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Original Article

Prevalence of Phonological Awareness Skills and Speech Intelligibility in Typically Developing Children

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ABSTRACT

Background: Phonological awareness supports literacy development, while accurate speech production contributes to effective communication. Limited descriptive evidence is available for typically developing Pakistani schoolchildren. **Objective:** To determine the distribution of phonological-awareness performance and consonant-production accuracy among typically developing children aged 5–10 years. **Methods:** This descriptive cross-sectional study included 233 children recruited through convenience sampling from four schools in Lahore, Pakistan. Phonological awareness was assessed using an informal structured assessment sheet and classified as high, moderate, or low. Consonant-production accuracy was assessed using the Test of Articulation and Phonological Processes of Urdu and calculated as Percentage of Consonants Correct. Data were analysed descriptively using frequencies and percentages. **Results:** Of the participants, 118 (50.6%) were aged 5–7 years, 115 (49.4%) were aged 8–10 years, 121 (51.9%) were female, and 112 (48.1%) were male. High phonological-awareness performance was observed in 127 (54.5%) children, moderate performance in 80 (34.3%), and low performance in 26 (11.2%). Percentage of Consonants Correct was within the good-performance band in 178 (76.4%) children, mildly reduced in 44 (18.9%), and moderately reduced in 11 (4.7%). **Conclusion:** Most participants performed within the upper study-defined categories, although a minority demonstrated lower phonological-awareness or consonant-production scores. These findings are preliminary and do not constitute population norms or diagnostic prevalence estimates. **Keywords:** Children; Consonant Production; Percentage of Consonants Correct; Phonological Awareness; Speech Sound Production; Urdu.

INTRODUCTION

Phonological awareness and speech intelligibility are important but conceptually distinct components of children's communication development. Phonological awareness is a metalinguistic ability involving the conscious recognition and manipulation of the sound structure of spoken language, including rhyme recognition, syllable segmentation, sound blending, phoneme identification, and phoneme manipulation. Speech intelligibility refers to the extent to which a listener can understand a speaker's verbal output. Although these constructs represent different aspects of communication, both depend partly on the quality of a child's underlying phonological representations and speech-sound processing abilities (1).

Phonological awareness develops progressively from sensitivity to larger sound units, such as words, rhymes, and syllables, to awareness of smaller units, including individual phonemes. These abilities are

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particularly important during the preschool and early school years because they support decoding, spelling, word recognition, and the acquisition of literacy skills. Children with stronger phonological-awareness abilities generally perform better in early reading tasks, whereas persistent difficulty in identifying and manipulating speech sounds may increase the risk of subsequent reading and spelling problems (2,3).

Speech production also develops substantially during childhood. As children acquire more accurate phonological representations and greater control over the motor processes involved in speech, their spoken output generally becomes clearer and more understandable. Developmental studies have demonstrated progressive improvements in single-word and connected-speech intelligibility across childhood, although considerable variation may occur among children of the same chronological age (4,5). Accurate characterization of this variability is important because reduced speech clarity can affect classroom participation, peer interaction, expression of needs, and access to educational activities (4-6).

Phonological awareness and speech production may be related through their shared dependence on the perception, storage, retrieval, and production of speech sounds. Children with stable and well-specified phonological representations may be better able both to manipulate sound structures during phonological-awareness tasks and to produce speech sounds accurately. Conversely, omission errors, atypical speech errors, and unstable phonological representations have been associated with weaker phonological-awareness performance among children with and without identified speech sound disorders (1,6). However, the strength and clinical meaning of this relationship may vary according to age, language, literacy exposure, and the instruments used to assess each construct (7-11).

Formal educational experience may also contribute to phonological-awareness development. Exposure to print, letter–sound correspondence, rhyming activities, syllable exercises, and structured language instruction may reinforce children's ability to analyse spoken sound patterns. Intervention research has further shown that structured phonological-awareness activities can improve phonological processing abilities, particularly among children with speech or language difficulties (7). Nevertheless, evidence from clinical or intervention populations cannot be applied directly to typically developing schoolchildren without considering differences in language, educational context, and developmental status.

The interpretation of children's phonological and speech abilities is also influenced by linguistic and cultural context. Speech-sound inventories, syllable structures, orthographic systems, and patterns of bilingual or multilingual exposure differ across populations. Assessment instruments developed for one language or cultural setting may therefore produce inaccurate classifications when applied without appropriate linguistic adaptation. Research involving bilingual children has demonstrated that some conventional speech measures may retain diagnostic value, but their interpretation requires careful consideration of the child's language background and the linguistic appropriateness of the assessment material (8).

Most available developmental evidence has originated from Western and predominantly English-speaking populations. Comparatively limited information is available regarding phonological-awareness performance and speech-production accuracy among typically developing Pakistani children, particularly those assessed using Urdu-language speech material. Locally derived descriptive data may assist speech-language pathologists and educators in understanding the range of performance observed among schoolchildren and in identifying areas requiring more rigorous normative investigation. Such data should, however, be interpreted cautiously when obtained through convenience sampling or study-defined performance thresholds rather than nationally representative sampling and validated diagnostic cut-offs (11-14).

The present study therefore aimed to determine the distribution of phonological-awareness performance and speech-production accuracy among typically developing children aged 5–10 years attending

selected schools in Lahore, Pakistan. Speech-production accuracy was operationalized using the Percentage of Consonants Correct, which was used in this study as an indirect indicator related to speech intelligibility rather than as a direct listener-rated measure of intelligibility. The study further described the proportions of participating children classified within predetermined phonological-awareness and Percentage of Consonants Correct performance bands.

MATERIALS AND METHODS

A descriptive cross-sectional study was conducted to determine the distribution of phonological-awareness performance and speech-production accuracy among typically developing schoolchildren aged 5–10 years. The cross-sectional design was selected because the study assessed each participant at a single time point and was intended to describe the proportions of children falling within predetermined performance categories rather than to evaluate developmental change, treatment effects, or causal relationships. Data were collected from Front Line School System, Al-Islamic Public High School, Punjab Premier School, and Larsen High School in Lahore, Pakistan. The study was completed over a six-month period following formal approval of the research synopsis (14-18).

The target population comprised male and female children aged 5–10 years who were enrolled in regular school programmes. Participants were recruited using non-probability convenience sampling according to their availability and willingness to participate. Children were eligible when they were within the specified age range, were attending a regular school programme, and had no reported history of speech, language, hearing, neurological, intellectual, or developmental disorders. Hearing status and the absence of known speech or language difficulties were established through information obtained from parents, guardians, or teachers rather than through formal audiological or diagnostic testing. Children with a diagnosed speech or language disorder, reported hearing impairment, autism spectrum disorder, intellectual disability, another neurological or developmental condition, or inability to cooperate with the assessment procedures were excluded.

The required sample size was calculated using the single-population proportion formula:

$$n = [Z^2 \times p \times (1 - p)] / E^2$$

A 95% confidence level, an expected proportion of 18.6%, and an absolute precision of 5% were applied, producing a required sample of approximately 233 participants. A total of 233 eligible children completed the reported assessments and were included in the final descriptive analysis.

Following permission from the relevant school authorities, parents or guardians were informed about the purpose and procedures of the study. Written informed consent was obtained from the parents or guardians before assessment. Participation was voluntary, and participants could withdraw from the study without disadvantage. Assessments were performed individually in a quiet area within the participating schools to reduce environmental distraction and facilitate consistent administration. Demographic information, including age, gender, and educational grade, was recorded on a structured data-collection sheet (16).

Phonological awareness was assessed using an informal, structured phonological-awareness assessment sheet. The assessment included age-appropriate tasks addressing sound identification, blending, segmentation, rhyme-related awareness, and sound manipulation. Participant responses were recorded systematically, and correct responses were summed to produce an overall phonological-awareness score. The score was converted into a percentage of the total obtainable score. For descriptive reporting, performance was classified using the study's predetermined bands as high when the percentage score was 80%–100%, moderate when it was 50%–79%, and low when it was below 50%. These bands were used as study-defined descriptive categories and were not treated as diagnostic thresholds for a phonological disorder.

Speech production was assessed using the Test of Articulation and Phonological Processes of Urdu. Each child was asked to produce the target words included in the assessment, and the productions were documented on the corresponding scoring sheet. Consonant productions were examined for accuracy, and the Percentage of Consonants Correct was calculated using the established method described by Shriberg and Kwiatkowski (9):

Percentage of Consonants Correct = (Number of correctly produced consonants / Total number of intended consonants) × 100

The Percentage of Consonants Correct represented consonant-production accuracy and was used as an indirect speech-performance measure related to intelligibility. It did not constitute a direct listener-transcription measure of how many words or utterances were understood. For descriptive presentation, the study classified Percentage of Consonants Correct values as good at 85%–100%, mild reduction at 65%–84%, and moderate reduction at 50%–64%. These labels reflected the performance bands used in the original study dataset and were interpreted descriptively rather than as independently confirmed clinical diagnoses. No participant was reported in an additional category below 50%.

Completed assessment sheets were reviewed for completeness before the recorded demographic variables, phonological-awareness scores, and Percentage of Consonants Correct values were entered into IBM SPSS Statistics version 25.0. The analysis was descriptive because the stated objective was to characterize the distribution of performance within the participating sample. Categorical variables were summarized using frequencies and percentages. Age was presented in the predefined groups of 5–7 and 8–10 years, while gender, educational grade, phonological-awareness category, and Percentage of Consonants Correct category were reported according to their respective classifications. All 233 participants had data included in the reported frequency tables. No causal, developmental, or correlational conclusions were drawn from the descriptive cross-sectional analysis.

The study was conducted after approval through the relevant institutional research and ethical processes of the University of Lahore and after administrative permission had been obtained from the participating schools. Parents or guardians provided written informed consent before the children participated. Participant identities were not included in the analytical dataset, and collected information was used exclusively for research purposes. Paper records were maintained in secured storage, while electronic records were kept on a password-protected computer accessible to the research team.

RESULTS

All 233 participants included in the study had complete demographic, phonological-awareness, and Percentage of Consonants Correct category data available for the descriptive analysis. Of these, 118 (50.6%) were aged 5–7 years and 115 (49.4%) were aged 8–10 years. Female participants accounted for 121 (51.9%) of the sample, while 112 (48.1%) were male. Participants were enrolled in preparatory class through Grade 3, with the largest proportion attending preparatory class.

Table 1. Demographic and Educational Characteristics of the Participants

Characteristic	Category	n (%)	95% CI
Age group, years	5–7	118 (50.6)	44.3–57.0
	8–10	115 (49.4)	43.0–55.7
Gender	Female	121 (51.9)	45.5–58.3
	Male	112 (48.1)	41.7–54.5
Educational grade	Preparatory class	67 (28.8)	23.3–34.9
	Grade 1	54 (23.2)	18.2–29.0
	Grade 2	50 (21.5)	16.7–27.2
	Grade 3	62 (26.6)	21.3–32.6

Data are presented as n (%). CI: confidence interval. Percentages were calculated using 233 as the denominator. Confidence intervals were calculated using the Wilson method.

Phonological-awareness performance was classified using the predetermined study-defined percentage bands. High phonological-awareness performance was observed in 127 participants (54.5%; 95% CI: 48.1%–60.8%), while 80 (34.3%; 95% CI: 28.5%–40.6%) demonstrated moderate performance. The remaining 26 participants (11.2%; 95% CI: 7.7%–15.8%) were classified in the low-performance category.

For consonant-production accuracy, 178 participants (76.4%; 95% CI: 70.5%–81.4%) had Percentage of Consonants Correct values within the good-performance band. Mildly reduced performance was identified in 44 participants (18.9%; 95% CI: 14.4%–24.4%), while 11 participants (4.7%; 95% CI: 2.7%–8.3%) were classified in the moderately reduced band. No category below 50% was reported in the available results.

Table 2. Distribution of Phonological-Awareness and Consonant-Production Performance

Outcome	Study-Defined Performance Band	n (%)	95% CI
Phonological awareness	High, 80%–100%	127 (54.5)	48.1–60.8
	Moderate, 50%–79%	80 (34.3)	28.5–40.6
	Low, <50%	26 (11.2)	7.7–15.8
Percentage of Consonants Correct	Good, 85%–100%	178 (76.4)	70.5–81.4
	Mildly reduced, 65%–84%	44 (18.9)	14.4–24.4
	Moderately reduced, 50%–64%	11 (4.7)	2.7–8.3

Data are presented as n (%). CI: confidence interval. Percentages were calculated using 233 as the denominator. Confidence intervals were calculated using the Wilson method. The phonological-awareness and Percentage of Consonants Correct bands were the predetermined descriptive categories used in the study and should not be interpreted as independently validated diagnostic classifications.

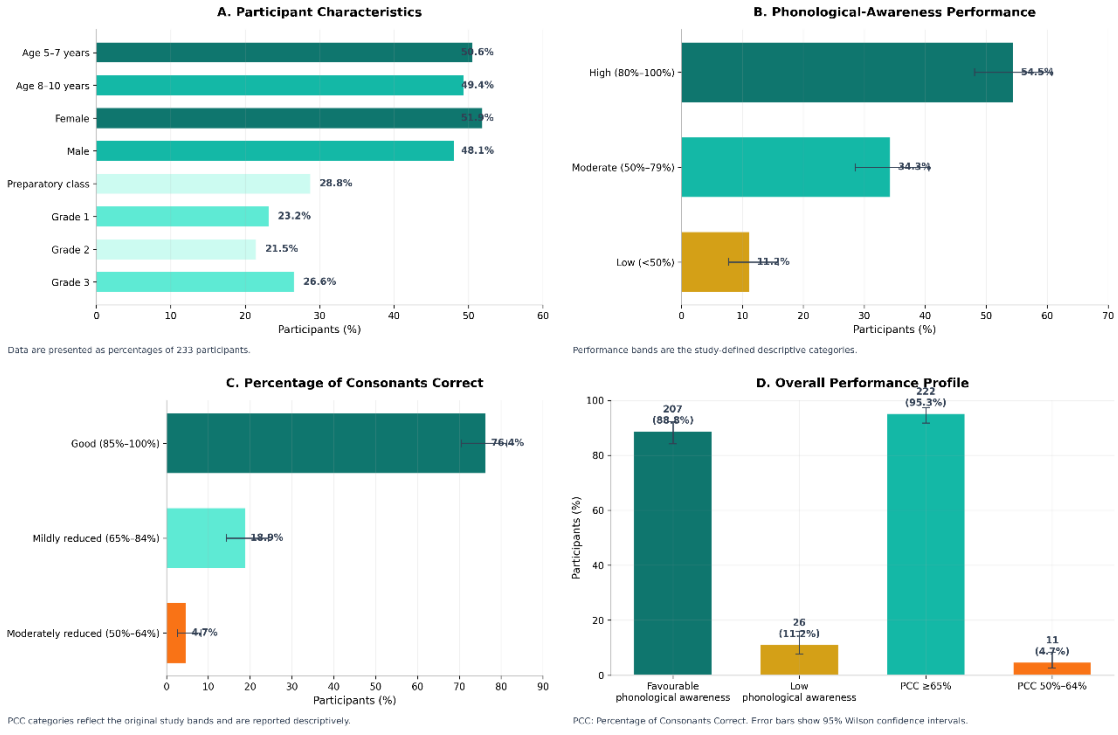


Figure 1. Developmental profile and reported concerns among preschool children. Panel A presents the demographic and educational composition of the 377 participants. Panels B–D show the proportions of children rated as experiencing each behavioral-emotional, cognitive, or communication difficulty at least sometimes, calculated by combining the "sometimes," "often," and "very frequently" categories. Social withdrawal was reported in 21.8% of children, peer-relationship difficulty in 21.5%, emotional dysregulation in 20.7%, and frustration during difficult tasks in 20.5%. Cognitive concerns ranged from 19.0% for basic-concept acquisition to 22.3% for difficulty attending to developmentally appropriate tasks. Communication concerns ranged from 18.6% for interpreting or using nonverbal cues to 22.6% for limited ability to ask questions or clarify misunderstandings. One invalid response was excluded from the adaptation item, giving a denominator of 376 for that variable.

Overall, 207 participants (88.8%) demonstrated either high or moderate phonological-awareness performance, whereas 26 (11.2%) were classified in the low-performance band. Similarly, 222 participants

(95.3%) had Percentage of Consonants Correct values of at least 65%, comprising the good and mildly reduced bands, while 11 (4.7%) were classified in the moderately reduced band. These results describe the distribution of performance within the participating school-based sample and do not establish age-specific normative values or diagnostic prevalence.

DISCUSSION

The present study described phonological-awareness performance and consonant-production accuracy among 233 typically developing children aged 5–10 years attending selected schools in Lahore. More than half of the participants were classified in the high phonological-awareness band, while approximately one-third demonstrated moderate performance and 11.2% fell within the low-performance band. Consonant-production accuracy was concentrated in the upper performance category, with 76.4% of participants achieving Percentage of Consonants Correct values between 85% and 100%. A further 18.9% had mildly reduced scores, whereas 4.7% were classified in the moderately reduced band. These findings indicate that most children in the participating school-based sample performed within the upper study-defined categories, although a meaningful minority demonstrated lower phonological-awareness or consonant-production scores.

The predominance of high and moderate phonological-awareness performance is broadly consistent with the expected development of sensitivity to syllables, rhymes, and individual phonemes during the early school years. Phonological awareness becomes increasingly important as children are exposed to print, decoding, spelling, and explicit letter–sound instruction. Previous research involving children learning to read in a transparent orthography showed that weaker readers performed less favourably on phonological-awareness tasks and that abilities such as phoneme segmentation, initial-phoneme identification, and syllable blending were particularly relevant to reading acquisition (2). Although literacy performance was not assessed in the present study, the distribution of phonological-awareness scores may partly reflect participants' exposure to formal schooling and sound-based learning activities. This explanation remains tentative because educational exposure, reading ability, home literacy practices, and language of instruction were not measured.

The finding that 11.2% of participants fell within the low phonological-awareness category is also clinically and educationally relevant. Phonological-awareness performance varies among children, including those without a formally identified communication disorder. Difficulties with underlying phonological representations may affect a child's ability to identify, retain, and manipulate speech sounds. Research involving children with developmental disabilities has shown that phonological awareness is related to receptive language and print-related abilities, although speech ability alone may not independently explain performance after other developmental factors are considered (3). The low-performing group identified in the present study should therefore not be interpreted as having a confirmed disorder; rather, the finding identifies a subgroup that may benefit from further assessment using validated, age-specific instruments.

Most participants also achieved Percentage of Consonants Correct values within the study-defined good-performance band. Developmental research using direct listener transcription has demonstrated that speech intelligibility generally increases across childhood, although substantial individual variation remains and complete intelligibility may not be achieved at the same age by all children (4,5). The present findings are broadly compatible with increasingly accurate speech production among school-aged children. However, direct comparison with listener-based intelligibility studies is limited because Percentage of Consonants Correct measures consonant-production accuracy rather than the proportion of words or utterances understood by listeners.

This distinction is important when interpreting the reported speech findings. Percentage of Consonants Correct was developed as a metric of phonological severity based on the proportion of intended consonants produced correctly and has demonstrated clinical utility in characterizing speech sound

involvement (9). Although consonant accuracy can influence how understandable a child's speech is, intelligibility is also affected by vowel accuracy, prosody, speech rate, utterance length, linguistic context, listener familiarity, and the communicative environment. The upper Percentage of Consonants Correct values observed in most participants therefore indicate relatively accurate consonant production under the assessment conditions but do not independently establish normal listener-rated intelligibility.

The observed coexistence of generally favourable phonological-awareness and consonant-production distributions is theoretically plausible because both abilities depend partly on the formation and access of phonological representations. Roepke and Brosseau-Lapré found that greater variability in segmental speech errors was associated with weaker phonological-awareness performance among preschool children with typical speech and those with speech sound disorder (1). Brosseau-Lapré and Roepke similarly reported that omission and atypical speech errors were associated with poorer phonological-awareness performance among children aged 4–5 years (6). Nevertheless, the present study did not analyse participant-level associations between phonological-awareness scores and Percentage of Consonants Correct. It therefore cannot determine whether children with higher phonological-awareness performance also had more accurate consonant production.

The findings also support the practical importance of monitoring phonological-awareness abilities during the early school years. Structured phonological-awareness training has been shown to improve sound-awareness skills among children with specific language impairment and co-occurring speech sound disorders, with greater gains in phonological awareness than those achieved through phonological therapy alone (7). The present study did not evaluate an intervention and cannot establish a need for treatment based solely on the reported categories. However, children performing in the lower bands may warrant further age-appropriate assessment, particularly when teachers or parents also report difficulties involving speech, reading, spelling, or classroom communication.

Language and cultural context must also be considered. Participants were recruited from schools in Lahore, and consonant production was assessed using Urdu-language material. Differences in phoneme inventories, syllable structures, orthographic transparency, language dominance, and bilingual exposure can influence speech and phonological assessment. Research involving monolingual and bilingual preschool children has indicated that some conventional phonological measures may retain diagnostic usefulness across language groups, but interpretation must remain sensitive to the child's linguistic background and the appropriateness of the assessment material (8). Because the present study did not report home language, dominant language, bilingual exposure, or school medium of instruction, the extent to which these factors influenced performance could not be determined.

A strength of the study was the inclusion of 233 children recruited from four schools, providing preliminary information from a comparatively under-researched Pakistani population. The assessment of phonological awareness and consonant-production accuracy within the same sample also allowed two related communication domains to be described concurrently. In addition, the use of Urdu speech material increased the linguistic relevance of the consonant-production assessment compared with the unadapted use of an English-language articulation test.

Several limitations restrict interpretation of the findings. Participants were recruited through convenience sampling from a limited number of schools in one city, reducing population representativeness and introducing the possibility of selection bias. The designation of participants as typically developing relied largely on parental or teacher reports, and formal audiological, developmental, speech, and language screening procedures were not reported. The informal phonological-awareness assessment lacked reported psychometric characteristics, and the selected high, moderate, and low thresholds were study-defined rather than established diagnostic cut-offs. Similarly, the Percentage of Consonants Correct categories used in the study should not be treated as direct listener-based intelligibility classifications.

The broad age range was collapsed into two categories, and no age-specific, grade-specific, gender-specific, school-specific, or language-specific outcome analyses were available. Raw phonological-awareness and Percentage of Consonants Correct scores were also unavailable, preventing assessment of score distributions, ceiling effects, or relationships between the two outcomes. Assessor training, inter-rater reliability, intra-rater reliability, and independent rescoring procedures were not reported. The cross-sectional design further prevented assessment of individual developmental change. These limitations mean that the results should be considered exploratory descriptive findings rather than normative values or diagnostic prevalence estimates (19).

Future research should recruit larger, geographically diverse samples using probability-based or stratified sampling and should report outcomes separately for individual ages and educational grades. Validated, language-appropriate phonological-awareness instruments, formal hearing screening, and direct listener-based intelligibility measures should be incorporated alongside Percentage of Consonants Correct. Linguistic exposure, school medium, socioeconomic circumstances, parental education, and literacy performance should also be evaluated. Participant-level analyses could then determine whether phonological awareness and consonant-production accuracy are associated after accounting for age, grade, language background, and other relevant factors.

CONCLUSION

Most participating children aged 5–10 years demonstrated high or moderate phonological-awareness performance and Percentage of Consonants Correct values within the upper study-defined bands. However, 11.2% had low phonological-awareness performance and 4.7% had moderately reduced consonant-production accuracy. These findings provide preliminary descriptive information from selected schools in Lahore but should not be interpreted as population norms, diagnostic prevalence estimates, or evidence of a correlation between the two outcomes. Further age-specific assessment using validated, linguistically appropriate instruments is required.

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