

Diagnosis of Speech Disorders in Children with Down Syndrome: The Role of the Speech Card in the Work of a Defectologist and Neurologist

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Abstract The diagnosis of speech disorders in children with Down syndrome represents a significant challenge in clinical practice that requires a comprehensive and multidisciplinary approach. The speech assessment card serves as a crucial diagnostic and monitoring tool, facilitating systematic documentation of speech and language development patterns specific to children with Down syndrome. This standardized method enables defectologists and neurologists to evaluate articulation disorders, vocabulary limitations, grammatical difficulties, and pragmatic communication skills.

Keywords Down syndrome, Speech disorders, Speech assessment card, Speech diagnostics, Defectology, Neurology, Interdisciplinary approach, Developmental disorders, Speech therapy, Language development, Articulation disorders, Early intervention, Diagnostic protocols, Communication skills, Cognitive development

1. Introduction

The collaborative use of speech cards allows for more targeted therapeutic interventions, better monitoring of developmental progress, and improved coordination between specialists [1,6]. Early and accurate diagnosis through properly maintained speech assessment cards contributes significantly to the effectiveness of speech therapy, cognitive development, and overall social integration of children with Down syndrome. This approach underscores the importance of specialized diagnostic protocols that account for the unique neurophysiological characteristics of Down syndrome and supports evidence-based intervention strategies [2,7].

In the early 1980s, active research was conducted in the field of diagnosis and treatment of speech dysfunctions in children with Down syndrome. In recent years, an increasing number of scientific literature sources present works on speech requirements, reasoning, and communication. For instance, in 2010, Albertini B. and colleagues conducted a study on voice timbre control: low, abnormal crying at birth, and using specific computer programs, identified the coefficient of voice timbre variation [3,8]. During the same period, Bisterveldt and colleagues determined that "the average speech intelligibility score for children with Down syndrome was 83.1% and 80% for connected speech." Many authors attribute this characteristic to anatomical and

physiological disorders (deficiency and abnormality of facial sinuses, larynx). Other specialists in this field note peculiarities of the respiratory tract, such as laryngomalacia, tracheomalacia, and bronchomalacia. As seen, the problem of speech disorders is not straightforward and depends on many factors and the level of individual variability [4,9].

Karmiloff-Smith and colleagues (2016), who conducted research on a large number of children with Down syndrome, discovered a phenomenon where comprehension exceeds performance organization, which manifests in lexicon, as opposed to execution technique. Accordingly, issues of language barriers in children with Down syndrome remain a priority and should be addressed through comprehensive collaboration of specialists: neurologist, speech therapist, psychologist, otolaryngologist, etc. Furthermore, the approach should not be limited to a single age range, such as early childhood, but should utilize a long-term rehabilitation program with prospects for the older adolescent period [5,10].

The aim of the study is to examine and evaluate the effectiveness of the "Speech card" as a tool for diagnosing speech disorders in children with Down syndrome in the complex of defectological and neurological observation.

2. Research Material

The research material consisted of children with Down syndrome who underwent preventive specialized examinations by neurologists, speech therapists, psychologists, and otolaryngologists at a forum organized by the MESCA

Foundation - Switzerland together with doctors from Uzbekistan (September 2024). Children with Down syndrome and their parents were invited to this forum after receiving prior notification and invitation. The total number of participants was 117 children aged from 2 to 15 years; of these, urban children (Samarkand city) comprised 79 children, district children (Samarkand region) 38 children; 62 boys and 55 girls. The examination process of children with Down syndrome took place at the Multidisciplinary Clinic of Samarkand State Medical University, in the department of outpatient functional diagnostics. The inclusion criteria were based on the main principles of the research objective: speech disorder, lack of language skills, division of speech into receptivity and imagery. Consequently, from the total number of participants, children with Down syndrome were selected with an average age category of 9 ± 2 years, having severe speech disorders and children with relatively stable speech, totaling 59 children. In the first stage, as per standard, medical history was collected, questionnaires were filled out (for parents); previous diagnostic studies were checked (based on presented documents: genetic data, previous treatment and rehabilitation, extracts from specialized educational schools); examination by a neurologist, pediatrician, psychologist, speech therapist; diagnostic research: ECG, EEG, MRI. In the second stage, children underwent testing, during which a "Speech card and development card" was compiled (jointly created by a neurologist and defectologist, approved at the department meeting). The card consists of three main sections: the first section contains 21 main points (speech character, tongue mobility, voice strength and timbre, etc.); the second section contains five points (hearing condition, speech comprehension, cognitive tasks); the third section contains eight points (speech structure, sentence formation, thinking development, etc.). For more accurate comparison of indicators, healthy children of identical age and gender were selected from among those who came for preventive examinations and provided written consent for use. All test responses were recorded and scored manually; statistical data analysis was conducted on an individual computer with standard calculation of mean values. The study also used Fisher's exact test, Student's t-test, and linear regression analysis to test differences between children with Down syndrome and healthy children.

3. Results of the Research

Thus, based on the purpose and methods of the study, the indicators in the main group (children with Down syndrome) were as follows: the total number of examined children was 59, 34 boys and 25 girls. All children had common characteristics: communication through gestures, touch (especially noticeable when the child tries to express a request to their mother with a special facial expression), meaning non-verbal communication predominated over verbal. It should be noted that children with Down syndrome characteristically respond to requests-questions with short "yes" or "no" answers, so-called "black-and-white" thinking,

sometimes without understanding the answer (or corresponding question). Such answers without analysis (the so-called dichotomous process) were detected in patients in 73.1% of cases. Additionally, decreased response speed, slowed thinking, and delayed answers to questions (requiring several repetitions in 56% of cases) were observed, consequently demonstrating difficulty in speech fluency, where $p < 0.001$ compared to the healthy group of children.

As noted above, one of the research tasks in the speech card was to determine the relationship between speech skills and sound pronunciation (voice strength, speech tempo, voice timbre, sound). Each parameter was reproduced several times, and average values were determined. In one case, the patient had to repeat sounds and words after the doctor; all data were recorded in a table (which sound or word is being examined, whether the patient pronounces it in isolation, i.e., between teeth; and in which part of the word: at the beginning, middle, or end). Additionally, it was important to determine what type of disorder was present: sound or word substitution, partial substitution, or distortion. The second method involved showing a picture and asking to name what was in the picture, where the sound in words should be in different positions. A correlation was noted between speech skills and sound pronunciation in all positions, where voice strength was reduced, and considering the low speech skills, the average relationship had a limit of 5 to 6 points (normally 10 or more points). Speech tempo showed small or moderate values, on average 4 points, and when controlling non-verbal mental use from 2 to 3 points.

Voice timbre and sound, when controlling correlation values, had a weak degree of significance, indicating no connection with speech skills and cognitive ability to reproduce sound. Nevertheless, the general characteristic of correlation between the four indicators affects the results in the full concept; therefore, voice strength and speech tempo (slowness) are significant for monitoring all four parameters.

The evaluation of the research results according to criteria: hearing condition, understanding of surrounding speech, vocabulary, and phonemic hearing, on average, had the following values and are presented by reduced stagnation for each individually, combined with non-verbal deviation of speech skills. Thus, if hearing (biological) and understanding of surrounding speech in percentage ratio with healthy children had a lower level, only 59%, then in the position of correlation with speech skills, indicators varied within 4-6 points, which is a relatively good level, which coincides with literature data. Meanwhile, vocabulary and phonemic hearing had low values from 2 to 3 points, which is statistically significant in the general sample of the result corresponding to $p < 0.005$. The next stage of the research was to determine the difference between emotional and impressionable character traits in combination with grammatical speech construction, thinking abilities, and the state of general and fine motor skills. To ensure comparability of variable calibration, average values were also used. Changes were revealed between the emotional property of character and differences between the level of thinking and grammatical structure of speech (Tables 1-3).

Table 1. Speech Level in Children with Down Syndrome Compared to a Group of Healthy Children of Identical Age and Gender (%)

Indicator	Children with Down syndrome (n=59)	Healthy children (controls) (n=31)
Standard	0	90
Easy	23	10
Average	34	0
Tall	44	0

Table 2. Assessment of the "Speech map" in children with Down syndrome with moderate and high levels of speech impairment

Indicators	Children with Down syndrome have a high level of speech deficiency (n=44)	Children with Down syndrome with an average level of speech deficiency (n=34)
	score	score
Non-verbal communication		
gestures	5-7	1-33
touch	6-8	1-3
Grammatical structure of speech	0-2	1-6
Phonemic hearing	0-1	2-4
Sound reproduction		
The power of the voice	0-2	3-4
The timbre of the voice	0-3	3-6
The speed of answering a question	0-2	2-5

Note p<0.005

Table 3. The result of the analysis of the control of speech dysfunctions in children with Down syndrome

Indicators	Children with Down syndrome have a high level of speech deficiency (n=44)	Children with Down syndrome with an average level of speech deficiency (n=34)
Vocabulary	2	13
Grammatical structure of speech (independent speech)	6	29,5
Phonemic hearing (pronunciation)	5	7,3
Tempo of speech, timbre of speech	1	9
Generalization (of the speech map)	3	18

Note p<0.005

At the same time, impressionability, as a separate property of the personality character, did not have clear correlational observations (making a sentence, using a diminutive form of the word, comparing a geometric figure). In addition, it should be noted that the emotional and receptivity factors were not very important for the grammatical structure of speech, and the development of thinking itself (imagination, a combination of hearing and vision), and the development of fine motor skills play an important role here. Thus, there is a general tendency to divide among patients with low cognitive level and difficulty of speech skills than among patients with speech skills with an average level, where $p < 0.05$.

4. Conclusions

Thus, the result of a study of children with Down syndrome, the topic of discussion of which was language and speech disorders, indicates a high frequency of the formation

of polysyllabic speech compared with children of the same age and gender in a healthy group. In addition, a significant relationship was found between speech skills and some symptoms, such as voice strength, voice timbre, and pronunciation. A correlation has been found between hearing and phonemic hearing with understanding of the surrounding speech and grammatical structure of speech, at the same time, independent speech, imagination, and the use of speech depend little on the emotional perception and impressionable nature of patients, which are caused by cognitive insufficiency and decreased fine motor skills. Therefore, the issue of combined observation of specialists of various profiles, children with Down syndrome, remains important, where the lack of speech development and the conclusion of a speech pathologist is considered a priority as a result of forecasting and optimizing therapy. The use of a "speech card" during the examination and dynamic monitoring of patients with Down syndrome will make it possible to identify long-term projects for older adolescents.

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