

## Speech Disorders in Down Syndrome: A Brief Narrative Review Study

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### Review Article

#### Abstract

**Introduction:** The speech intelligibility of people with Down syndrome (DS) is often weak, which may not necessarily improve with age. In contrast, phonological development may be monotonous and slow; therefore, speech therapy is needed for improving speech intelligibility. In this regard, there is a variety of information in the field of speech production and related disorders in the DS population. This study reviews some features of speech production like verbal apraxia in these people, the features that may interfere with the listener's understanding and reduce the clarity of the speaker's speech. Then, the study provides some general solutions to improve the speech of these people.

**Materials and Methods:** In this review study, articles were searched by using the following keywords: "Down syndrome", "speech intelligibility", "verbal apraxia", and intervention or treatment or rehabilitation in Google Scholar and Science Direct databases in the years 2000 to 2022.

**Results:** Out of 193 original articles found, 13 described the speech characteristics of people with DS and only one study considered oral-verbal apraxia and its treatment.

**Conclusion:** The literature review has provided various information about the speech characteristics of people with DS. Although the etiology classes may not directly contribute to the clinical interventions, knowing the strengths and weaknesses in the profile of people with DS along with a specialized diagnosis may help speech and language therapists to make accurate assessments and treatment plans. Besides, reviewing the literature indicates that most of the studies have described different aspects of speech disorders in people with DS. Therefore, interventional studies should be done to find the most effective treatment methods to improve the speech intelligibility of people with DS, especially to treat their verbal apraxia.

**Keywords:** Down syndrome; Speech; Apraxia; Rehabilitation

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#### Introduction

Studies have been conducted on vocabulary and grammar development of people with Down syndrome (DS). However, there is limited information on their speech articulation (1, 2). These individuals often have weak speech intelligibility that may not necessarily disappear with age. It can lead to uniform and slow phonological development. Therefore, speech therapy is necessary to improve their speech intelligibility (1, 2). Speech problems in people with DS are a complex combination of phonological and speech-motor delay or deviation. Common cases include final consonant deletion,

using a stopping instead of a frication, and producing voiced sounds instead of voiceless ones (1). Previous studies have shown that their speech delay is similar to the developmental patterns of normal children (1). However, Roberts et al. reported more systematic and different errors, such as palatal fronting, fricative simplification, deaffrication, or lateralization of sibilant (3). Dodd and Thompson showed that children with DS articulated more than half of the words differently in different repetitions (4). Moreover, young people with DS have been reported to have variations in the articulation of fricatives (3). This review study examines some elements of speech

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articulation in these individuals, including verbal apraxia, which may interfere with the listener's understanding and reduce their speech intelligibility.

Inclusively, speech therapy is crucial for improving the speech intelligibility of people with DS. This review study provides general solutions to improve their speech articulation, which can help them communicate more effectively.

### Materials and Methods

For this review study, the author searched for papers on "Down syndrome", "speech intelligibility", and "verbal apraxia" along with the terms "intervention", "treatment", or "rehabilitation" published between 2000 and 2022. A total of 193 articles were found, but irrelevant ones were eliminated by carefully analyzing the title and abstract. Ultimately, 14 articles relevant to the purpose of study were obtained and used.

### Results

Out of the 14 found initially, only one study focused on the treatment of apraxia in people with DS, while the remaining 13 articles described the speech characteristics of these individuals. In the following section, this review will describe these features in detail.

### Discussion

**Segmental and supra-segmental characteristics:** The studies by Bray indicate that differences in supra-segmental aspects of speech may be linked to difficulties in identifying and marking word and phrase segments (1). Individuals with DS often have better proficiency in producing the end of words and phrases, with greater emphasis on the first syllable or stressed sounds. Omission of syllables is also more frequent in their speech (1). Stoel-Gammon (5) and Folden (6) have suggested that syllables deletion could allow individuals to simplify the rhyming structure and the construction of neurophysiological processes of speech. However, the correlation between speech production and comprehension requires further investigation (1, 4). Stoel-Gammon (5) and Pettinato and Verhoeven (7) have shown that adults with DS struggle to understand weak syllables, as highlighted by Pettinato and Verhoeven.

**Apraxia:** Children with DS often experience difficulties in spontaneous planning, combining, organizing, and sequencing the movements required for speech, which influences their speech clarity. In the past, this condition, known as childhood verbal apraxia, was not identified and treated in people with DS. However, over the last two decades, research has

identified and confirmed symptoms of childhood verbal apraxia in these children. A study conducted in 2006 revealed that almost 15% of parents with a child with DS (out of 1620 participants) responded to the Kumin study questionnaire and stated that their child had symptoms of verbal apraxia (8). Children with this condition exhibit speech characteristics such as a decrease in intelligibility with increasing speech length, instable speech errors, difficulty following the sequence of movements and sounds, and language comprehension being better than language expression. The study also showed that those children with DS who showed symptoms of childhood verbal apraxia had more problems in speech intelligibility.

Moreover, a significant correlation exists between childhood verbal apraxia and speech intelligibility of their parents. According to Kumin's study (2006), children with apraxia often do not begin to speak until age 5. There is also a correlation between speech intelligibility and the age at which a child begins to speak. For instance, children who start talking after five years of age have lower speech intelligibility levels, and their parents' speech intelligibility level was also lower (8).

**Stuttering or non-fluency:** People with DS often experience speech problems, including stuttering. Non-fluency refers to difficulty completing a sentence due to the repetition of sounds, syllables, or words, prolonged sounds or silence, and high-stress pauses (filled or empty), often accompanied by an apparent struggle to articulate words. Identifying non-fluency in the speech of people with DS as stuttering remains an unsolved problem, as its definition includes more than just speech behaviors (i.e., level of awareness, anxiety, and avoidance as parts of the set of stuttering symptoms). Different texts about the speech disorder of people with DS report a higher prevalence of non-fluency than the general population (10%-45% vs. 1% prevalence of stuttering in the general population) (8, 9). In addition to the weakness in these people's speech intelligibility, non-fluency can add another difficulty in their speech articulation. According to Van Borsel, non-fluency in children with typical development is related to language processing. As the morphological-syntactic characteristics grow faster, the child suffers a significant increase in the processing load, failing fluency (9). However, a study conducted on two children with DS by Bray found that speech non-fluency had no specific relationship with word-finding problems. The nature of speech output is a complex pattern of interposing sounds, articulating sounds that do not exist in

language (like a click sound). In addition, changes in prosodic characteristics, such as the increase in the duration of sounds, sudden changes in pitch, and numerous full and empty pauses, are also seen (1). These speech problems in a young man with DS who used click sounds (in Afrikaans-English). As this individual attempted to articulate an abrasive sound, an involuntary closure occurred at the back of the palate (9). This example suggests a motor-speech deficit rather than a language programming problem. Children with DS often have poorer speech than younger children with a similar non-verbal intellectual age. Several phonological factors, such as apraxia of speech, dysarthria, and voice quality, may affect speech intelligibility. Additionally, low speech dysfluency can also affect the components of linguistic articulation. These factors can lead to speech and language development difficulties among children with DS (5).

*Structural differences and oral motor skills:*

People with DS may have differences in mouth structure and function, affecting their speech articulation. These differences include a small mouth cavity, a relatively large tongue, a narrow palate with a deep arch, a muscle weakness, small differences or the presence of extra muscles in the facial structure, and differences in nerve supply. These structural differences can result in reduced speech intelligibility due to dysarthria symptoms such as slowing down, reducing the range of motion and coordination of articulators, chest drop during inhalation and exhalation, and respiratory insufficiency. People with DS may also experience difficulty with dynamic jaw movements, tongue stability, graded movements, and tongue, jaw, and lips movement during eating, drinking, and speaking. They may have difficulty keeping their mouth closed, affecting sucking and swallowing (10). Boys with DS may have more pronounced differences in the structure of the lips, tongue, and palatopharyngeal area, as well as in the motor functions of speech and coordination, compared to girls (8, 11). Speech-motor disorders are complex in people with DS, and symptoms of apraxia of speech in childhood have also been reported (8).

*Rehabilitation and supportive measures:* This section has provided suggestions for interventions based on the speech profiles of people with DS. However, it is essential to note that clinical processes should be designed based on the unique strengths and weaknesses of each client with DS and their family. The low intelligibility of speech in people with DS can be related to both the structural, segmental, and suprasegmental levels of speech. Additionally, it is

equally related to the listener's understanding and expectations. Therefore, finding ways to enhance the message conveying by people with this syndrome is crucial. There is evidence that treatments aimed at improving speech intelligibility can be effective. Furthermore, it is essential to increase listeners' awareness of the communication patterns of individuals with DS.

Research has shown that cognitive factors directly affect speech planning and articulation. Therefore, it is important to have a free and comfortable two-way conversation where both parties understand each other, instead of only one person understanding or both parties communicating with anxiety. In a study emphasized the need to understand the different learning styles of children with DS. The study suggests that we should facilitate the learning environment (12). In relation to stuttering, it is important to create a balance between language, cognition, and implementing demands to make the child more efficient in maintaining speech fluency. This is known as the demand and capacity model.

Several possible approaches can be helpful when it comes to managing speech output disorders in people with DS. A holistic approach can support all communication efforts of the child, reducing the demands that can lead to failure and improving motor processing in the brain. Listeners can also help by being patient and careful when trying to understand speech, as this can facilitate linguistic and motor processing in the brain. Additionally, efforts to understand the speech patterns of people with DS are important for improving message detection for listeners. A simple rhythm can help improve speech fluency and reduce problems with polysyllabic words or phrases. Visual and tactile clues can also help locate speech articulators effectively, reducing the burden on listening memory (12). Another approach can be teaching speech and fluency in separate functional words or simple phrases with parental support and training (12). For those children with DS who speak but whose speech is difficult to understand, speech interventions can target phonological processing and sounds with errors. Finally, anatomical limitations can also contribute to reduced speech intelligibility in these individuals; therefore, interventions that directly affect the anatomy of the oral-facial complex, such as a palatal stimulating plate, can also be considered (10, 13).

*Complementary and alternative communication systems (14):* Limited research has been done on treatments and interventions that can improve the speech of individuals with DS. However, some

studies have suggested that parent-centered treatments focusing on listening and articulation exercises can improve speech accuracy in children with DS (15). For those individuals with DS who exhibit unstable patterns of errors, it may be beneficial to target stability in word articulation before specific phonological goals. In addition, interventions that aim to reduce the processing of syllable structure have been found to improve the speech intelligibility of people with DS who exhibit a common speech profile. The return cycles approach may be especially helpful for individuals with very low speech intelligibility (16). For those with very slurred speech, initial treatment may involve more functional vocabulary, such as vocabulary that pertains to their basic needs and the names of family members (17). Augmentative and alternative communication systems are another potential treatment option that can improve the communication skills of the people (14).

#### Limitations

No limitation.

#### Recommendations

.None.

#### Conclusion

The literature review has provided valuable information on the speech characteristics of individuals with DS. While the etiological causes may not directly impact clinical practice, understanding the strengths and weaknesses of this population, along with a specialized diagnosis, can help therapists

conduct a more careful assessment and treatment (16, 17). The review reveals that most studies focus on the description of speech characteristics and disorders in individuals with DS. Therefore, more interventional studies, particularly clinical trials, are needed to identify the most effective treatment methods to enhance the speech intelligibility of individuals with DS, particularly in treating verbal apraxia (18).

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#### Authors' Contribution

The author contributed to all processes of this article entailing writing the proposal, design, data collection, data analysis, writing the manuscript, and revision. The author approved the version to be published and is responsible for all facets of the work to ensure the accuracy and integrity of all questions. She appropriately reviewed and resolved the total parts of the article.

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#### Conflict of Interest

There is no declaration in this study.

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