

Early Screening Of Neurodevelopmental Disorders In Preschool Children Living In The Aral Sea Region

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Abstract: Neurodevelopmental disorders in early childhood remain one of the leading medical and social problems worldwide. Delayed psychomotor and neuropsychological maturation significantly affects cognitive abilities, speech formation, adaptive behavior, and social integration of children. Environmental factors, adverse perinatal conditions, and chronic ecological stress may contribute to disturbances in child development, especially in ecologically unfavorable territories such as the Aral Sea region.

The aim of the study was to assess the effectiveness of developmental screening methods for the early identification of neurodevelopmental disorders among preschool children living in the Aral Sea region.

Materials and methods. The study included 720 children aged 1–6 years who underwent routine preventive examinations in outpatient clinics and preschool institutions of the Republic of Karakalpakstan. Neuropsychological development was evaluated using the Denver Developmental Screening Test II (DENVER-II). Four developmental domains were analyzed: gross motor skills, fine motor coordination, speech and language development, and personal-social adaptation.

Results. Normal neurodevelopment was identified in 86.8% of examined children, whereas developmental delay was detected in 13.2% of cases. The highest prevalence of delayed neuropsychological development was observed among children aged 3 and 6 years. Impaired development was associated with reduced speech abilities, delayed motor coordination, cognitive dysfunction, and impaired adaptive behavior. Follow-up examination after corrective recommendations demonstrated partial improvement in children with questionable developmental status.

Conclusion. Early developmental screening is an effective approach for identifying neurodevelopmental abnormalities in preschool children. Comprehensive evaluation of psychomotor development allows timely rehabilitation and preventive interventions, particularly in children exposed to unfavorable ecological and perinatal factors.

Keywords: Children, neurodevelopmental disorders, psychomotor development, Denver II test, preschool children, Aral Sea region.

Introduction: Neuropsychological and psychomotor development of children represents one of the most important indicators reflecting the functional state of the central nervous system and the general health of a child. Disorders affecting speech formation, cognitive abilities, motor coordination, and adaptive-social

functioning frequently lead to learning difficulties, emotional instability, and social maladaptation during later childhood and adolescence [1,2].

According to modern pediatric and neurological studies, disorders of the nervous system occupy one of the leading positions in the structure of childhood

disability. Approximately half of all cases of childhood disability are associated with nervous system pathology, while perinatal damage of the central nervous system remains one of the principal causes of developmental delay [3,4]. Children born under conditions of complicated pregnancy, intrauterine hypoxia, prematurity, intrauterine infection, or nutritional deficiency are considered to be at particularly high risk for neurodevelopmental abnormalities [5].

In recent years, increasing attention has been paid to the impact of environmental and ecological factors on child health. The Aral Sea region is characterized by significant ecological instability associated with soil salinization, atmospheric pollution, deficiency of clean water resources, and adverse climatic conditions. Chronic exposure to ecological stressors may negatively influence both physical and neuropsychological development in children [6,7].

Early diagnosis of developmental disorders is considered one of the key approaches for reducing long-term neurological complications. Screening methods used during preschool age enable healthcare specialists to identify children belonging to risk groups and to initiate corrective interventions before stable cognitive and behavioral impairment develops [8]. Among the available screening tools, the Denver Developmental Screening Test II (DENVER-II) is widely applied because of its simplicity, accessibility, and high diagnostic value [9].

The present study aimed to evaluate the effectiveness of neurodevelopmental screening among preschool children living in the ecologically unfavorable Aral Sea region.

Materials and Methods

The study was carried out in outpatient clinics and preschool educational institutions of the Republic of Karakalpakstan. A total of 720 children aged from 1 to 6 years who were born and permanently resided in the Aral Sea region were included in the investigation.

All children underwent routine preventive examinations conducted by pediatricians and neurologists. Assessment of neuropsychological development was performed using the Denver Developmental Screening Test II (DENVER-II), adapted for practical pediatric examination.

The Denver II test evaluates gross motor development, fine motor-adaptive skills, speech and language functions, as well as personal-social adaptation.

The child's developmental level was assessed according to age-specific tasks recommended by the DENVER-II methodology. Development was considered normal

when the child successfully completed tasks corresponding to 25–75% of age standards. Developmental delay was diagnosed when the child failed to complete tasks successfully performed by 90% of peers of the same age group. Advanced development was registered when the child completed tasks achieved by only 25% of peers.

Children with delayed or questionable developmental results were classified into a risk group for persistent neuropsychological dysfunction. Parents received detailed recommendations regarding developmental exercises, speech stimulation, psychological support, and additional consultation with neurologists, speech therapists, and neuropsychologists.

Statistical analysis of obtained data was performed using standard biomedical statistical methods. Quantitative indicators were presented as percentages and mean values.

Results

Among the 720 examined children, normal neuropsychological development was observed in 86.8% of cases, while developmental delay was diagnosed in 13.2% of children.

The proportion of children with age-appropriate neurodevelopment according to DENVER-II testing was 80.2% among one-year-old children, 84.8% among two-year-old children, 77.4% among three-year-old children, 82.1% among four-year-old children, 82.8% among five-year-old children, and 75.0% among six-year-old children.

The prevalence of delayed neurodevelopment differed depending on age. Developmental delay was identified in 10.1% of children aged 1 year, 8.9% among two-year-old children, 16.2% among children aged 3 years, 11.4% among four-year-old children, 7.8% among five-year-old children, and 14.1% among children aged 6 years.

The obtained findings demonstrated that impaired psychomotor development negatively affected cognitive performance, speech acquisition, motor activity, adaptive behavior, and emotional-social interaction. The greatest frequency of developmental abnormalities was detected among children aged 3 and 6 years.

Detailed analysis of developmental domains revealed substantial reduction of indicators in all examined groups. Gross motor impairment was more common in younger children, while deficits in fine motor coordination and speech development were more pronounced in preschool-age children. Personal-social maladaptation was observed mainly in older children.

Children demonstrating delayed or questionable developmental indicators were included in a high-risk

group for persistent cognitive dysfunction. Parents of these children were informed about the necessity of corrective developmental programs aimed at improving motor coordination, speech activity, and social adaptation.

After three months, repeated examination was performed in 141 children from the risk group. Persistent psychomotor delay remained in all children with previously confirmed developmental impairment (n=81). Among children with initially questionable developmental status (n=60), normal neurodevelopment was later identified in 46 children, whereas 14 children continued to demonstrate signs of developmental delay.

Discussion

The results of the present study confirm that developmental disorders among preschool children remain an important pediatric and neurological problem in the Aral Sea region. Environmental stressors, adverse social conditions, and complications during the perinatal period may contribute to impaired maturation of the nervous system and delayed neuropsychological development.

The identified prevalence of developmental delay corresponds to findings reported by other international and regional investigations [10,11]. Previous studies demonstrated that children exposed to unfavorable prenatal and environmental factors are more likely to develop speech impairment, behavioral disorders, learning difficulties, and reduced adaptive functioning [12].

One of the major advantages of developmental screening is the possibility of detecting early abnormalities before severe cognitive and neurological impairment becomes clinically apparent. The DENVER-II test allows practical and relatively rapid assessment of different developmental domains in preschool children and can be successfully implemented during routine pediatric examinations.

The present study also demonstrated the importance of repeated follow-up assessment. Some children with initially questionable developmental indicators showed positive dynamics after parental counseling and corrective interventions. These findings confirm the necessity of early preventive and rehabilitation programs.

Children living in ecologically unfavorable territories require regular developmental monitoring because chronic environmental exposure may negatively affect neurocognitive maturation. Timely identification of developmental abnormalities enables early medical, psychological, and pedagogical intervention aimed at

improving long-term outcomes. The obtained findings emphasize the importance of implementing developmental screening programs in primary pediatric healthcare, particularly in ecologically vulnerable regions.

Conclusion

The present study demonstrated that neurodevelopmental disorders remain relatively common among preschool children living in the Aral Sea region. Delayed psychomotor and neuropsychological development was mainly associated with impairments in speech formation, fine motor coordination, cognitive functioning, and social adaptation. The highest frequency of developmental abnormalities was observed in children aged 3 and 6 years.

The Denver II developmental screening test proved to be an effective and practical method for the early identification of children at risk for neurodevelopmental disorders during routine pediatric examinations. Early detection of developmental delay allows timely implementation of corrective, rehabilitation, and preventive measures aimed at improving long-term neurological and social outcomes.

Children exposed to unfavorable ecological and perinatal factors require continuous medical observation, multidisciplinary assessment, and individualized rehabilitation programs. Regular developmental monitoring in ecologically disadvantaged regions may contribute to reducing the prevalence of persistent cognitive and behavioral impairment in children.

References

1. Zavadenko N.N., Davydova L.A., Zavadenko A.N. Neuropsychological development of children born extremely preterm with extremely low and very low birth weight. S.S. Korsakov Journal of Neurology and Psychiatry. 2018;118(11):49–55.
2. McCoy D.C., Peet E.D., Ezzati M., Danaei G., Black M.M., Sudfeld C.R., et al. Early childhood developmental status in low- and middle-income countries: national, regional, and global prevalence estimates using predictive modeling. PLoS Medicine. 2016;13(6):e1002034. doi:10.1371/journal.pmed.1002034
3. Olusanya B.O., Davis A.C., Wertlieb D., Boo N.Y., Nair M.K.C., Halpern R., et al. Developmental disabilities among children younger than 5 years in 195 countries and territories, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. The Lancet Global Health. 2018;6(10):e1100–e1121. doi:10.1016/S2214-

109X(18)30309-7

4. Karkashadze G.A., Namazova-Baranova L.S., Vishneva E.A., et al. Digital devices and cognitive functions in children. *Current Pediatrics*. 2021;20(6):506–520. doi:10.15690/vsp.v20i6.2357
5. Grantham-McGregor S., Cheung Y.B., Cueto S., Glewwe P., Richter L., Strupp B. Developmental potential in the first 5 years for children in developing countries. *The Lancet*. 2007;369(9555):60–70. doi:10.1016/S0140-6736(07)60032-4.
6. Rybalko O.N. Prognostic significance of psychomotor scales in diagnosing consequences of hypoxic-ischemic CNS lesions in premature newborns. *Tavrisheskiy Mediko-Biologicheskii Vestnik*. 2019;22(3):111–118.
7. Bulbul A., Kaya D.K., Keskin G.Y., Kose G., Bulbul L., Elitok G.K., et al. Midterm neuromotor development results of preterm babies less than 34 weeks gestational age. *Medical Bulletin of Sisli Etfal Hospital*. 2020;54(3):337–345. doi:10.14744/SEMB.2020.06881
8. Charan G.S., Vagha J. Study of perinatal factors in children with developmental delay. *International Journal of Contemporary Pediatrics*. 2017;4:182–190. doi:10.18203/2349-3291.ijcp20164602
9. Denver Developmental Materials. Denver II Developmental Screening Test. Available from: <http://www.hogrefe.co.uk/denver-ii-developmental-screening-test.html>
10. Formiga C.K.M.R., Vieira M.E.B., Fagundes R.R., Linhares M.B.M. Predictive models of early motor development in preterm infants: a longitudinal prospective study. *Journal of Human Growth and Development*. 2017;27(2):189–197. doi:10.7322/jhgd.111288
11. World Health Organization. Improving Early Childhood Development: WHO Guideline. Geneva: WHO; 2020.
12. Black M.M., Walker S.P., Fernald L.C.H., Andersen C.T., DiGirolamo A.M., Lu C., et al. Early childhood development coming of age: science through the life course. *The Lancet*. 2017;389(10064):77–90. doi:10.1016/S0140-6736(16)31389-7