ISSN: 2549-8959 (Online - Elektronik)
Pages 2114-2120
Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini
journal homepage: https://obsesi.or.id/index.php/obsesi

Percent Consonants Correct and Vowels Correct as Predictors of Word-Level Intelligibility in Children: Evidence from 394 Indonesian-Speaking Children

Jumiarti [a], Rexsy Taruna [b]✉, Stella Rosalina Phandinata [c]
[a] Terapi Wicara, Politeknik Arutala Johana Hendarto, Indonesia
[b] Terapi Wicara, Universitas Mercubaktijaya, Indonesia
[c] Rumah Sakit Pantai Indah Kapuk, Indonesia
DOI: 10.31004/obsesi.v10i3.8447

Abstract
Speech intelligibility is a key indicator of children's communicative competence, yet evidence regarding its phonological predictors in Indonesian-speaking children remains limited. This study investigated the extent to which consonant and vowel accuracy predict word-level intelligibility in Indonesian children. A total of 394 typically developing Indonesian children aged 3-6 years participated. Speech production measures included Percent Consonants Correct (PCC), Percent Vowels Correct (PVC), and word-level intelligibility scores. Statistical analyses comprised descriptive statistics, Mann-Whitney U tests for gender comparisons, Spearman correlations controlling for age, and linear regression. Mean scores were 85.25 (PCC), 87.56 (PVC), and 80.04 (intelligibility). Girls outperformed boys across all three measures. Strong correlations were found between PCC, PVC, and intelligibility, with PCC demonstrating the strongest association. Regression analysis indicated that PCC and PVC together explained 75.8% of the variance in intelligibility, with PCC emerging as the dominant predictor. Consonant accuracy is the primary determinant of intelligibility, although vowel accuracy provides additional predictive value. These findings align with cross-linguistic literature and contribute empirical reference data for Indonesian children, highlighting implications for assessment and intervention in speech-language pathology..

Keywords: *speech intelligibility, Percent Consonants Correct, Percent Vowels Correct, phonological development, Indonesia*

Copyright (c) 2026 Jumiarti, et al.
✉ Corresponding author : Rexsy Taruna
E-mail address : rexsytaruna.terapiswicara@gmail.com (Padang, Indonesia)
Received 13 May 2026, Accepted 21 June 2026, Published 21 June 2026

Introduction
Speech intelligibility, defined as the extent to which a listener can accurately understand a speaker's intended message, represents one of the most important functional outcomes of children's speech development. Beyond accurate sound production, intelligibility reflects the integration of multiple linguistic processes, including phonological organization, articulatory precision, prosodic control, and listener perception (Kent, 2007). Reduced intelligibility may negatively affect children's social participation, academic readiness, and communication effectiveness, making its assessment a central component of pediatric speech-language pathology (Flipsen, 2006; McLeod & Baker, 2017). Therefore, identifying the factors that contribute to intelligible speech is essential for establishing accurate developmental benchmarks and evidence-based intervention strategies.

Among various factors influencing intelligibility, segmental accuracy has received considerable attention because speech sound production directly affects word recognition. Two commonly used clinical and research measures are Percent Consonants Correct (PCC) and Percent Vowels Correct (PVC), which quantify the accuracy of consonant and vowel production relative to adult targets (Shriberg & Kwiatkowski, 1982).

DOI: 10.31004/obsesi.v10i3.8447

These measures provide objective indicators of phonological development and have been widely applied to describe speech acquisition patterns, classify speech sound difficulties, and monitor intervention outcomes (McLeod & Baker, 2017).

Previous research suggests that consonants and vowels contribute differently to speech intelligibility. Consonants generally carry a higher phonemic load because they provide critical contrasts that distinguish lexical meaning, making consonant accuracy highly influential in listener perception (Munson et al., 2012). In contrast, vowels contribute to intelligibility through their roles in maintaining syllable structure, acoustic stability, and speech rhythm. Although vowels are typically acquired earlier and show greater developmental stability, atypical vowel errors may substantially reduce intelligibility, particularly among children with speech sound disorders (Flipsen & Ogiela, 2015; Preston & Edwards, 2007).

Cross-linguistic developmental evidence demonstrates that vowel systems tend to stabilize earlier, whereas consonant acquisition follows a longer developmental trajectory and shows greater variability across languages (McLeod & Crowe, 2018). This pattern supports the hypothesis that PCC may serve as a stronger predictor of overall intelligibility compared with PVC. Studies conducted primarily in English-speaking populations have consistently reported that consonant accuracy explains a substantial proportion of variability in children's speech intelligibility (Shriberg & Kwiatkowski, 1982; Munson et al., 2012). However, the extent to which these findings apply across languages with different phonological structures remains insufficiently investigated.

In addition to phonological factors, demographic variables such as gender may influence speech development. Previous studies have reported that girls often demonstrate earlier speech sound acquisition and higher phonological accuracy compared with boys (Robb et al., 2009; Stokes & Klee, 2009). These differences may be associated with maturational, biological, or sociolinguistic factors affecting early language development. Examining gender-related patterns in PCC, PVC, and intelligibility may therefore provide more precise developmental expectations and improve interpretation of speech assessment outcomes.

Despite extensive evidence from English and other Indo-European languages, research investigating predictors of speech intelligibility among Indonesian-speaking children remains limited. Most available developmental norms and assessment frameworks are derived from English-speaking populations, although phonemic inventories, syllable structures, and phonotactic patterns differ substantially across languages (McLeod & Crowe, 2018). Consequently, direct application of international findings to Indonesian children without empirical validation may reduce the accuracy and cultural relevance of clinical decision-making.

Within the Indonesian context, clinicians frequently rely on adapted assessment procedures because standardized local data regarding consonant accuracy, vowel accuracy, and intelligibility remain scarce. This limitation affects the identification of children at risk for speech sound disorders and restricts clinicians' ability to establish appropriate intervention targets. Developing language-specific evidence on the relationship between PCC, PVC, and intelligibility is therefore necessary to support culturally and linguistically appropriate speech assessment practices.

Although previous studies have established the predictive relationship between segmental accuracy and intelligibility in several languages, empirical evidence from Indonesian-speaking populations is still lacking. To the best of our knowledge, this study is the first large-scale investigation validating the predictive roles of PCC and PVC in determining word-level intelligibility among Indonesian children. By examining consonant and vowel contributions within the Indonesian phonological system, this research provides novel cross-linguistic evidence beyond the predominantly English-based literature.

The present study aimed to identify the descriptive profiles of PCC, PVC, and word-level intelligibility among Indonesian children, examine potential gender differences across these measures, and determine the predictive contributions of consonant and vowel accuracy to intelligibility outcomes. Specifically, this study investigated whether PCC and PVC independently contribute to intelligibility and whether consonant accuracy represents the stronger predictor within the Indonesian linguistic context.

By addressing these objectives, the present study contributes both theoretical and clinical evidence to the field of child speech development. The findings expand cross-linguistic understanding of how segmental accuracy shapes intelligibility and provide Indonesian clinicians with locally relevant reference data for assessment and intervention planning. Furthermore, establishing evidence-based relationships among PCC, PVC, and intelligibility may enhance early identification and management of children with speech production difficulties.

DOI: 10.31004/obsesi.v10i3.8447

Method

The study included 394 Indonesian-speaking children aged 3-6 years. Participants were typically developing children recruited from preschool settings and represented a range of early childhood developmental stages. Demographic information, including chronological age and gender, was recorded for each participant. Children were included if they met the following criteria: (a) aged between 3 and 6 years, (b) native speakers of Indonesian, (c) demonstrated typical developmental profiles based on parent and/or teacher reports, (d) had no history of diagnosed speech, language, cognitive, or developmental disorders, and (e) were able to participate in structured picture-naming tasks. Children were excluded if they had a reported history of hearing loss, neurological disorders, intellectual disability, developmental disorders, structural abnormalities affecting speech production (e.g., cleft palate or other craniofacial conditions), or other medical conditions known to influence speech and language development.

Speech production was assessed using the Tes Produksi Bunyi Prasekolah (Preschool Sound Production Test) developed by Taruna et al. (2025). This instrument was designed to evaluate speech sound production abilities in Indonesian-speaking children by eliciting representative samples of Indonesian consonants and vowels across different word positions. The test consists of a structured picture-naming task in which children produce target words containing selected phonemes, allowing systematic analysis of segmental speech accuracy.

The Preschool Sound Production Test has demonstrated evidence of construct-related validity through a known-groups validity approach (Taruna et al., 2025). Previous validation findings showed that the instrument was able to differentiate children with speech sound disorders (SSD) from typically developing children, with the SSD group demonstrating significantly lower speech intelligibility and Percent Consonants Correct (PCC) scores compared with typically developing groups ($p < .001$). These findings support the validity of the instrument for identifying individual differences in speech production abilities among Indonesian-speaking children.

In the present study, children's responses were phonetically analyzed to obtain three quantitative speech production measures: Percent Consonants Correct (PCC), Percent Vowels Correct (PVC), and word-level intelligibility. PCC and PVC were calculated as the percentage of accurately produced consonants and vowels relative to adult target productions, whereas intelligibility represented the percentage of target words correctly identified by listeners.

Each child was individually assessed in a quiet room at their school. Stimuli were presented using printed picture cards, and the children were instructed to name each picture spontaneously. All responses were recorded with a high-quality digital recorder for subsequent transcription and analysis.

Recordings were transcribed phonetically by trained speech-language therapists. Each consonant and vowel was coded as correct or incorrect relative to the adult target. PCC was calculated as the proportion of correctly produced consonants relative to the total number of attempted consonants. PVC was calculated analogously for vowels. Word-level intelligibility was calculated as the proportion of whole words correctly identified by independent raters.

Data were analyzed using JASP. Descriptive statistics were calculated for all variables. Gender differences were tested using Mann–Whitney U tests, given non-normal distributions. Associations between PCC, PVC, and intelligibility were assessed using Spearman's partial correlations controlling for age. Finally, linear regression was conducted with intelligibility as the dependent variable and PCC and PVC as predictors. Multicollinearity diagnostics were included to evaluate model stability.

Results and Discussion

Descriptive Statistics

From 394 children, the mean score for PCC was 85.25 (SD = 14.09), PVC was 87.56 (SD = 13.17), and word-level intelligibility was 80.04 (SD = 20.30). Minimum scores were low (PCC = 10, PVC = 17, intelligibility = 3), while maximum scores reached 100 across measures, indicating a wide range of performance levels.

Table 1. Descriptive Statistics of Key Variables (N = 394)

Variable	M	SD
Percent Consonants Correct (PCC)	85.25	14.09
Percent Vowels Correct (PVC)	87.56	13.17
Word-level Intelligibility	80.04	20.30

Note. M = Mean; SD = Standard Deviation.

DOI: 10.31004/obsesi.v10i3.8447

Gender Comparisons

Mann–Whitney U tests revealed significant gender differences. Girls scored higher than boys on PCC (U = 16133.00, p = .004), PVC (U = 16066.50, p = .003), and intelligibility (U = 15801.00, p = .002).

Table 2. Gender Comparisons

Variable	U	p
PCC	16133.00	.004
PVC	16066.50	.003
Intelligibility	15801.00	.002

Correlations

Spearman's partial correlations, controlling for age, showed strong associations: PCC with PVC (ρ = .85, p < .001), PCC with intelligibility (ρ = .88, p < .001), and PVC with intelligibility (ρ = .72, p < .001). These results indicate that both consonant and vowel accuracy are strongly related to intelligibility, with PCC more influential.

Table 3. Spearman Partial Correlations Controlling for Age

Variable	1	2	3
1. PCC	—		
2. PVC	.853***	—	
3. Intelligibility	.876***	.717***	—

Note. Values are Spearman's rho. ***p < .001.

Regression Analysis

Multiple regression indicated that PCC and PVC together predicted 75.8% of the variance in intelligibility (R^2 = .758, F(2,391) = 611.86, p < .001). PCC was the stronger predictor (β = .77, p < .001), while PVC contributed a smaller yet significant effect (β = .12, p = .009). Variance Inflation Factor values (VIF = 3.45) were below the conservative threshold of 5, suggesting no serious multicollinearity concerns.

Table 4. Linear Regression Predicting Intelligibility

Predictor	B	SE B	β	t	p	VIF
(Constant)	-30.39	3.42	—	-8.88	<.001	—
PCC	1.10	0.07	.77	16.59	<.001	3.45
PVC	0.19	0.07	.12	2.61	.009	3.45

Model statistics: R^2 = .758, Adjusted R^2 = .757, F(2, 391) = 611.86, p < .001.
Note. Dependent variable = Word-level intelligibility.

Contribution of PCC and PVC to Word-Level Intelligibility

The present study investigated the predictive contribution of consonant and vowel accuracy to word-level intelligibility among Indonesian children. The findings demonstrated that both Percent Consonants Correct (PCC) and Percent Vowels Correct (PVC) significantly predicted intelligibility outcomes; however, PCC emerged as the stronger predictor. These findings are consistent with previous studies indicating that consonant accuracy represents one of the strongest indicators of speech development and functional communication ability (Shriberg & Kwiatkowski, 1982; Gordon-Brannan & Hodson, 2000; McLeod & Baker, 2017).

The dominance of PCC in predicting intelligibility can be explained by the linguistic function of consonants in spoken communication. Consonants generally carry greater phonemic information because they create lexical contrasts that allow listeners to differentiate one word from another (Munson et al., 2012). Errors involving consonant substitution, omission, or distortion may substantially change word identity and increase listener difficulty in recognizing intended messages. Therefore, reduced consonant accuracy directly affects speech clarity and overall communicative effectiveness (Kent, 2007; Flipsen, 2006).

The present results are also aligned with developmental evidence showing that consonant acquisition follows a longer and more complex developmental trajectory compared with vowel acquisition. McLeod and Crowe (2018), through a cross-linguistic review of children's consonant acquisition across 27 languages,

DOI: 10.31004/obsesi.v10i3.8447

demonstrated that consonant mastery varies considerably according to language-specific phonological systems. Similarly, Smit et al. (1990) and Dodd et al. (2003) reported that consonant acquisition continues throughout early childhood, whereas vowel systems typically stabilize earlier. This developmental variability may explain why PCC provides greater sensitivity in capturing individual differences in speech production abilities.

Although PCC demonstrated the strongest contribution, PVC remained a significant predictor of intelligibility. This finding suggests that vowel accuracy should not be considered clinically irrelevant. Vowels provide essential acoustic information related to syllable structure, word shape, and speech rhythm. Previous studies have shown that atypical vowel errors may significantly reduce intelligibility, particularly among children with speech sound disorders or motor speech difficulties (Preston & Edwards, 2007; Flipsen & Ogiela, 2015). Roepke and Brosseau-Lapré (2021) also demonstrated that children with speech sound disorders produce more vowel errors compared with typically developing peers, indicating that PVC contributes important information regarding the integrity of the phonological system.

The relationship between PCC, PVC, and intelligibility found in this study supports multidimensional models of speech intelligibility. Intelligibility is not determined by a single speech component but emerges from interactions among segmental accuracy, prosody, speech rate, linguistic context, and listener characteristics (Kent, 2007; Hustad et al., 2015). Although consonant accuracy appears to provide the greatest contribution at the word level, comprehensive assessment should include multiple speech dimensions to obtain a complete representation of children's communication abilities.

Gender Differences in Speech Production Measures

The present study also identified significant gender differences, with girls demonstrating higher PCC, PVC, and intelligibility scores than boys. These findings are consistent with previous research suggesting that girls often show earlier advantages in speech and language development (Robb et al., 2009; Stokes & Klee, 2009). Similar developmental patterns have been reported in studies examining early vocabulary development, phonological acquisition, and speech production accuracy (Eriksson et al., 2012; Zambrana et al., 2012).

Several explanations may account for these gender-related differences. Biological maturation differences may contribute to earlier development of neural systems supporting speech and language processing among girls. In addition, environmental and sociolinguistic factors, including interaction patterns and language exposure, may influence developmental outcomes (Stokes & Klee, 2009). However, gender differences should be interpreted cautiously because individual variability remains substantial, and gender alone should not be used as a diagnostic indicator of speech difficulties.

Clinical Implications for Speech-Language Pathology

The findings of this study provide important implications for speech-language pathology assessment and intervention. First, PCC may serve as a clinically efficient marker for estimating speech intelligibility and monitoring speech development. Because consonant accuracy strongly predicts intelligibility outcomes, clinicians should prioritize systematic analysis of consonant production when evaluating children with suspected speech sound disorders (Shriberg & Kwiatkowski, 1982; Dodd, 2014; McLeod & Baker, 2017).

Second, intervention planning should consider consonant targets that produce the greatest functional impact on intelligibility. Treatment approaches focusing on improving phonological contrasts and reducing patterns that affect word recognition may result in meaningful improvements in communication effectiveness (Williams et al., 2010). However, vowel accuracy should also be assessed because persistent vowel errors may indicate broader difficulties involving phonological representation or speech motor planning (Preston & Edwards, 2007; Flipsen & Ogiela, 2015).

Third, the findings support the need for culturally and linguistically appropriate assessment tools for Indonesian-speaking children. Since phonological development differs across languages, clinicians should avoid relying exclusively on norms derived from English-speaking populations (McLeod & Crowe, 2018). The availability of Indonesian-based PCC, PVC, and intelligibility data may improve diagnostic accuracy and intervention decision-making in local clinical practice.

Contribution to Cross-Linguistic Evidence

This study expands existing cross-linguistic evidence by demonstrating that the dominant contribution of consonant accuracy to intelligibility also applies within the Indonesian language context. Previous evidence has primarily originated from English and other Indo-European languages (Shriberg & Kwiatkowski, 1982;

DOI: 10.31004/obsesi.v10i3.8447

Munson et al., 2012; McLeod & Baker, 2017). The present findings suggest that despite differences in phonological structure, consonant accuracy may represent a universal factor influencing speech intelligibility.

At the same time, the significant role of PVC highlights the importance of considering language-specific characteristics. Languages differ in vowel inventory, syllable complexity, and phonotactic organization; therefore, the relative contribution of consonants and vowels may vary across linguistic systems. Further cross-linguistic investigations are necessary to determine which aspects of intelligibility development are universal and which are language-specific.

Conclusion

This study investigated the contribution of consonant and vowel accuracy to word-level intelligibility among Indonesian-speaking children. The findings demonstrated that both Percent Consonants Correct (PCC) and Percent Vowels Correct (PVC) significantly predicted children's intelligibility outcomes, with PCC emerging as the strongest predictor. These results indicate that consonant accuracy plays a central role in determining speech clarity because consonants provide essential phonemic contrasts that support lexical recognition. Although PVC showed a smaller predictive contribution, vowel accuracy remained an important component of speech production and provided additional information regarding children's overall phonological abilities.

The present study extends previous international findings by providing empirical evidence from Indonesian-speaking children, a population that remains underrepresented in speech development research. By establishing the relationship among PCC, PVC, and intelligibility within the Indonesian linguistic context, this study contributes language-specific evidence and supports the development of culturally appropriate benchmarks for pediatric speech assessment. These findings highlight that while the dominant role of consonant accuracy may represent a cross-linguistic pattern, evaluation of both consonant and vowel production remains necessary for comprehensive assessment.

From a clinical perspective, PCC may serve as a sensitive and practical indicator for evaluating speech production abilities, estimating intelligibility outcomes, and monitoring intervention progress in speech-language pathology practice. However, clinicians should not rely exclusively on consonant-based measures because vowel accuracy may reveal additional difficulties related to phonological representation or speech production processes. Therefore, integrating PCC, PVC, and intelligibility measures may provide a more complete framework for identifying children's speech difficulties and developing individualized intervention targets.

Several limitations should be considered when interpreting the findings. Although this study involved a relatively large sample, participants may not fully represent the linguistic and sociocultural diversity of Indonesian children, including variations related to regional dialects, bilingual exposure, and environmental factors. In addition, the cross-sectional design limits conclusions regarding developmental changes over time. The use of word-level intelligibility measures also may not fully capture the complexity of everyday communication, which involves connected speech, prosody, fluency, and listener-related variables.

Future research should expand these findings through longitudinal studies examining developmental trajectories of PCC, PVC, and intelligibility across childhood. Further investigations involving broader Indonesian populations and clinical groups, including children with articulation disorders, phonological disorders, motor speech disorders, hearing impairment, and developmental language disorders, are needed to determine whether these predictive relationships differ across communication profiles. Future studies should also incorporate connected speech analysis, acoustic measures, and listener-based intelligibility ratings to provide a more comprehensive understanding of speech development. This study provides evidence that consonant accuracy is the primary predictor of word-level intelligibility among Indonesian children, while vowel accuracy offers additional predictive value. These findings strengthen cross-linguistic evidence regarding the role of segmental accuracy in speech development and support the implementation of evidence-based, culturally relevant assessment and intervention practices in speech-language pathology.

References

Dodd, B. (2014). Differential diagnosis of pediatric speech sound disorder. *Current Developmental Disorders Reports, 1*, 189–196. https://doi.org/10.1007/s40474-014-0017-3.

Dodd, B., Holm, A., Hua, Z., & Crosbie, S. (2003). Phonological development: A normative study of British English-speaking children. *Clinical Linguistics & Phonetics, 17(8)*, 617–643. https://doi.org/10.1080/0269920031000111348.

Eriksson, M., Marschik, P. B., Tulviste, T., Almgren, M., Pérez Pereira, M., Wehberg, S., Marjanovič-Umek,

DOI: 10.31004/obsesi.v10i3.8447

L., Gayraud, F., Kovacevic, M., & Gallego, C. (2012). Differences between girls and boys in emerging language skills: Evidence from 10 language communities. *British Journal of Developmental Psychology, 30(2)*, 326–343. https://doi.org/10.1111/j.2044-835X.2011.02042.x.

Flipsen, P. (2006). Measuring the intelligibility of conversational speech in children. *Clinical Linguistics & Phonetics, 20(4)*, 303–312. https://doi.org/10.1080/02699200500266674.

Flipsen, P., & Ogiela, D. A. (2015). Psychometric characteristics of single-word tests of children's speech sound production. *Language, Speech, and Hearing Services in Schools, 46(2)*, 166–178. https://doi.org/10.1044/2015_LSHSS-14-0055.

Flipsen, P., & Ogiela, D. A. (2015). Vowel errors in children with speech sound disorders. Clinical Linguistics & Phonetics, 29(8–10), 747–761. https://doi.org/10.3109/02699206.2015.1011713.

Gordon-Brannan, M., & Hodson, B. W. (2000). Intelligibility/severity measurements of prekindergarten children's speech. *American Journal of Speech-Language Pathology, 9(2)*, 141–150. https://doi.org/10.1044/1058-0360.0902.141.

Hustad, K. C., Schueler, B., Schultz, L., & DuHadway, C. (2015). Intelligibility of 4-year-old children with and without cerebral palsy. *Journal of Speech, Language, and Hearing Research, 58(4)*, 1177–1189. https://doi.org/10.1044/2015_JSLHR-S-14-0303.

Kent, R. D. (2007). Speech intelligibility and communicative competence in children. *Topics in Language Disorders, 27(2)*, 110–131. https://doi.org/10.1097/01.TLD.0000269926.53007.18.

Kent, R. D. (2007). The MIT encyclopedia of communication disorders. MIT Press.

McLeod, S., & Baker, E. (2017). Children's speech: An evidence-based approach to assessment and intervention. Pearson https://doi.org/10.1080/17489539.2017.1370215

McLeod, S., & Crowe, K. (2018). Children's consonant acquisition in 27 languages: A cross-linguistic review. *American Journal of Speech-Language Pathology, 27(4)*, 1546–1571. https://doi.org/10.1044/2018_AJSLP-17-0100.

Munson, B., Edwards, J., & Beckman, M. E. (2012). Phonological representations in language acquisition: Climbing the ladder of abstraction. The Oxford Handbook of Laboratory Phonology, 288–309 https://doi.org/10.1080/10489223.2012.685025

Munson, B., Schellinger, S. K., & Edwards, J. (2012). Assessment of phonological knowledge: Linking speech perception and production. Journal of Speech, Language, and Hearing Research, 55(2), 631–642. https://doi.org/10.1044/1092-4388(2011/10-0324)

Preston, J. L., & Edwards, M. L. (2007). Phonological processing skills of adolescents with residual speech sound errors. Language, Speech, and Hearing Services in Schools, 38(4), 297–308. https://doi.org/10.1044/0161-1461(2007/032)

Robb, M. P., Bauer, H. R., & Tyler, A. A. (2009). A quantitative analysis of consonant acquisition in children. Journal of Speech, Language, and Hearing Research, 52(3), 632–643.

Robb, M. P., Saxman, J. H., & Grant, L. (2009). Vocal fundamental frequency characteristics during the first two years of life. Journal of Speech, Language, and Hearing Research, 52(2), 572–582. https://doi.org/10.1044/1092-4388(2008/07-0158)

Shriberg, L. D., & Kwiatkowski, J. (1982). Phonological disorders III: A procedure for assessing severity of involvement. *Journal of Speech and Hearing Disorders, 47(3)*, 256–270. https://doi.org/10.1044/jshd.4703.256.

Smit, A. B., Hand, L., Freilinger, J. J., Bernthal, J. E., & Bird, A. (1990). The Iowa articulation norms project and its Nebraska replication. *Journal of Speech and Hearing Disorders, 55(4)*, 779–798. https://doi.org/10.1044/jshd.5504.779.

Stokes, S. F., & Klee, T. (2009). Factors that influence vocabulary development in two-year-old children. *Journal of Child Psychology and Psychiatry, 50(3)*, 498–505. https://doi.org/10.1111/j.1469-7610.2008.02012.x.

Taruna, R., Jumiarti, & Phandinata, S. R. (2025). Construct-related validity of the Preschool Sound Production Test in Indonesian-speaking children. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini, 9(4)*, 1036–1041. https://doi.org/10.31004/obsesi.v9i4.71.

Williams, A. L., McLeod, S., & McCauley, R. J. (Eds.). (2010). Interventions for speech sound disorders in children. Paul H. Brookes Publishing https://doi.org/10.1002/9781444318975.ch15

Zambrana, I. M., Ystrom, E., & Pons, F. (2012). Impact of gender, maternal education, and birth order on the development of language comprehension: A longitudinal study from 18 to 36 months of age. *Journal of Developmental & Behavioral Pediatrics, 33(2)*, 146–155. https://doi.org/10.1097/DBP.0b013e31823d4f83.