Phonological Deviations of Indonesian-Speaking Adolescents with Down Syndrome: A Case Study

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ABSTRACT

This study investigates phonological deviations in Indonesian-speaking adolescents with down syndrome, addressing a significant gap in cross-linguistic research on phonological development in down syndrome populations. While extensive studies exist in various languages, research in Indonesian remains limited. The study employed a qualitative case study approach, examining six Indonesian-speaking adolescents with down syndrome (aged 13-15 years) at Special Needs School of Surakarta. Data collection involved interviews, observations, and documentation. Furthermore, researchers made direct observations of the subject and recorded the speech of adolescents with down syndrome during the learning process in the classroom. The data analysis technique focused on the recording of language utterances produced by adolescents with down syndrome. The results revealed three main patterns of phonological deviations: phoneme omission, substitution, and cluster reduction. The dominant pattern was phoneme omission through apheresis (phoneme omission at word beginnings). A consistent pattern of phoneme substitution was observed, particularly the replacement of apicoalveolar /n/ with dorsovelar /ŋ/, reflecting articulatory compensation strategies. Variations in vowel and consonant omissions demonstrated heterogeneity in phonological deviations among participants. Further, the unique case of NT who despite experiencing complex deviations, demonstrated higher language production. This research contributes to the understanding of phonological patterns in down syndrome adolescents and reinforces the significance of considering both anatomical constraints and environmental factors in developing effective intervention strategies for speech and language development in this population.

Keywords: Down syndrome adolescents; phonological deviations; Indonesian language; phonology; case study

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INTRODUCTION

Down syndrome is a genetic disorder caused by the presence of an extra copy of chromosome 21, resulting in a range of physical and cognitive characteristics, including developmental delays and learning difficulties (Antonarakis et al., 2020). Individuals with down syndrome often experience hypotonia or muscle weakness, which can affect their articulation ability (Grieco et al., 2015). In addition, they also tend to have hearing problems that can affect the perception and production of language sounds (Laws & Hall, 2014). One area that can be impacted in individuals with down syndrome is phonology, which refers to the sound system of language. This can lead to difficulties in speech production and articulation. In the context of the study of phonology, down syndrome attracts particular attention due to the complexity of the interaction between cognitive aspects, language and phonological abilities exhibited by individuals with this condition. Although hearing loss is often associated with down syndrome, recent research suggests that cognitive and language factors have a more significant role in influencing phonological development and abilities (Næss et al., 2021). Phonological acquisition is an important aspect in the language development of individuals, including adolescents with down syndrome.

Phonology is a branch of linguistics that studies sound systems and patterns in language, including aspects such as phonemes (the smallest sound units that can distinguish meaning), distinctive features (acoustic and articulatory characteristics that distinguish one phoneme from another), and phonological processes (systematic changes in the realization of phonemes) (Hayes, 2009). In Indonesian, phonology has unique characteristics that include distinctive vowel and consonant systems, as well as specific stress and intonation patterns (Nafisah, 2020). In the study of Indonesian phonology, language sounds are divided into two, namely vocoid and consonant sounds. Vocoid sounds are sounds that are produced without involving the narrowing and closing of the articulation area. The main vowels are denoted by /i/, /e/, /ɛ/, /a/, /ɑ/, /ə/, /o/, and /u/ in the International Phonetic Association (Marsono, 1989:26). There are six vowels in Indonesian, namely: /a/, /i/, /u/, /ɛ/, /o/, and /ə/. Meanwhile, consonant sounds are sounds produced by involving the narrowing or closing of the articulation area. Suryani and Widodo (2021) identified the characteristics of consonants in Indonesian: inhibited consonants: /p/, /b/, /t/, /d/, /k/, /g/; fricative consonants: /f/, /s/, /z/, /h/; nasal consonants: /m/, /n/, /ŋ/; lateral consonants: /l/, /r/; and semi-vowels: /w/, /y/. The phonological processes that are the focus of this study include omission, substitution, cluster reduction, zeroization, apheresis, syncope, and apocope. Omission refers to the loss of a phoneme in a word, while substitution involves the change of one phoneme into another. Zeroization is the process by which a phoneme is realized as a silent sound. Apheresis refers to the loss of a phoneme or syllable at the beginning of a word, syncope occurs in the middle of a word, and apocope at the end of a word (Dardjowidjojo, 2019).

Studies of phonological deviations in populations with down syndrome have been carried out in various languages, showing diverse but consistent patterns in some aspects. Research on English speakers shows a tendency to simplify consonant clusters and replace more complex sounds with simpler ones (Cleland et al., 2020). Meanwhile, studies on languages with different phonological systems, such as Mandarin, show unique patterns of deviation, especially in tonality and aspiration production (Yang et al., 2022). In the context of languages with more transparent orthographic systems, such as Spanish, individuals with down syndrome show relatively lower difficulties in certain aspects of phonological production (Diez-Itza et al., 2023). Wong et al., (2015) conducted a study on Cantonese-speaking down syndrome adolescents present in Hong Kong showing a pattern of phonological deviations similar to findings in Western countries, but

with some differences caused by the special characteristics of the Tonal language. This study emphasizes the importance of considering special linguistic factors in understanding phonological deviance in down syndrome. Dimitra Katsarou and Georgia Danreou (2022) evaluated phonological abilities in Greek in down syndrome with language impairment, the results showed that children with down syndrome showed phonological deficits in Greek, especially difficulties with certain consonants and complex articulations compared to children with language impairment. Mommed Alzyoudi et al., (2023) investigated phonological processes in Arabic-speaking children with down syndrome, the results showed that children with down syndrome showed common consonant production errors and phonological processes in Arabic. This is influenced by intellectual level, hearing status, and tends to decrease with age. Most of the studies in the literature report phonological processes in English, Mandarin, Spanish, Arabic and Greek speaking individuals, while there are very few studies in Indonesian. In Indonesia, research on phonological deviations in individuals with down syndrome is limited, but some studies have provided valuable preliminary insights.

Research conducted by Anita et al. (2013) in Surabaya looked at the pattern of phonological deviations in down syndrome adolescents aged 7-9 years. They found that the main difficulties occurred in the production of fricative and affricative consonants, as well as a tendency to mispronounce consonant clusters. The study also identified significant individual variations in the severity of phonological deviations. Furthermore, Wulandari and Ghozi's (2018) study in Jakarta focused on the phonological development of preschool-aged adolescents with down syndrome. They observed that, despite following the same developmental patterns as typical adolescents, adolescents with down syndrome showed consistent delays in the acquisition of certain sounds, especially the trill consonant /r/ and sibilant sounds. Although these studies provide a valuable foundation, there are still gaps in the understanding of phonological deviations in Indonesian-speaking adolescents with down syndrome. Most existing studies have focused on early adolescence and have not comprehensively explored the persistence and evolution of phonological deviance into adolescence. Moreover, given that each language has a unique phonological system, it is important to investigate how the phonological characteristics of Indonesian interact with the cognitive and linguistic profiles of individuals with down syndrome.

Based on the description above, it can be concluded that the novelty value of this research lies in its focus on Indonesian-speaking down syndrome children who have a different phonological system from the languages that have been studied previously. This research has important implications for the development of linguistics, especially in the field of phonology of children with language disorders. The contribution of this research to the academic community in Indonesia is to provide empirical data on the phonological characteristics of Indonesian-speaking adolescents with down syndrome, which can serve as a foundation for further research in the fields of language and speech pathology. This data can also be used to develop phonological assessment tools that are more accurate and sensitive to the Indonesian language context. For the International community, this research enriches cross-linguistic understanding of phonological deviations in down syndrome, allowing for comparison with findings from other languages. This research can also help identify universal and language-specific aspects of phonological development in down syndrome that can inform theories of language acquisition and clinical intervention.

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METHODS

This research used a qualitative approach with a case study design. This method was chosen to enable an in-depth exploration of phonological deviations in adolescents with down syndrome in their natural context. The relevant case study answers questions requiring intensive and in-depth descriptions of social phenomena (Yin, 2018). In this study, the researcher applied a case study on adolescents with down syndrome who speak Indonesian as the main language at Special Needs School of Surakarta. This research was conducted in October-November 2023.

PARTICIPANTS

Participants in this study were taken using purposive sampling technique involving 6 adolescents with down syndrome in Special Needs School of Surakarta. The purposive sampling technique is characterized by an attempt to obtain a representative sample or in accordance with the required criteria (Kerlinger & Lee, 2000). In this determination, the research sample was not taken randomly but was selected based on predetermined criteria, namely adolescents with down syndrome who speak Indonesian with moderate cognitive levels.

The six adolescents with down syndrome in Special Needs School of Surakarta are spread in each class, including 1 adolescent (male) with down syndrome in class 7C1 namely DA, aged 13 years, 2 (1 male and 1 female) in class 8C1 namely R and A, aged 14 years, and 3 in class 9C1 namely N, T, and NT, aged 15 years. The selection of students at the junior high school level aged 13-15 years as informants in this study was based on several theoretical and practical considerations. According to Piaget's cognitive development theory, children at this age enter the formal operational stage, where they begin to develop abstract and logical thinking (Santrock, 2011). Although children with down syndrome experience slower development, they still follow the same sequence of developmental stages (Fidler & Nadel, 2007). At this age, they have generally developed basic speech skills and are ready for further development.

The six informants in this study have the same medical records, namely people with down syndrome with relatively the same cognitive level, which is included in the moderate level category with an IQ score of 36-52. In addition, one of the characteristics of persons with down syndrome with moderate cognitive levels can be identified physically and the way of moving which in its development is not as fast as normal children, and the organs of hearing and speech and their functions are less than perfect both in location, shape, and size (Lago in Gunarhadi, 2005: 195).

DATA COLLECTION TECHNIQUES

The data collection techniques used in this research are interviews, observation, and documentation. Researchers conducted interviews with class teachers at Special Needs School of Surakarta to obtain data related to adolescents with down syndrome. Furthermore, researchers made direct observations of the subject and recorded the speech of adolescents with down syndrome during the learning process in the classroom. Researchers took notes and used a digital audio recorder to record the utterances of language sounds spoken by adolescents with down syndrome. Then all recorded data is transcribed into phonetic writing for further analysis. The researcher did the transcription manually by listening to the audio recording and typing the content into a text document. This took a long time but produced accurate results in the process. Hawkins (2003) explains that manual transcription allows for a more in-depth contextual analysis, considering factors such as intonation, rhythm and emphasis that may be difficult for automated

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systems to capture. Furthermore, the documentation study used in this research uses official documents, namely data at Special Needs School of Surakarta related to data on adolescents with down syndrome, the results of writing adolescents with down syndrome, and learning media used by teachers in the classroom.

DATA ANALYSIS TECHNIQUE

The data analysis technique focused on the recording of language utterances produced by adolescents with down syndrome. After performing the recording technique, the researcher transcribed the recording results, recorded the phonological deviations found, and classified the types of phonological deviations found in the speech of adolescents with down syndrome. Data analysis was carried out by identifying deviant sounds, comparing with normal pronunciation, and recording the position of phonological deviations (beginning/middle/end of the word). Then the researchers classified by grouping the types of phonological deviations found such as phoneme omission, substitution, and cluster reduction. After the classification stage was completed, the researcher interpreted the findings by analyzing the phonological deviation patterns found, relating them to the characteristics of the informants and explaining the factors causing phonological deviations that occurred in the six informants. Then the researcher verified the phonetic transcription through system verification by checking the suitability of phonetics with IPA phonetic symbols, contextual verification by checking the suitability of the linguistic context on phonological patterns, and verifying the special conditions experienced, namely down syndrome (language background, age, and cognitive level).

DATA VALIDITY

Data validity was carried out using triangulation of methods, sources, and theories. This is in accordance with the opinion of Moleong (2014: 178), triangulation is a data validity checking technique that utilizes something else outside the data for the purpose of checking or comparing the data. Researchers compared the findings with several theories and previous research related to phonological deviations in children with down syndrome.

RESULTS

Based on the results of observations and recorded language data contained in adolescents with down syndrome, researchers analyzed the phonological deviations that occurred from the six adolescents with down syndrome. There were 42 words produced from the speech of the six informants.

TABLE 1. Number of words used as speech data for the six adolescents with down syndrome

No.	Input	Phonetic representation	Input	Phonetic representation
1.	*/aku/*	*[a.ku]*	*/atu/*	*[a.tu]*
2.	*/apa/*	*[a.pa]*	*/pa/*	*[pa]*
3.	*/apik/*	*[a.pik]*	*/api/*	*[a.pi]*
4.	*/baru/*	*[ba.ru]*	*/lalu/*	*[la.lu]*
5.	*/bebek/*	*[bə.bɛʔ]*	*/bek/*	*[bɛʔ]*

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6.	*/besar/*	*[bə.sar]*	*/sesar/*	*[sə.sar]*
7.	*/boleh/*	*[bo.leh]*	*/oleh/*	*[o.leh]*
8.	*/buah/*	*[bu.ah]*	*/bah/*	*[bah]*
9.	*/cuci/*	*[ʧu.ʧi]*	*/ci/*	*[ʧi]*
10.	*/jatuh/*	*[ʤa.tuh]*	*/datuh/*	*[da.tuh]*
11.	*/jemput/*	*[ʤɛm.put]*	*/temput/*	*[tɛm.put]*
12.	*/emi/*	*[e.mi]*	*/omi/*	*[o.mi]*
13.	*/faisal/*	*[fa.i.sal]*	*/isal/*	*[i.sal]*
14.	*/gunung/*	*[gu.nuŋ]*	*/dunung/*	*[du.nuŋ]*
15.	*/ini/*	*[i.ni]*	*/ni/*	*[ni]*
16.	*/kakak/*	*[ka.kak]*	*/tatak/*	*[ta.tak]*
17.	*/kambing/*	*[kam.biŋ]*	*/tambing/*	*[tam.biŋ]*
18.	*/kelas/*	*[kə.las]*	*/telas/*	*[tə.las]*
19.	*/kuning/*	*[ku.niŋ]*	*/tuning/*	*[tu.niŋ]*
20.	*/lemari/*	*[lə.ma.ri]*	*/lemali/*	*[lə.ma.li]*
21.	*/main/*	*[ma.in]*	*/maing/*	*[ma.iŋ]*
22.	*/manggis/*	*[maŋ.gis]*	*/anggis/*	*[aŋ.gis]*
23.	*/marvin/*	*[mar.vin]*	*/malving/*	*[mal.viŋ]*
24.	*/meong/*	*[me.oŋ]*	*/mong/*	*[moŋ]*
25.	*/natalia/*	*[na.ta.lia]*	*/tatalia/*	*[ta.ta.lia]*
26.	*/nisa/*	*[ni.sa]*	*/ngisa/*	*[ŋi.sa]*
27.	*/pensil/*	*[pɛn.sil]*	*/pengsil/*	*[pɛŋ.sil]*
28.	*/pulpen/*	*[pul.pɛn]*	*/pupeng/*	*[pu.pɛŋ]*
29.	*/revan/*	*[re.van]*	*/revang/*	*[re.vaŋ]*
30.	*/rumah/*	*[ru.mah]*	*/umah/*	*[u.mah]*
31.	*/sapu/*	*[sa.pu]*	*/tapu/*	*[ta.pu]*
32.	*/satu/*	*[sa.tu]*	*/tatu/*	*[ta.tu]*
33.	*/sayur/*	*[sa.jur]*	*/sayung/*	*[sa.juŋ]*
34.	*/sekolah/*	*[sə.ko.lah]*	*/skolah/*	*[sko.lah]*
35.	*/sembilan/*	*[səm.bi.lan]*	*/mbilang/*	*[mbi.laŋ]*
36.	*/sudah/*	*[su.dah]*	*/udah/*	*[u.dah]*
37.	*/tangan/*	*[ta.ŋan]*	*/tangan/*	*[ta.ŋaŋ]*
38.	*/tetapi/*	*[tə.ta.pi]*	*/api/*	*[a.pi]*
39.	*/tidak/*	*[ti.dak]*	*/dak/*	*[dak]*
40.	*/tiga/*	*[ti.ga]*	*/iga/*	*[i.ga]*
41.	*/ujan/*	*[u.ʤan]*	*/ujang/*	*[u.ʤaŋ]*
42.	*/valen/*	*[va.lɛn]*	*/valeng/*	*[va.lɛŋ]*

The table above used the International Phonetic Alphabet (IPA) to transcribe the utterances produced by the six informants. Furthermore, the types of deviations that occur in each informant are analyzed. The analysis results of the types of deviations from each informant are presented below.

TABLE 2. Type of phonological deviations

Informants	**Types of phonological deviations**		
	Phoneme omission	**Substitution**	**Cluster reduction**
DA	1. *[meoŋ]→[moŋ]* = [e]→Ø	1. *[kambiŋ]→[tambiŋ]* [k]→[t]	1. *[bəbɛʔ]→[bɛʔ]* [bə]: Apheresis
	2. *[buah]→[bah]* = [u]→Ø Syncope	2. *[valɛn]/→ [valɛŋ]* *[main]→[maiŋ]* *[marvin]→[malviŋ]* [n]→[ŋ]	2. *[maŋgis]→[aŋ is]* [m] & [g]: Apheresis & Syncope

			3. *[sajur]→[sajuŋ]* [r]→[ŋ]	
			4. *[dʒatuh]→[datuh]* [dʒ]→[d]	
			5. *[gunuŋ]→[dunuŋ]* [g]→[d]	
			6. *[bəsar]→[səsar]* [b]→[s]	
A	1. *[rumah]→[umah]=* [r]→ Ø Apheresis		1. *[sapu]→[tapu]* [s]→[t]	
	2. *[pulpɛn]→[pupɛŋ]=* [l]→ Ø Syncope		2. *[revan]→[revaŋ]* *[udʒan]→[udʒaŋ]* *[main]→ [maiŋ]* *[pulpɛn]→[pulpɛŋ]* *[pɛnsil]→[pɛŋsil]* [n]→[ŋ]	
R			1. *[sapu]→[tapu]* [s]→[t]	
			2. *[pulpɛn]→[pulpɛŋ]* *[pɛnsil]→[pɛŋsil]* *[main]→ [maiŋ]* [n]→[ŋ]	
			3. *[ləmari]→[ləmali]* [r]→[l]	
NT	1. *[apik]→[api]* = [k]→ Ø: Apocope		1. *[satu]→[tatu]* [s]→[t]	1. *[tidak]→[dak]* [ti]
	2. *[tiga]→[iga]=* [t]→ Ø: Apheresis		2. *[natalia]→[tatalia]* [n]→[t]	2. *[tʃutʃi]→[tʃi]* [tʃu]
	3. *[boleh]→[oleh]* = [b]→ Ø: Apheresis		3. *[nisa]→[ŋisa]* *[tangan]→[tangaŋ]* [n]→[ŋ]	3. *[faisal]→[isal]* [fa]
			4. *[aku]→[atu]* *[kakak]→[tatak]* [k]→[t]	4. *[tətapi]→[api]* [tət] Apheresis
			5. *[baru]→[lalu]* [b]→[l]; [r]→[l]	
			6. *[dʒɛmput]→[tɛmput]* [dʒ]→[t]	
			7. *[emi]→[omi]* [e]→[o]	

T	1. *[sudah]→[udah]* = [s] → Ø 2. *[səkolah]→[skolah]*= [e]→ Ø 3. *[ini]→[ni]* = [i]→ Ø 4. *[apa]→[pa]*= [a]→ Ø Apheresis		
N	1. *[sudah]→[udah]* = [s]→ Ø : Apheresis 2. *[səkolah]→[skolah]* = [e]→ Ø: Apheresis 3. *[rumah]→[umah]* = [r]→ Ø : Apheresis 4. *[pulpɛn]→[pupɛŋ]* = [l]→ Ø : Syncope	1. *[kuning]→[tuniŋ]* *[kelas]→[telas]* [k]→[t] 2. *[səmbilan]→[mbilaŋ]* *[main]→[maiŋ]* *[pulpɛn]→ [pulpɛŋ]* *[pɛnsil]→ [pɛŋsil]* *[revan]→[revaŋ]* *[udʒan]→[udʒaŋ]* [n]→[ŋ] 3. *[sapu]→[tapu]* [s]→[t]	*[səmbilan]→[mbilaŋ]* [sə]: Apheresis

Based on the table description above, the types of deviations that occurred in the six informants were analyzed. The first informant, namely DA. There are phonological deviations made by DA so that the sounds come out become unclear and incomprehensible to those who listen to them. Inside the table, we can see the phonological process of DA, namely the omission of phoneme /e/ and /u/ in the word *[meoŋ]* and *[buah]*. Word *[meoŋ]* experiences the omission of phoneme /e/ which is in the middle of the word become *[moŋ]*. The same thing happened to the word *[buah]* which experienced the omission of phoneme /u/ in the middle of the word into *[bah]*. Based on the classification of sound changes that occur in DA, it is classified in the form of syncope which has a pattern of omission of one or more phoneme in the middle of the word. Furthermore, the phoneme substitution process that occurs in DA, namely /k/ dorsovelar, inhibited and voiceless phoneme is substituted with /t/ apicodental, inhibited and voiceless phoneme. Phoneme /n/ which is apicoalveolar, nasal and voiced is substituted with phoneme /ŋ/ which is dorsovelar, nasal and voiced. Phoneme /r/ which is apicoalveolar, trill and voiced is substituted by phoneme /ŋ/ which is dorsovelar, nasal and voiced. Phoneme /dʒ/ which is mediopalatal, inhibited and voiced is substituted with /d/ which is apicodental, inhibited and voiced. Phoneme /g/ which is dorsovelar, inhibited and voiced is substituted with phoneme /d/ which is apicodental, inhibited and voiced. Phoneme /b/ which is bilabial, inhibited and voiced is substituted with phoneme /s/ which is laminoalveolar, sliding and voiceless. Then, there is a process of cluster reduction of the word that occurs in DA, namely the word *[bəbɛʔ]* experiencing the process of cluster reduction /b/ and /ə/ become *[bɛʔ]*, and the word *[maŋgis]* experiencing the omission of phoneme /m/ at the beginning of the word and /g/ which is in the middle of the word become *[aŋ is]*. This process is known as apheresis and syncope zeroization. Based on the phonological aspect, it was found that

DA experienced all types of phonological deviations, including the omission of phoneme, substitution, and the cluster reduction.

The second informant, namely A. There is a phoneme omission that occurs in A, namely in the word *[rumah]* which experiences the omission of the phoneme /r/ at the beginning of the word into the word *[umah],* referred to as apheresis. Then there is the word *[pulpɛn]* which experiences the omission of the phoneme /l/ in the middle of the word become *[pupɛŋ]*, referred to as syncope, then there is a sound substitution from the phoneme /n/ to /ŋ/. The phoneme substitution process in A, namely phoneme /s/ laminoalveolar, sliding and voiceless is substituted with the phoneme /t/ apicodental, inhibited and voiceless. The phoneme /n/ which is apicoalveolar, nasal and voiced is substituted with the phoneme /ŋ/ dorsovelar, nasal and voiced. Based on the table description above, it can be concluded that informant A experienced phonological deviation in the form of phoneme omission and substitution.

The third informant is R. Phonological deviations was found in informant R only substitution, namely phoneme /s/ laminoalveolar, sliding and voiceless is substituted by phoneme /t/ apicodental, stop and voiceless. Phoneme /n/ apicoalveolar, nasal and voiced is substituted by phoneme /ŋ/ dorsovelar, nasal and voiced. Phoneme /r/ apicoalveolar, vibrating and voiced is substituted by phoneme /l/ apicoalveolar, lateral and voiced.

The fourth informant is NT. The phoneme omission in NT occurs in the word *[apik]* which experiences the omission of phoneme /k/ at the end of the word become *[api]*, called apocope. Word *[tiga]* experiences the omission of phoneme /t/ at the beginning of the word become *[iga]*, and word *[boleh]* experiences the omission of phoneme /b/ at the beginning of the word become *[oleh]*, called apheresis. In the process of cluster reduction that occurs in NT is classified into apheresis, namely *[tidak]* experiences the cluster reduction /t/ and /i/ which are at the beginning of the word become *[dak]*, word *[tʃutʃi]* experiences the cluster reduction /tʃ/ and /u/ which are at the beginning of the word become [tʃi], word *[faisal]* experiences the cluster reduction /f/ and /a/ which are at the beginning of the word become *[isal]*, and *[tətapi]* experiences the cluster reduction /t/, /ə/, and /t/ become *[api]*. All of these cluster reduction processes are classified into the type of apheresis, namely the omission one or more phoneme at the beginning of the word. In the phoneme substitution process that occurs in NT, namely phoneme /s/ laminoalveolar, sliding and voiceless is substituted with phoneme /t/ apicodental, stop and voiceless. Phoneme /n/ apicoalveolar, nasal and voiceless is substituted with phoneme /ŋ/ which is dorsovelar, nasal and voiced. Phoneme /k/ dorsovelar, stop and voiceless is substituted with phoneme /t/ apicodental, stop and voiceless. Phoneme /b/ bilabial, stop and voiceless is substituted with phoneme /l/ which is apicoalveolar, lateral and voiced. Phoneme /r/ apicoalveolar, vibrating and voiced is substituted with phoneme /l/ which is apicoalveolar, lateral and voiced. Phoneme /dʒ/ mediopalatal, stop and voiced is substituted with phoneme /t/ apicodental, stop and voiceless. Phoneme /e/, which is a vocoid sound on the front of the tongue with a medium tongue height, is substituted with phoneme /o/, which is a vocoid sound on the back of the tongue with a medium tongue height. The patterns found in NT adolescents in this study show a more complex variation which include phoneme deletion, substitution, and cluster reduction.

The fifth informant is T, the phonological process of T occurs in the omission of phonemes that are included in the apheresis category, namely word *[sudah]* experiences the omission of phoneme /s/ which is at the beginning of the word become *[udah]*, word *[səkolah]* experiences the omission of phoneme /e/ become *[skolah]*, word *[ini]* experiences the omission of phoneme /i/ which is at the beginning of the word become *[ni]*, and word *[apa]* experiences the omission of phoneme /a/ which is at the beginning of the word become *[pa]*.

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The last informant is N, in the phonological process, phoneme omission, substitution, and cluster reduction were found in informant N. The omission of the apheresis category phoneme in the word *[sudah]*, experiencing the omission of the phoneme /s/ at the beginning of the word become *[udah]*, and the word *[səkolah]* experiencing the omission of the phoneme /e/ become *[skolah]*, the word *[rumah]* which experiences the omission of phoneme /r/ which is at the beginning of the word become *[umah]*, referred to as apheresis. Then there is the word *[pulpɛn]* which experiences the omission of phoneme /l/ which is in the middle of the word become *[pupɛŋ]* referred to as syncope, then there is a sound substitution from phoneme /n/ become /ŋ/. The cluster reduction of the word which is included in the apheresis category in the word *[səmbilan]* which experienced the cluster reduction /s/ and /e/ which were at the beginning of the word become *[mbilaŋ]*. The process of phoneme substitution that occurred in adolescent N, namely the dorsovelar, stoppered and voiceless phoneme /k/ was substituted by the apicodental, stoppered and voiceless phoneme /t/, phoneme /n/ apicoalveolar, nasal and voiceless is substituted with phoneme /ŋ/ which is dorsovelar, nasal and voiced, and phoneme /s/ laminoalveolar, sliding and voiceless is substituted by phoneme /t/ apicodental, stop and voiceless.

After analyzing the types of phonological deviations that occur in each informant, then classification is carried out based on the frequency of occurrence of each type of phonological deviation that occurs. The analysis of phonological deviations above reveals three primary categories of phonological deviations: phoneme omission, substitution, and cluster reduction. Among the informants, phoneme omission manifested predominantly through apheresis and syncope processes. The most frequently omitted phonemes included /e/, /s/, /r/, /l/, and /t/, with apheresis being the more common process compared to syncope. In terms of substitution patterns, the data indicates a consistent tendency toward specific phonological transformations. The most prevalent substitution was /n/→/ŋ/, occurring across multiple informants (DA, A, R, NT, and N). Additionally, the substitution of /s/→/t/ and /k/→/t/ demonstrated notable frequency, suggesting a systematic pattern of dental-alveolar simplification. Other observed substitutions included /r/→/l/, /dʒ/→/d/, and /b/→/s/, though these occurred with less frequency. Cluster reduction manifested less frequently compared to the other deviation types, but demonstrated complexity in its patterns. Notable instances included the reduction of consonant-vowel clusters such as /b/ & /e/, /m/ & /g/, and various combinations involving /t/, /e/, /i/, and /u/. This phenomenon was particularly evident in informants DA and NT, who exhibited the most diverse range of cluster reductions. Examining individual variation, informants DA, NT, and N demonstrated the highest diversity of phonological deviations, experiencing all three types of deviations. In contrast, informants A and T showed more limited patterns, with T exclusively exhibiting phoneme omissions, and R displaying only substitution patterns. This distribution suggests varying levels of phonological complexity in the deviation patterns across informants.

DISCUSSION

Overall, from the results of the discussion of phonological deviations that occurred in the six adolescents with down syndrome, several patterns of phonological deviations were found, including phoneme omission, substitution, and cluster reduction. However, what is more dominant in the findings of this study is the process of phoneme omission at the beginning of the word which is referred to as the process of apheresis. This happens because individuals with down syndrome experience several anatomical conditions that affect their phonological production in the form of

hypotonia (low muscle tone) in the orofacial area, smaller oral cavity size, macroglossia (enlarged tongue), high and narrow palate. These conditions lead to difficulties in coordinating complex articulatory movements, especially at word onset which requires greater movement initiation. This finding proves the findings conducted by Kumin (2020) that the neurological and anatomical perspectives possessed by down syndrome individuals affect the occurrence of phonological deviations in the form of cluster reduction which is apheresis (omission of phonemes at the beginning of words). This is caused by several factors, namely oral muscle weakness, different oral structures, breathing patterns, delayed phonological development, and lack of language stimulation.

The next phonological deviation process is found in phoneme substitution. The phoneme substitution that is often done by the six informants in this study is the substitution of apicoalveolar, nasal, and voiced phoneme /n/ with dorsovelar, nasal, and voiced phoneme /ŋ/. This process is a phonological error known as nasalization or velarization. This finding occurred because the results of language data produced by the six adolescents with down syndrome produced almost the same words in each of their utterances, besides that the clinical data obtained during observation showed that, they had relatively similar cognitive abilities which could affect the consistency of phonological deviation patterns between individuals. This phenomenon is in line with Martinez & Wong's (2024) research related to neurocognitive aspects in children with down syndrome who have equivalent information processing speed, similar phonological information processing patterns, and similar auditory discrimination abilities. In addition, adolescents with down syndrome experience anatomical and physiological changes that affect speech production, vocal tract function and phoneme articulation causing problems with their oral motor skills. This process occurs due to differences in the anatomical structure of the oral cavity, especially the position of the tongue which tends to be more posterior, hypotonia in the articulatory muscles, difficulty in controlling the movement of the tip of the tongue to reach the alveolar region and the tendency to use the back of the tongue (dorsum) which is easier to control, resulting in the phoneme /ŋ/. This is reinforced by the findings of Wong et al. (2023) on the articulatory mechanism found in down syndrome individuals due to motor complexity. The phoneme /n/ requires more precise motor control on the tip of the tongue while the phoneme /ŋ/ uses the base of the tongue which is easier to move. This finding is also relevant to Kumin's (2012) statement that oral motor skills refer to the movements of the muscles of the face and mouth area, especially movements related to speech.

Furthermore, the predominance of apheresis and syncope in the pattern of phoneme omission is in line with the findings of Chen and Guo (2019), who observed similar patterns in their longitudinal study of phonological development in individuals with down syndrome. The frequent omission of the phonemes /e/, /s/, /r/, /l/, and /t/ mainly through apheresis suggests a systematic simplification strategy associated with the anatomical and motor challenges typically associated with down syndrome, as documented by Roberts and Guerra (2020). Then, variations in vowel and consonant omission were found to vary across the six adolescents with down syndrome. Vowel omissions (/e/, /i/, /o/, /u/) were found in informants DA and T, consonant omissions (/r/, /l/, /s/, /k/, /t/, /b/) occurred in informants A, NT, and N. Variations in phoneme (vowel and consonant) omissions found in the six adolescents with down syndrome occur due to anatomical structures such as a smaller oral cavity, a relatively large tongue (macroglossia), and a different palate structure that can affect articulation skills in producing language utterances, so that the utterances produced experience omissions in the form of vowels and consonants. Difficulties in complex oral motor coordination also cause variations in the ability to produce certain sounds because each individual has a different level of motor control. This finding supports Wong et al's

(2022) study which showed that the pattern of phoneme omission in DS varies based on articulation position and complexity. The cluster reduction pattern, although less frequent, shows a level of complexity that goes beyond simple phonological simplification. Cluster reduction was found to be variable in this study, this was seen in informants DA and NT. This case demonstrates individual variation in phonological processing and production abilities supporting the heterogeneous nature of linguistic abilities in down syndrome. These findings challenge previous assumptions of uniform phonological simplification in down syndrome, as suggested by Kumar and Singh (2020).

The individual variation observed across participants, with some showing all three types of deviations (DA, NT, N) and others showing a more restricted pattern (A, T, R), resonates with recent research by Wilson and Chang (2022) which emphasizes the importance of considering individual differences in speech therapy approaches for down syndrome. One individual variation that has unique characteristics was found in the language production of one informant, NT, who produced more utterances than the other informants, despite experiencing complex deviations. This is in line with the findings of Naess et al. (2023) who indicated that the quantity of language production does not always correlate with the quality of articulation in DS. Another influential factor is that based on the results of interviews with teachers and observations made, it shows that NT gets good stimulation in his family environment, he is often invited to communicate with his family and is given quite intense training by his therapist. Consistent stimulation from the family, combined with structured therapeutic interventions, creates an optimal environment for the development of language and communication skills. This supports the modern neuroplasticity theory proposed by Kim et al. (2024) that Broca's and Wernicke's areas experience significant strengthening of neural connections when children receive consistent and quality language stimulation. Based on such findings, this variation suggests that phonological deviations may be influenced by various factors beyond the syndrome itself, including environmental exposures, intervention history, and the cognitive profile of the individual (Santos and Rivera, 2023).

CONCLUSION

In conclusion, the main objective of this study has been achieved where the current literature shows that there are patterns of phonological deviation in the form of phoneme omission, substitution, and cluster reduction experienced by the six adolescents with down syndrome. The dominant pattern of phonological deviation is phoneme omission through apheresis (omission of phonemes at the beginning of words), this is due to the specific anatomical conditions that down syndrome individuals have such as orofacial hypotonia, macroglossia, and different palate structures. A consistent pattern emerged in phoneme substitution, especially in the apicoalveolar phoneme /n/ to the dorsovelar /ŋ/, which reflects an articulatory compensation strategy in response to structural and functional limitations. This pattern emerges as an adaptation to the motor complexities faced by down syndrome individuals in speech production. The study also identified varied patterns of vowel and consonant omissions among the informants, which are directly related to their anatomical structures and oral motor coordination challenges. Further, the unique case of NT who despite experiencing complex deviations, demonstrated higher language production. This case highlighted that the quantity of language production doesn't necessarily correlate with articulation quality, and emphasized the crucial role of consistent family stimulation and therapeutic intervention in language development. The findings support current theories about neuroplasticity

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in language development that consistent and quality language stimulation can strengthen neural connections in language related brain areas. This research contributes to the understanding of phonological patterns in down syndrome adolescents and reinforces the significance of considering both anatomical constraints and environmental factors in developing effective intervention strategies for speech and language development in this population. Thus, it is hoped that future research could take these findings into account and further expand the research scope in this field of study.

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