



PHONOLOGICAL DISORDERS AS A DETERMINANT OF SPEECH INTELLIGIBILITY AMONG LEARNERS WITH DOWN SYNDROME IN PUBLIC PRIMARY SCHOOLS, NAIROBI COUNTY, KENYA

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Abstract:

This study aimed to analyze the impact of phonological disorders on the speech intelligibility of learners with Down syndrome. The study was guided by the Theory of Natural Phonology by David Stampe. A descriptive study design was used. Piloting was conducted in one of the public primary schools with learners with DS to ensure the validity and reliability of the instruments. The study used the available population of 25 learners with DS and 10 teachers trained in special needs education who were purposely selected from public primary schools in Kasarani Sub-county. Data was collected through tests of phonology, speech intelligibility tests and questionnaires for teachers. Descriptive statistics such as frequencies and percentages were used to analyze quantitative data, whereas the qualitative data that was obtained from open-ended questions was analyzed thematically. The study established that learners with Down syndrome displayed consistent phonological error patterns that have been classified as a disorder. From the ordinal speech intelligibility index scale, 65% of the learners had severe speech

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intelligibility, 25% had moderate speech intelligibility, while 10% had mild speech intelligibility. Further, the study established that the speech intelligibility of learners with Down syndrome is impaired due to the presence of phonological disorders, which have been noted to affect not only the academics and classroom participation but also the social aspect of their lives, self-esteem and interaction with their peers. The study recommended that special needs teachers should be trained in identifying learners with phonological disorders and methods of assisting in bringing clarity to their speech, thereby positively influencing the intelligibility of the learners with DS. Trained speech therapists should also collaborate with teachers to assist them in developing IEPs that target academics and different aspects of communication in the case of language impairment, such as phonological disorders.

Keywords: phonological disorders; speech intelligibility; learners with Down syndrome

1. Introduction

Down syndrome (DS) is a chromosomal condition that was first identified by Langdon Down in 1886, and part or whole trisomy of chromosome 21 is the cause (Diez-Itza *et al.*, 2021). Trisomy 21 is the most common cause of DS, whereby there is the presence of an additional chromosome 21 copy (Micalle, 2018). Translocation is another cause of DS, which occurs when one chromosome is attached to another during the fragmentation of chromosome 21. In contrast, chromosome 21 non-disjunction causes mosaicism, resulting in an additional chromosome copy in one of the cells (Naess *et al.*, 2021); these factors vary from child to child and affect speech and language development. According to Erin *et al.* (2019), moderate to extreme cognitive disability is also linked to DS. An impairment in cognitive skills affects thinking abilities such as reasoning, concentration, concept analysis and, most importantly, communication, primarily through speech and language (Carl *et al.*, 2020).

Language in DS is usually impaired from the age of 20 months when children with DS start to show differences in their language learning (Gammon, 2018). Language is classified into the pre-linguistic or linguistic stage, with the pre-linguistic stage being the most significant (Shari & Kristina, 2021). Children with DS face the challenge of going beyond single utterances, acquiring two-word combinations and eventually sentences, which therefore reflect difficulties in aspects of language (Akram, 2015), majorly on production. In addition, learners with DS encounter challenges in linguistic components such as syntax, phonology, semantics and pragmatics (Najwa, 2018). As a result, most such learners do not use some or all of the speech sounds required to form words at the expected age (Bauman, 2013). This affects their speech intelligibility, which, according to Terband *et al.* (2018), is a crucial factor in verbal communication.

Research on persons with DS has demonstrated that communication breakdown resulting from reduced speech intelligibility is a significant problem affecting both the social lives and academic achievement of such individuals (Terband *et al.*, 2018).

According to Bülent (2015), speech intelligibility refers to how clearly a person speaks so that his or her speech is comprehensible to a listener. Similarly, Akram (2015) defines speech intelligibility as the degree to which a person's speech can be understood. Speech intelligibility difficulties are a frequent issue that arises at the early stages of speech production for children with DS and continues during adolescence and adulthood (Terband *et al.*, 2018).

In the United States, speech intelligibility among learners with Down syndrome has been of concern, whereby the learners experience difficulties participating in school activities with their peers, which has led to their poor performance. Due to communication difficulties brought by unintelligible speech, these learners become socially isolated (Fox *et al.*, 2004). Similarly, in Norway, as explained by Dolva (2009), speech intelligibility in learners with DS affects learners' participation in school to the extent that they assume the passive role of listening or withdraw from interactions while their typical peers assume an active role in interactions. This shows that achievement of speech intelligibility by persons with Down syndrome facilitates their participation in society.

In Uganda, the Uganda Down Syndrome Association (UDSA) notes that Unintelligible speech is the most common communication difficulty in learners with Down syndrome (Kakooza, 2021). Unintelligible speech hinders effective learning among learners with DS.

In Kenya, it has been noted that most children with DS do not attend school since they are deemed unfit for mainstream schools due to speech and language problems. Phonological disorders also interfere with the learning of the English language in learners with DS as they hinder phonological awareness, which helps learners read (Nyathama, 2018). Phonological disorders affect not only literacy skills such as reading but also speech intelligibility, which is an integral part of communication that will enable the learner's speech to be understood clearly and promote less frustration during communication exchange.

There is limited literature concerning DS in Kenya since most children are hidden in homes by their caregivers and, hence, do not have access to primary education (Chabeda *et al.*, 2019). Children with access to primary education face the challenge of inclusion in mainstream schools, as most schools prefer to have them learn in special schools.

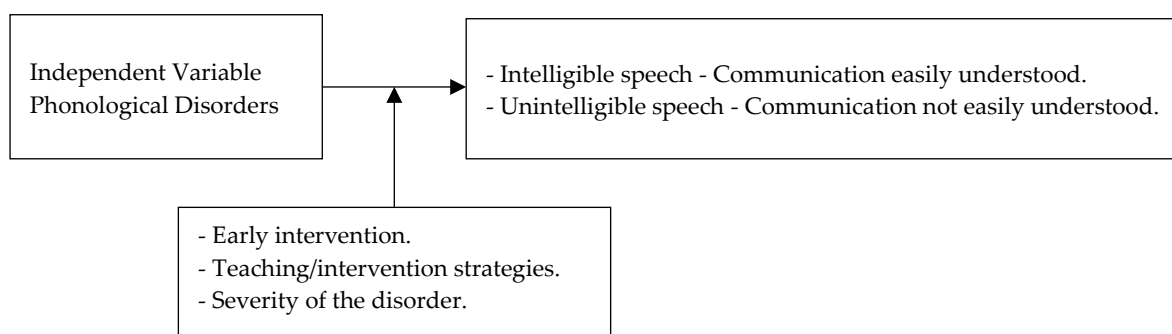
Despite the changes done to the education system, learners with Down syndrome in public schools still face a different reality, such as a lack of adequate learning resources as compared to the other learners in private schools, and this is the reason the researcher focused on public schools with learners with Down syndrome. On the other hand, Nairobi County has a higher number of special education facilities than other counties. Concerning this, it was expected that the needs of learners with DS were fully met such as adequate learning resources, early intervention services provided in school such as speech therapy, teacher-to-learner ratio as well as training and workshops organized for the teachers to create awareness and offer skills in handling such learners. This was

expected to allow the researcher to collect adequate data on the problem at hand and establish how phonological disorders affect speech intelligibility in children with Down syndrome.

2. Purpose of the Study

This research investigated the impact of phonological disorders on speech intelligibility among learners with Down syndrome in primary public schools.

Figure 1: Conceptual Framework



3. Literature Review

This section discusses the theoretical framework and the literature related to the study topic.

3.1 Theoretical Review

The theory of natural phonology by Stampe (1979) that focuses on phonological structure, acquisition and phonological processes informed the study. The theory explains that phonological disorders result from the inability to suppress the different simplifications experienced by children. This suppression occurs naturally in typically developing children as opposed to children with DS. Phonology as a language component is based on phonological processes where a child has to inhibit some of the processes to arrive at a language-specific phonology. The main objective of the theory is to teach children how to inhibit their inborn phonological processes. Phonological processes have been regarded as the underlying representations that have been used in children's speech until they could be completely suppressed. The theory also suggests that a child must conquer these physiological weaknesses to communicate effectively, especially those that do not restrict their language patterns. As in the case of Down syndrome, they are constrained in terms of anatomy and physiology features, which affect the way they communicate. Hence, the theory suggests that in order for children to communicate, they simplify what they want to convey in order for them to be able to say it. During phonological development, children learn to reduce the natural processes, which are the gradual simplifications as their speech eventually improves to become more adult-like.

According to the theory, a child with a phonological disorder, like those with Down syndrome, cannot suppress the phonological processes, eventually resulting in a disorder. Suppose the child cannot suppress these processes naturally, like in the case of children with DS. In that case, early intervention should take place to assist them in communicating intelligibly and effectively.

3.2 Phonological Disorders and Speech Intelligibility

A phonological disorder affects a speaker's production of speech sounds, which in turn has an impact on the performance and competence of the sound system (Gierut, 1990; Kamhi, 1992). According to the National Institute of Deafness and Communication Disorders [NICHD] (1994), phonological disorders affect approximately 10% of preschool and school-age children, and as stated from the experience of speech therapists, phonological disorders make up the majority of the caseloads of language pathologists working in schools.

These disorders have been found to affect an individual's daily activities. For instance, adults with phonological disorders who were diagnosed and treated as children tended to have retrieval difficulties, slower processing of information related to language and the sound system and more errors (Marla, 2018).

Graham (2017), in his study on the challenges faced by children with speech sound disorders, such as those with Down syndrome, revealed that these children experience low self-confidence and reduced engagement in learning activities that require verbal response in the classroom. A child with a phonological disorder will speak less when communicating with his/her peers because of being uncomfortable, which leads to withdrawal from interaction. Individuals with Down syndrome speak in a way that has been characterized as "*gibberish, incomprehensible in a conversation and characterized by a particular articulatory deficit*" (Spragge, 1962). While it is acknowledged that children with Down syndrome have a higher occurrence of articulation issues, research on articulatory and phonological patterns is limited.

Communication problems are common in children with DS due to reduced speech intelligibility; speakers and their partners may experience frustration, which affects spoken language (Kent & Vorperian, 2013; Price & Malkin, 2007). Reduced speech intelligibility interferes with effective message communication, causing the individual with Down syndrome to minimize speaking attempts and thus lose out on the ability to practice spoken language production skills required for language learning. According to Thurman (2022) and Roberts, Price and Malkin (2007), children with DS face lifelong challenges with producing understandable speech, as only one- or two-word utterances could be well comprehended as opposed to lengthy utterances which proved to be problematic in both production and perception.

McCormack (2010) investigated parents' and speech pathologists' perspectives on the impact of speech impairment on preschool children with Down syndrome and found that speech intelligibility affected social relationships, interpersonal relationships, learning, and verbal communication. The extent to which the children's speech could be

understood was said to be dependent on the type of conversational discussion as well as the close relationship between the listener and the child. Any speech or language impairment, as in the case of phonological language disorders, causes speech to be unclear and not easily understood.

In a survey that was carried out by Bulent (2015) in Turkey on 346 children with an average range of 5; to 3 years, on how families with children with Down syndrome perceive speech intelligibility indicated that the majority of the children displayed unintelligible speech, which was not diagnosed due to lack of proper screening and assessment tools as well as limited number of speech pathologists. The families noted that the children have difficulty in saying some words or phrases. Phonological disorders, when left undiagnosed and untreated, affect communication; the level of speech intelligibility determines the effectiveness of communication within an environment. When the speech is unclear, it becomes difficult to comprehend the spoken utterance.

The underlying cause of speech intelligibility in the studies was not established. The current study sought to establish whether the speech of learners with DS is affected by phonological disorders and the extent of the severity of the disorders produced concerning how well their speech can be understood.

4. Methodology

4.1 Research Design and Target Population

The study employed a descriptive research design. In order to achieve the research objectives, Orodho (2014) proposes that descriptive research design allows researchers to employ various methods of data collection, enabling triangulation of data, hence the collection of reliable information. The design was the most suitable given that research questions guided the study. In addition, this design was appropriate since it was possible to administer questionnaires to a sample of teachers and observe the sample population of learners with DS through various tasks, record the linguistic data, analyze it through transcription, interpret and thereby make a conclusion. The target population was 25 learners with DS, ages 11-20 years, and 10 teachers trained in special needs education in all the twenty-five public primary schools in Kasarani Sub-county.

4.2 Sampling Techniques and Sample Size

This study employed purposive sampling to select all public primary schools with learners with special needs. Creswell (2016) states that purposive sampling enables researchers to sample particular respondents with specific characteristics of interest. In addition, the researcher purposively sampled learners with Down syndrome and mild to moderate intellectual disabilities. The sample consisted of five public primary schools, 25 learners with Down syndrome, and 10 teachers, for a total of 35 respondents.

4.3 Research Instruments and Data Collection

The researcher used four tools to collect data: a phonology test as a learner's assessment tool, questionnaires for the teachers and a speech intelligibility rating scale. The questionnaires comprised both open and closed-ended questions, which captured difficulties and issues encountered in the classroom and participation of the learners due to these disorders, how the disorders affect the speech of the learners is understood and intervention measures that can be employed to address the challenges. The speech intelligibility rating scale was used to measure the speech intelligibility of the learners by using the percentages scored from the computation of utterances and word production which determined the range of intelligibility of speech from normal to severe.

The learners were taken through a phonological task. They were presented with stimuli pictures, and the learner was supposed to identify and name the items. This task focused on the initial, medial, and final positions of speech sounds. Then, the speech was recorded according to their articulation.

4.4 Pilot Study

The authenticity and reliability of the instruments were determined through piloting. It ensured that the chosen research instruments were clear and appropriate, as well as detected the need for any modifications to the instruments to be used through this exercise. Research instruments were pilot-tested in one public primary school, which was randomly selected from a broad range of public primary schools in Kasarani Sub-county. Two learners with DS and a teacher who handles these learners participated in this exercise.

4.5 Data Analysis

Data was sorted to verify whether all sections of the tools were filled and analysed using qualitative and quantitative methods. The researcher coded the quantitative data into SPSS version 22 and analyzed quantitative data and analyzed it using percentages, frequencies and mean scores. Further, the Pearson Product Moment of correlation was used to establish the influence of phonological disorders on speech intelligibility. The results were presented in the form of charts and tables. Data in qualitative was analyzed thematically according to the study objectives. The qualitative data was used to provide in-depth discussions on the quantitative data obtained from the questionnaires.

5. Results and Discussions

The study's objective was to determine the extent to which phonological disorders affect the speech intelligibility of speech of learners with Down syndrome. For speech intelligibility, the researcher used a speech intelligibility test that consisted of three word sentences and the intelligibility level was measured using an ordinal index intelligibility scale intelligible to classify the learners' percentage of intelligible words as Normal (≥ 90 -

100% intelligible), minimal(≥ 75 -89% intelligible), mild (≥ 60 -74% intelligible), moderate (≥ 25 -59% intelligible) and severe(≥ 24 %)

The findings are presented in Figure 1:

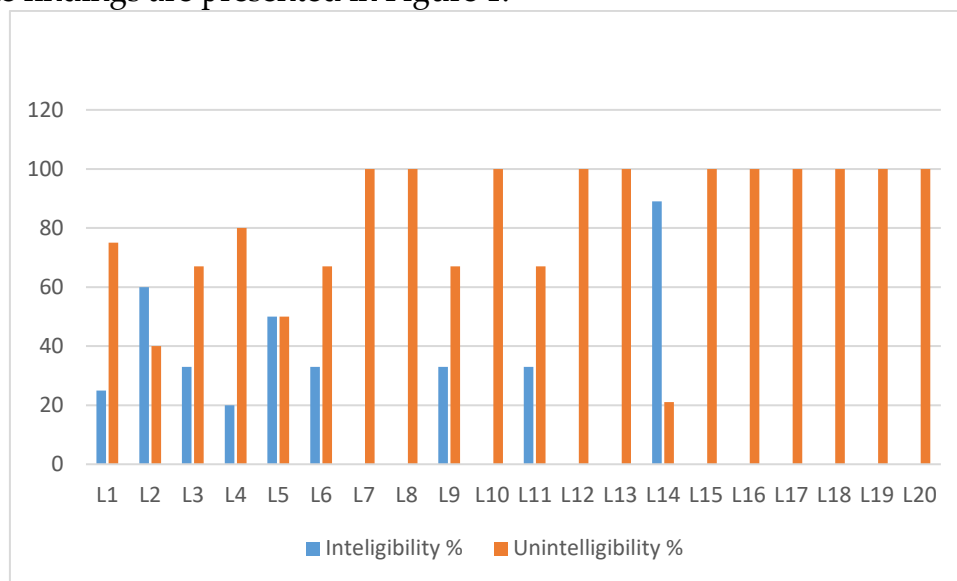


Figure 1: Speech Intelligibility Test Analysis

From the phonological test done, most of the learners produced different phonological disorders ranging from substitution, epenthesis, initial, medial, final deletion, backing, devoicing, stopping, cluster reduction, fronting, alveolarization, syllable reduction and gliding. L1 had one intelligible word out of a total of four words presented, which translates to an intelligibility of 25 per cent against an intelligibility of 75 per cent. L2 had three intelligible words out of a total of five words presented, which translates to an intelligibility of 60 per cent and an intelligibility of 40 per cent. Learners L3, L6, L9 and L11 had one intelligible word out of the three presented, translating to an intelligibility of 33 per cent and an intelligibility of 67 per cent. L4 had one intelligible word out of the five presented, which translates to an intelligibility of 20 per cent and an intelligibility of 80 per cent. L5 had one intelligible word out of the two presented, translating to 50 per cent intelligibility and 50 per cent unintelligibility. Learner L14 had sixteen intelligible words out of the eighteen presented, which was the highest amongst the learners and translated to an intelligibility of 89 per cent and an unintelligibility of 21 per cent.

Learners L7, L8, L10, L12, L13, L15, L16, L17, L18, L19 and L20 had no intelligible word, which translates to 100 per cent unintelligibility and 0 per cent intelligibility. Phonological disorders make it difficult for people to understand their utterances. The researcher had to read out some of the sentences for the learners to imitate, as some could not read. They managed to sound out the different sounds in a word, but blending the sounds together was challenging; however, other learners with phonemic awareness could read the sentences but with phonological disorders as well.

Phonological processes and speech intelligibility in children are equivalent to age in that the more a child grows older in age, the more intelligible their speech should be.

Children should be able to eliminate these phonological processes up to age six, so when phonological processes are used past the type age of elimination in a child, then it becomes a disorder. Similarly to speech intelligibility, at least by 6 years of age a large extent of the child's speech should be understood by both familiar and unfamiliar listeners (Sheldrick *et al.*, 2020).

Similar data was collected from teachers who indicated that learners with DS experience difficulties affecting their speech intelligibility, making it difficult for them to participate in school activities with their peers. This is as reported:

"These learners are unable to express themselves and understand in class. Due to communication difficulties brought by unintelligible speech, these learners become socially isolated." (Teacher 1)

"Majority of them have speech-related issues, they are not able to speak clearly. This makes it difficult for them to have meaningful interaction with others." (Teacher 2)

"They can't articulate many words correctly; they stutter and have short attention span." (Teacher 3)

"They have distorted speech. Some use signs and have to be prompted in order to express themselves. Those that can express themselves have poor pronunciation of some words." (Teacher 4)

"These learners exhibit phonological errors in speech. Some of the learners with Down syndrome have some form of hearing loss. Their hearing level is moderate. As a result, they take time to learn, they are unable to produce sounds in words correctly." (Teacher 5)

From the teacher's perspective, as they were handed out some questionnaires to fill, one of their responses was that it was difficult to understand the speech of some of the learners with Down syndrome in the classroom, and even eluded that it could be the presence of a 'heavy tongue'. The appearance of an enlarged size of the tongue (macroglossia) is part of the physical structures in Down syndrome (Antonarakis, 2009). As much as macroglossia affects speech production, phonological disorders that occur consistently affect how speech produced by the learner with Down syndrome is understood. This is observed in cases where the teacher asks them to respond to questions in class, and some of them respond in shyness to the extent that they are inaudible; the teacher has to reassure them and boost their confidence levels in order to express themselves.

Unintelligible speech creates a social gap in that when the learners with DS interact with their peers outside the classroom, some teachers mention that the learners would prefer grouping themselves away from the other learners because they tend to understand each other better instead of mingling with them. When spoken to, some

learners prefer to keep silent to avoid engaging in a conversation where an individual misunderstands them or is asked to repeat their utterances, which also causes and increases frustration.

The researcher also observed that due to the presence of phonological disorders, some learners also experience difficulties in reading either three-letter words, phrases or even simple sentences, which is why the learners were unable to read the narrative provided. In order for a learner to read the narrative, they require the ability to sound out the phonics in segmentation and blending the sounds in the words, which they lack (phonological awareness).

The inability to speak clearly by learners with DS due to the presence of phonological disorders also creates stress for the learner and also becomes a source of embarrassment when expressing themselves. Morales (2009) also argued that unintelligible speech could seriously limit how a learner interacts when placed in different contexts, which, over time, could create aggressiveness for being misunderstood and would later avoid situations in which they are required to be social.

The results show that most learners had high levels of unintelligibility. These findings concur with Kamhi (1992), who stated that a phonological disorder affects a speaker's production of speech sounds, which in turn impacts the sound system's performance and competence. Similarly, the findings agree with Marla (2018), who established that phonological disorders affect an individual's daily activities. Such individuals have slower processing of language and sound system information and make more errors. Also, the findings agree with McCormack (2010), who investigated parents' and speech pathologists' perspectives on the impact of speech impairment on preschool children with Down syndrome and found out that speech intelligibility affected social relationships and interpersonal relationships, learning as well and verbal communication. The extent to which the children's speech could be understood was said to be dependent on the type of conversational discussion as well as the close relationship between the listener and the child.

In the same breath, Graham (2017), in his study on the challenges faced by children with speech sound disorders, such as those with Down syndrome, revealed that these children experience low self-confidence and reduced engagement in learning activities that require verbal response in the classroom. A child with a phonological disorder will speak less when communicating with his/her peers because of being uncomfortable, which leads to withdrawal from interaction. Individuals with Down syndrome speak in a way that has been characterized as *"gibberish, incomprehensible in a conversation and characterized by a particular articulatory deficit"*.

The findings also agree with Kent and Vorperian (2013), who established that communication problems are common in children with DS due to reduced speech intelligibility. Both speakers and the partners they communicate with may experience frustration, which affects spoken language. Reduced speech intelligibility interferes with effective message communication, causing the individual with Down syndrome to

minimize speaking attempts and thus lose out on the ability to practice spoken language production skills required for language learning.

The findings from the current study concur with Thurman (2022) who established that children with DS face lifelong challenges with producing understandable speech, as only one- or two-word utterances could be well comprehended as opposed to lengthy utterances which proved to be problematic in both production and perception. McCormack (2010) investigated parents' and speech pathologists' perspectives on the impact of speech impairment on preschool children with Down syndrome and found that speech intelligibility affected social relationships, interpersonal relationships, learning, and verbal communication.

Further, the findings agree with Dalvand (2015), who conducted a cross-sectional study on speech intelligibility of twelve Persian children ages 3 to 5 years and compared the speech of TD to that of DS. The test involved a naming task and the intelligibility scale of 1-3 where 1 was unintelligible and 3 intelligible. The results showed a difference in both groups where the speech of TD children was normal while for children with DS ranged low and concluded that the low speech intelligibility in children with DS could be as a result of motor problems as children with DS could not deliver speech as TD children. In Dalvand's (2015) study, children below four years are bound to have unintelligible speech as they are still in the process of acquiring and learning the sound system.

Similarly, a survey that was carried out by Bulent (2015) in Turkey on 346 children with an average range of 5; 3 years on how families with children with Down syndrome perceive speech intelligibility indicated that the majority of the children displayed unintelligible speech, which was not diagnosed due to lack of proper screening and assessment tools as well as limited number of speech pathologists. The families noted that the children have difficulty in saying some words or phrases. Phonological disorders, when left undiagnosed and untreated, affect communication; the level of speech intelligibility determines the effectiveness of communication within an environment. When the speech is unclear, it becomes difficult to comprehend the utterance being spoken.

In addition, the findings are in agreement with the findings by Klein and Flint (2006), who sought to find out the impact on connected speech intelligibility of the three phonological processes of final consonant deletion, stopping of fricatives and affricates and fronting of velars in children with phonological disorders. Listeners were read live a series of passages in which one of the error patterns was present for every opportunity of that pattern. The researchers reported that final consonant deletion had the most impact on intelligibility, while fronting of velars had the most minor effect on speech intelligibility. The current study established not only the impact of three phonological processes as in the previous study done in children with phonological disorders but also found out specifically which phonological disorders affect children with Down syndrome and whether their intelligibility of speech is also affected.

Further, the findings agree with the findings reported by Dalvand (2015) in a cross-sectional study on speech intelligibility of twelve Persian children ages 3 to 5 years, which compared the speech of TD to that of DS. The test involved a naming task and the intelligibility scale of 1-3 where 1 was unintelligible and 3 intelligible. The results showed a difference in both groups where the speech of TD children was normal while for children with DS ranged low and concluded that the low speech intelligibility in children with DS could be as a result of motor problems as children with DS could not deliver speech as TD children.

On the same breath, Kumin (1994) also conducted a similar study, which was a questionnaire study on parents with children with DS to determine speech intelligibility and found that from the group of 937 parents reported that 95% of the children were reported to have unintelligible speech while 5% never experienced difficulty being. Improving or managing intelligibility is a crucial goal for speech and language therapists working with clients who have trouble speaking. Therefore, it is crucial to consider intelligibility when evaluating the efficacy of treatments for improving overall speech quality (Miller, 2013). The range of severity of a phonological disorder can be described by the ease or difficulty with which a listener can understand the speech of the learner. Reduced intelligibility in the DS population has not been substantially reported, and its causes have not been thoroughly explored.

6. Conclusions

The study concluded that learners with Down syndrome displayed consistent phonological error patterns that affected their speech. It is evident that the speech intelligibility of learners with Down syndrome is impaired due to the presence of phonological disorders, which have been noted to affect not only the academics and classroom participation but also the social aspects of their lives, self-esteem and interaction with their peers.

7. Recommendations

- 1) The government should find a way of incorporating and offering employment services to speech and language pathologists/therapists to work collaboratively with teachers to promote effective identification of communication disorders such as phonological language disorder and offer accurate interventions to the learners in schools, which will promote better communication through intelligible speech.
- 2) Teachers' parents and caregivers of learners with Down syndrome should be sensitized through training, seminars, and workshops on ways of assisting learners with DS with communication deficits such as unintelligible speech due to phonological disorders. Teachers should also be explicitly trained about learners with Down syndrome, their communication challenges, and ways of assisting them.

- 3) The Ministry of Education should allocate more funds for learning materials to enable teachers to assist the different needs of learners with Down syndrome in the classrooms, such as visual aids for the learners. Learners with DS are visual learners.
- 4) The Kenya Institute of Curriculum Development (KICD) should develop a curriculum specific for learners with DS instead of using one curriculum for all learners with intellectual disability.

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