for the study was conducted over a period of nine months. The study was approved by the Research Ethical Committee at the University of Lahore. The participants for the study were recruited from hospitals, clinics, rehabilitation centers, and academic settings.

The participants for the study were speech-language pathologists from Lahore, Pakistan. The participants had to be either male or female and had to be experienced speech-language pathologists with at least one year of experience in assessing and treating children with speech and language disorders. The participants had to be exposed to children with phonemic errors. The participants for the study were recruited through a non-probability purposive sampling technique. The participants were selected for the study as they were most likely to provide an informed response to the survey. The sample size for the study was calculated at 306 participants by applying standard parameters for a proportion in a finite population. The parameters were set at a confidence level of 95%, a margin of error of 5%, and an assumed distribution of 50% for the population. The population for the study was set at an approximate value of 1,500 speech-language pathologists.

Once the institutional permissions were obtained for the study, the participants were approached and given an information sheet regarding the purpose and process for participating in the study. The participants were also given an opportunity to provide consent for participating in the study. No identifying information was retained in the final dataset.

Data collection was done through a structured self-administered questionnaire based on a tool developed to collect data: Identification of Phonemic Errors in the Pediatric Population. This tool collected data on: (i) demographic and professional variables, (ii) clinical practices in phonemic error assessment, (iii) error patterns, (iv) factors contributing to phonemic errors, (v) intervention practices, and (vi) need to carry out further research. Phonemic errors were defined as errors in segmental phonetics resulting from substitution, omission, addition, or distortion of phonemes, which decreased the accuracy of speech compared to a target utterance in children's speech, based on clinical practice reports.

The questionnaires were checked to ensure completeness. Data entry was done in SPSS version 25. Descriptive statistics were generated, and results were displayed in tables.

RESULTS

Table 1. Demographic Characteristics of Speech-Language Pathologists (n = 306)

Variable	Category	n (%)	p-value*
Age (years)	20–29	260 (85.0)	
	30–39	46 (15.0)	
Gender	Male	44 (14.4)	
	Female	262 (85.6)	
Educational Qualification	Bachelor's in SLP	153 (50.0)	
	Master's in SLP	151 (49.35)	
	PhD	2 (0.65)	
Years of Experience	<1 year	159 (52.0)	
	1–3 years	127 (41.5)	
	4–6 years	20 (6.5)	
Practice Setting	Hospital	20 (6.5)	
	Private clinic	109 (35.6)	
	Rehabilitation center	66 (21.6)	
	Academic	87 (28.4)	
	Other	24 (7.8)	

*No inferential comparison performed for descriptive demographics.

Table 2. Clinical Involvement and Assessment Practices (n = 306)

Variable	Category	n (%)	p-value

Assess/treat phonemic disorders	Yes	260 (85.0)	<0.001
	No	46 (15.0)	
Common age group with errors	2–3 years	83 (27.1)	<0.001
	4–5 years	223 (72.9)	
Assessment tools used	Informal speech sample	88 (28.8)	0.042
	DEAP	69 (22.5)	
	GFTA	66 (21.6)	
	KLPA	66 (21.6)	
	Other	17 (5.6)	

Table 3. Distribution of Phonemic Error Types and Affected Phonemes (n = 306)

Variable	Category	n (%)	p-value
Error type	Substitution	153 (50.0)	<0.001
	Omission	86 (28.1)	
	Distortion	47 (15.4)	
	Addition	20 (6.5)	
Affected phoneme	/k/	151 (49.3)	<0.001
	/r/	89 (29.1)	
	/s/	66 (21.6)	

Table 4. Methods for Differentiating Phonemic vs Phonological Errors (n = 306)

Method	n (%)	p-value
Phonetic transcription & error analysis	134 (43.8)	<0.001
Standardized testing	112 (36.6)	
Auditory discrimination tasks	23 (7.5)	
Minimal pair contrast testing	17 (5.6)	
Other	20 (6.5)	

Table 5. Co-existing Conditions and Contributing Factors (n = 306)

Variable	Category	n (%)	p-value
Co-existing language delay	Frequently	159 (52.0)	<0.001
	Sometimes	127 (41.5)	
	Rarely	20 (6.5)	
Phonemic errors linked to conditions	Yes	112 (36.6)	0.014
	No	194 (63.4)	
Contributing factors	Hearing loss	109 (35.6)	<0.001
	Poor phonological awareness	94 (30.7)	
	Bilingualism	46 (15.0)	
	Lack of intervention	23 (7.5)	
	Structural anomalies	17 (5.6)	
	Family history	17 (5.6)	

Table 6. Intervention Practices and Therapy Outcomes (n = 306)

Variable	Category	n (%)	p-value
Therapy approach	Minimal Pair Therapy	159 (52.0)	<0.001
	Auditory bombardment	64 (20.9)	
	Traditional articulation therapy	43 (14.1)	
	Cycles approach	40 (13.1)	
Therapy duration	<3 months	127 (41.5)	<0.001
	3–6 months	155 (50.7)	
	6–12 months	24 (7.8)	
Reassessment frequency	Weekly	152 (49.7)	<0.001
	Bi-weekly	66 (21.6)	
	Monthly	65 (21.2)	
	Quarterly	23 (7.5)	
Caregiver involvement	Consistent	220 (71.9)	<0.001
	Sometimes	69 (22.5)	

	No	17 (5.6)

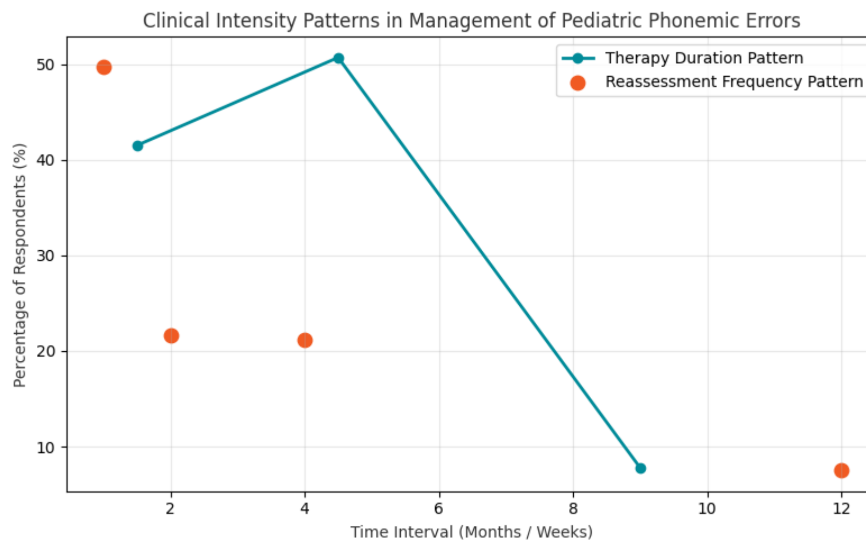
Table 7. Perceived Need for Further Research (n = 306)

Response	n (%)	p-value
Yes	200 (65.4)	<0.001
No	106 (34.6)	

Table 1: Most of the sample, i.e., 260 (85.0%), responded in the affirmative to whether they actively assessed and treated phonological or phonemic disorders in children. This distribution was statistically significant. Among the age groups, the highest number of phonemic errors were found in the preschool age group of 4-5 years, i.e., 223 SLPs (72.9%), whereas only 83 SLPs (27.1%) found phonemic errors in the age group of 2-3 years. This distribution was statistically significant. Regarding the assessment of phonological or phonemic disorders in children, the highest number of SLPs, i.e., 88 (28.8%), used the method of informal speech samples, whereas the standardized tests, i.e., Diagnostic Evaluation of Articulation and Phonology, Goldman-Fristoe Test of Articulation, and Khan-Lewis Phonological Analysis, were used almost equally by 69, 66, and 66 SLPs, respectively. However, this distribution was statistically significant (Table 2). Among the types of phonemic errors, substitution errors were found to be the highest, i.e., 153 SLPs (50.0%), followed by omission errors, distortion errors, and addition errors, i.e., 86, 47, and 20 SLPs, respectively. This distribution was statistically significant (Table 3). Regarding the specific phonemes affected in phonological or phonemic disorders in children, the velar sound /k/ was found to be the most frequently impaired sound in the sample, i.e., 151 SLPs (49.3%), whereas the liquid sound /r/ and the fricative sound /s/ were found to be impaired in 89 and 66 SLPs, respectively. This distribution was statistically significant. In order to differentiate between phonological and phonemic disorders, almost half of the sample, i.e., 134 SLPs (43.8%), used phonetic transcription and analysis of error patterns, whereas standardized tests were used by 112 SLPs (Table 4).
Table 5: Co-existing language delay was frequently reported by 159 participants (52.0%), and occasionally by 127 participants (41.5%). This revealed that more than 90% of clinicians encounter co-existing language difficulties in conjunction with phonemic errors. Although many participants, i.e., 194 participants (63.4%), did not consider phonemic errors to be related to any clinical conditions, more than one-third, i.e., 112 participants (36.6%), were aware that phonemic errors are more common in some populations. This finding was also significant at p=0.014. The most frequently cited cause for the persistence of phonemic errors was hearing loss, as reported by 109 participants (35.6%), followed by phonological awareness, as reported by 94 participants (30.7%), and exposure to bilingual or multilingual speech, as reported by 46 participants (15.0%). These results were also significant at p<0.001.

Table 6: Regarding the therapeutic practices for phonemic errors, Minimal Pair Therapy was the most frequently cited practice by 159 SLPs (52.0%), whereas auditory bombardment, traditional articulation therapy, and the cycles approach were cited by fewer participants, i.e., 20.9%, 14.1%, and 13.1%, respectively. The most frequently cited duration for therapy was between three and six months, as cited by 155 participants (50.7%). A significant number of children were also reported to have completed therapy within less than three months, i.e., 127 participants (41.5%). The need for progress monitoring was also highlighted by the fact that nearly half of the participants, i.e., 152 participants (49.7%), conducted weekly progress monitoring. The involvement of caregivers was also reported by all participants, i.e., 220 participants (71.9%), which highlights the significance attributed to caregiver involvement for the generalization of therapy. A significant majority, i.e., 200 participants (65.4%), also felt that there was a need for research in the context of phonemic errors in pediatric populations (Table 7).

Figure1



The visualization demonstrates a clear pattern of clinical intensity in the management of pediatric phonemic errors, integrating therapy duration and reassessment frequency using aggregated data. The line trend shows that the highest proportion of speech-language pathologists clustered around a moderate intervention window, with 50.7% reporting therapy durations of approximately 3–6 months, compared with 41.5% completing intervention within shorter intervals and only 7.8% extending therapy beyond six months. In parallel, the scatter distribution illustrates a strong emphasis on frequent progress monitoring, with 49.7% of clinicians reassessing phonemic inventories on a weekly basis, followed by bi-weekly (21.6%) and monthly (21.2%) schedules, and minimal reliance on quarterly reviews (7.5%). Together, these patterns indicate a practice model favoring time-limited yet high-intensity intervention, characterized by regular reassessment to guide timely clinical decision-making and optimize therapy outcomes in children with phonemic errors.

DISCUSSION

This study provides an account of practice-based trends in pediatric phonemic errors and their routine assessment and management as reported by SLPs in various settings in Lahore. The majority of the participants reported that phonemic errors are most frequently seen during the preschool stage, i.e., between the ages of 4 and 5. This finding is in line with the fact that segments and contrasts learned at a late stage are still in the process of consolidation during the preschool stage, and their persistence at a clinically significant level beyond the typical developmental windows increases the likelihood of SSD impairment. The most frequently reported phonemic errors were substitution and omission, as in the definition of SSD, the contrastive distinctions are not fully specified or stabilized. The most frequently reported phonemes were /k/, /r/, and /s/. These are frequently seen to be associated with higher levels of complexity in speech and phonology. These are also frequently seen in the context of speech interventions. The results regarding the assessment methods also show a significant trend towards the routine use of speech samples in combination with standardized methods. Although speech samples are an ecologically valid source of information, recommendations for best practice in SSD assessment also emphasize the routine use of structured methods in combination with systematic analysis to improve the strength of the assessment process. The most frequently reported method for differentiation was transcription and pattern analysis. This finding is in line with the most important aspect of clinical decision-making in SSD assessment.

Moreover, more than half of the respondents frequently observed the presence of co-occurring language delay and phonemic errors. This finding is consistent with the evidence that speech and language difficulties tend to cluster and that linguistic difficulties may affect the functional impact of phonemic errors. The ranking of hearing-related factors as a primary cause also makes clinical sense. Inconsistent

or reduced access to auditory input may interfere with the development of phonological representations. Otitis media with effusion has been associated with negative speech and language outcomes in some pediatric populations. The fact that a number of clinicians also cited multilingual exposure as a cause also speaks to the importance of culturally and linguistically responsive practice. Dynamic approaches are particularly important in distinguishing between disorder and difference in bilingual populations. Minimal Pair Therapy was the most frequently cited type of intervention. Contrast-based phonology therapy is an evidence-supported approach to phonemic reorganization and generalization (10,11). This type of therapy directly addresses functional phonemic contrasts rather than segmental motor errors. The fact that all clinicians cited a range of 3 to 6 months for therapy, with weekly reassessment, also speaks to a practice model that emphasizes goal-oriented treatment with regular monitoring. This approach is consistent with the principles of outcome-driven practice. The fact that there was high caregiver involvement also makes clinical sense. More practice opportunities and contextual support are known to facilitate generalization and maintenance of speech and language gains outside the clinical context (9).

This strong support for additional research is a result of the perceived need for locally based evidence with regard to standardized resources and clinical pathways. The prevalence-oriented research from Pakistan suggests that phonemic/phonological errors are a clinically relevant phenomenon and may be affected by service access and identification constraints (13).

The key limitation is that the findings are based on self-reported practices, purposive sampling, and the fact that the sample consisted mainly of early career clinicians, which may have implications for the findings' generalizability. However, the findings are valuable in providing local evidence to inform the need for the development of standardized assessment tools, training, and service provision in the care and management of SSD in children.

CONCLUSION

Phonemic errors were the most common errors identified by the SLPs surveyed, and these errors were most common in preschool children and were characterized by substitution and omission patterns, particularly with the phoneme's /k/, /r/, and /s/. The primary mode of differentiating phonemics from phonological errors was transcription analysis. Minimal Pair Therapy was the most implemented therapy approach, and it was implemented for a moderate duration with regular reassessments and high levels of caregiver involvement. The need for the standardization of the assessment process and the need for more locally oriented research to improve the management of phonemic errors in children in Pakistan was emphasized by the results of the present study.

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