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The role of risk factors in the development of speech and language disorders in preschool children

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Abstract

The article provides an overview of modern literature on the risk factors for the development of speech and language, which can be taken into account by pediatricians when forming a high-risk group of the corresponding contingent of preschool children. The leading risk factor for the development of speech/language disorders in children is childhood developmental brain disorders that arose in the prenatal, intrapartum and postnatal period of a child's life, which is often found in children with cerebral palsy, epilepsy, and after head injuries. The occurrence of disorders is greatly influenced by anatomical defects in the speech apparatus, requiring timely surgical correction, and hearing loss. Impairment or absence of speech/language in children is common causes for visiting a psychiatrist, which is observed in autistic spectrum disorders (including autism), elective mutism, mental retardation, attention deficit hyperactivity disorder. Many genetic factors which are often found in patients with other hereditary diseases (chromosome disorders, monogenic hereditary diseases, inherited metabolic diseases, genetic speech disorders) play a special role in the development of speech/language and are associated with developmental disorders, intellectual disability and behavioral deviations. Finally, social factors such as socioeconomic status and social structure of the family, family conflict, pedagogical neglect, child abuse and prolonged use of modern digital devices throughout the day contribute to speech/language development disorders in preschool children. Analysis of the causes of speech/language pathology is of great practical importance for improving the management strategy aimed at preventing the manifestation of the disorders in children.

Keywords: preschool children, speech and language disorders, risk factors.

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Speech and language are important means of communication between a child and the surrounding community. This is a special and the most perfect form of communication inherent only in humans. Currently, in the Russian Federation, there is no reliable data on the prevalence of speech and language disorders in children because they are not submitted to the Federal State Statistics Service [1]. Moreover, only the results of single studies have been published. In particular, an analysis of the detection rate of speech disorders among 5737 preschool children in Tyumen from 2008 to 2018 showed that speech dysfunctions are formed in 31.2% by age 3 years, in 44.3% by age 4, in 18.1% by age 5, and in 7% by age 6 [2]. Benilova (2017) noted that the frequency of referrals of children with systemic disorders of speech and language development to the Center for Speech Pathology and Neurorehabilitation of the Moscow Department of Health increased from 10.7% in 2004 to 37.5% in 2016 [3]. Studies performed in Canada have detected late speech development in 12.6% of children aged 24–30 months [4].

In the literature, the high prevalence of these disorders in preschool children and the lack of official statistical indicators of these disorders make it relevant to analyze the risk factors associated with speech and language retardation.

The word “risk” implies the “probability of the impact of negative consequences,” in this case on the formation of speech and language. At present, significant scientific efforts and most of the health care resources are aimed at correcting the identified disorders (diseases) and not at their prevention.

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However, the key element should be the study of factors to improve the management of the risk prevention strategy, as well as the provision of parental education.

Perinatal risk factors. Perinatal pathology of the central nervous system (CNS) is significant in the occurrence of speech disorders in children [5]. Early organic damage to the CNS (e.g., selective neuronal necrosis, parasagittal necrosis, periventricular leukomalacia, and damage to the basal ganglia, thalamus, cerebellum, and brainstem), which has arisen with pathologies of pregnancy and childbirth, is traditionally considered the main cause of speech disorders in children [6].

Antenatal risk factors such as insufficient use of vitamins, stress, and alcohol consumption are significantly associated with existing language (18.1%), behavioral (6.1%), and combined (3.3%) problems in children at 2 years of age [7]. Other studies have confirmed that maternal factors during pregnancy are closely related to the results of speech or language development in young children [8, 9]. However, Hendricks et al. (2020) denied the effect of alcohol consumption by a woman in the antenatal period on the development of speech in children [10].

According to the literature, speech and language disorders at an early age occur much more often in children who were prematurely born and had low birth weight. Thus, according to Ionio et al. (2016), even relatively healthy premature babies have lower scores than full-term babies on the Bayley Scales of Infant Development III cognitive and language developmental scales both on months 24 and 36, taking into account their adjusted and chronological age [11].

Debata et al. (2019), over the period from 2014 to 2017, followed up 200 children with normal hearing but were born with low birth weight (most of them were premature). In their study, 32% of children had language retardation by age 3 years, and a third of them had systemic developmental delay. According to the multivariate analysis, the most significant predictors of speech retardation in the examined children were late sepsis, patent arterial duct, and neurological disorders. However, no reliable relationship between gestational age and language development in children has been established [12].

A survey of Arabic-speaking Egyptian children aged 2–3 years revealed that the most important risk factors for language disorders were prematurity, hyperbilirubinemia, hypoglycemia, hypoxia, and respiratory distress syndrome [13].

Acute and chronic hypoxia in the perinatal period and infancy, as well as impaired development of sensory systems, worsen significantly the prognosis for the development of higher mental functions and speech in premature babies born with extremely low and very low body weight. Speech impairment was diagnosed in 18.3% of cases in patients older than 1 year. Moreover, in children with extremely low and very low body weight, speech retardation was established in 60.2% of cases, and 23.7% of these patients had a disabling organic pathology of the CNS. Among children weighing more than 1500 g at birth, 40% had speech formation disorders and 14.3% had severe encephalopathies [14].

Mondal et al. (2016) reported a similar prevalence of language retardation in full-term infants discharged from the intensive care unit. They did not find a relationship between speech development retardation and a history of sepsis in term infants [15].

A study conducted in Japan suggested that brain dysfunction such as speech retardation is a serious problem among premature babies. Evidence showed that the hemodynamic regulation of the brain functional systems developed with an increase in post-conceptual age [16].

Anatomical defects in the structure of the articulatory apparatus. Maxillary defects are significant medical risk factors for speech retardation [17]. Children with cleft lip and palate showed lower speech skills throughout the early period [18–21]. Studies have revealed that late palatine plastic repair (after 13 months), compared with the standard one, increases the probability of speech retardation in children [22], and an isolated lip defect does not affect speech formation [23].

Hearing impairment. Hearing acuity is an important element of the study of speech and language retardation in children. With hearing impairment, children have no reactions to sound stimuli, unable to imitate the sounds of adults, use excessive gestures, and pay close attention to the lips of the speaker. The sooner the auditory disorders are diagnosed, the less likely they are to affect speech formation [24]. Unilateral bradyacuasia is a relatively common problem found in newborn screening. These children have lower linguistic and verbal IQ scores than their siblings with normal hearing [25]. Acute otitis media not diagnosed in time in young children can also lead to middle ear infections and hearing loss [26].

Iranian scientists, in their work "Influence of early intervention on the development of speech in children with hearing impairments," confirm that timely diagnosis and correction of disorders contribute to more favorable development of the child's language skills [27]. This result was also confirmed by Alam et al. (2021) [28].

Mental disorders. In pediatric psychiatric practice, speech disorders are one of the most common reasons for visiting specialists. Speech impairment or even alalia is a common symptom in autism spectrum disorders (including autism) that can cause significant social, communication, and behavioral problems in children.

Three standard criteria should be considered in the diagnosis of autism, namely, qualitative impairment of social interaction, stereotypical behavior, and absence or impairment of reciprocal communication responses. This triad includes several dozen manifestations of the disease, which can replace each other, manifest themselves differently in different children, and be misinterpreted even by experienced specialists; therefore, in case of doubts or an incomplete "set" of signs, a working diagnosis of "autism-like disorders" is sometimes made with a recommendation for further case follow-up. Speech disorders in children with autism are specific and varied from babbling and "clanging" to perseverative-echolalia, from whispering subtonal to sharp high-tonal, and from imitative to spontaneous monologue speech [29, 30].

The lack of speech in elective mutism is selective and depends on the environment. Elective mutism usually occurs in early childhood. It is characterized by an inability to speak under certain conditions e.g., in kindergarten, with some specific people, it can be combined with a high order of intelligence, which is not possible to test because of the maladaptive nature of the impairments [31, 32]. With mental retardation, speech impairment is part of the general cognitive deficit. The totality of disorders is its distinctive feature. In addition to speech, the intellectual–amnestic, emotional–volitional, mental, perceptual spheres, as well as self-consciousness, are also affected [33].

Children with attention-deficit hyperactivity disorder are more likely to have language disorders. Their inattention and impulsiveness can limit their ability to learn and practice language skills [34]. A certain difficulty for diagnostics is presented by absence or poor speech in the so-called alexithymia, which is the inability to express the desired idea verbally. Assessment of alexithymic speech disorders should take into account indicators such as the child's inability to express his/her feelings in words, weak imagination, tendency to a behavioral response, lack of depth of relationships, desire to manipulate, and selective adaptation to external relations [35, 36].

Neurological disorders. Neurological pathology possibly occurs with speech and language disorders. Thus, children with cerebral palsy have significant speech and language disorders. These include dysarthria, developmental speech delay, and alalia. In infantile cerebral palsy, not only the sound pronunciation is disturbed but also the voice, respiration, and tempo-rhythmic component of speech change [37]. Children with bilateral spastic or dyskinetic cerebral palsy and insufficiently developed conversational speech by age 2 years have the highest risk of problems with speech and communication at age 5 years [38].

Speech development disorders in children are also detected in various forms of epilepsy. Zavadenko et al. (2018) distinguished conditionally three possible variants of the relationship between epilepsy and speech development disorder: (1) they can be present simultaneously but independent of each other, (2) they be a consequence of the same pathological process in the CNS, and (3) epilepsy may cause speech development disorders [39].

Speech disorders can occur after traumatic brain injuries. A study revealed changes in the phonatory utterance presentation, stuttering, dysarthria, developmental speech delay, and aphasia [40].

Speech disorders due to hereditary pathology. Many genetic factors that interact with each other and with environmental factors play a key role in a person's ability to develop language and use it successfully [41]. The lack of speech, speech development disorders, and regression of acquired speech skills are often detected in patients with various hereditary diseases. They can be secondary to chromosomal diseases, hereditary monogenic diseases, hereditary metabolic diseases, and hereditary speech disorders and are combined with developmental delay, mental handicap, and behavioral disorders.

Examples of several syndromes from the group of chromosomal diseases in which speech disorders are common include Angelman syndrome (caused by deletions in the chromosomal region 15q11.2–q13, less often by changes in the *UBE3A* gene) [42] and Williams syndrome (caused by deletions of the chromosome 7 long arm in the chromosomal region 7q11.22) [43].

Rett syndrome [changes in the *MECP2* (Xq28) genes in nearly 90% of cases and *FOXG1* (14q13)] is an example of severe speech disorders caused by hereditary monogenic syndromes, and it is accompanied by partial or complete loss of acquired (expressive) speech skills [44].

Hereditary speech or language disorders include childhood speech apraxia or speech and language impairment in orofacial dyspraxia caused by abnormalities in the *FOXP2* gene on chromosome 7q31, which are part of a complex interaction of transcription factors involved in the neurogenesis. The type of inheritance is autosomal dominant.

The main clinical manifestations of the disease are dyspraxia, impaired speech development, inability to use grammar rules, agrammatical speech, articulation defects, impaired pronunciation, and incomprehensible speech, and some children may have a "global" developmental arrest (associated with speech, cognitive, gross, and fine motor abilities), as well as behavioral disorders [45].

In the literature, 19 candidate genes, such as *CMIP, ATP2C2, CNTNAP2,* and *NFXL1,* are associated with common forms of specific speech disorders. *FOXP2* is involved in the formation of a monogenic form of speech and language impairment. *DYX1C1, KIAA0319, DCDC2,* and *ROBO1* are involved in the development of dyslexia.

Changes in *SRPX2* and *GRIN2A* lead to the development of the hereditary forms of epilepsy, speech apraxia, and epileptic aphasia, while changes in *FOXP1* result in mental retardation with speech impairment and autistic traits.

A pathogenic nucleotide variant in *CNTNAP2* in a homozygous and compound heterozygous state has been identified in patients with Pitt–Hopkins syndrome. Changes in *DDX3X* lead to an X-linked syndromic intellectual disability (DDX3X syndrome), dyspraxia, and severe speech impairment. In *GRIN2B, ERC1, SETBP1, CNTNAP5, DOCK4, SEMA6D*, and *AUTS2*, rare deletions or translocations contribute to speech, language, and/or reading impairments [46].

Other variants of genes may be of interest for studying the neurobiology of human speech, including information on gene functions and phenotypes associated with gene disruption in humans [47].

Social factors. The socioeconomic status of the family is an important predictor of speech or language development in children. Studies have shown a negative relationship between family poverty and speech and language formation in children [48]. The influence of the low socioeconomic status of the family on speech retardation in children was also noted [49]. However, Mondal et al. (2016) denied such relationships [15]. Along with the low socioeconomic status of the family, other unfavorable social factors have also been identified, such as irregular preschool education, having two or more brothers and sisters [50], and lack of higher education of the parents [51].

Recent findings reveal that the social structure of the family, attitude of the mother to the child, and level of the mother's anxiety has a significant effect on the development of the child's speech [52]. Studies revealed that street children [53, 54] or children subjected to violence are more likely to have speech or language impairments, and young children are the most vulnerable [54]. A conflict situation in the family and pedagogical neglect are significant risk factors for the development of speech or language retardation in children [15].

Influence of contemporary digital devices on speech development of children. In recent years, children often and for a long time use modern electronic devices, namely, gadgets (computers, tablets, etc.), which contribute to the developmental speech delay in children at an early and preschool age [55, 56].

Korean scientists have shown that speech retardation increases 2.7 times in 2-year-old children who watched TV for 2–3 h a day, that is, those who watched TV for >3 h in a row had a risk of increasing proportionally to the time spent [57]. A significant link was also found between mobile media usage and speech latency. An increase in the time of using mobile devices by 30 min per day in 18-month-old children (from an average of 15 min per day) is associated with a 2.3-fold increase in the risk of delayed development of expressive speech [58]. A study conducted in children aged 18–36 months showed that long-term exposure to digital devices is associated with a decrease in language abilities, regardless of age, gender, and socioeconomic status of the family [59].

Conclusion. Thus, many risk factors are associated with speech and language impairment (retardation) in preschool children. Perinatal risk factors include early organic damage to the CNS, aggravated antenatal period (stress, alcohol, and drug abuse by the mother), prematurity, extremely low and very low birth weight, sepsis, patent arterial duct, neurological disorders, hyperbilirubinemia, hypoglycemia, hypoxia, and respiratory distress syndrome.

Anatomical defects in the structure of the articulatory apparatus are most often associated with defects in the development of the upper jaw. Hearing impairment is one of the main causes of speech and language disorders.

Mental disorders are most often associated with autism spectrum disorders (including autism), elective mutism, mental handicap, attention-deficit hyperactivity disorder, and alexithymia. Neurological disorders are often associated with infantile cerebral palsy, various forms of epilepsy, and craniocerebral injuries.

Speech and language disorders are caused by various hereditary diseases, such as chromosomal diseases, hereditary monogenic diseases, hereditary metabolic diseases, and hereditary speech disorders, which can be combined with developmental delay, mental retardation, and behavioral disorders.

The most significant unfavorable social factors include the irregularity of preschool education, having of two or more brothers and sisters in the

family, patient's lack of higher education, low economic status of the family, attitude of the mother to the child, conflict situation in the family, pedagogical neglect, as well as the child's prolonged use of digital devices.

Knowledge of risk factors can improve the management of a strategy aimed at preventing speech or language disorders in children and contributing to the education of their parents.

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