

# Evaluation of Intellectual Development of Children after Traumatic Brain Injury

Artikova M. A., Avezov S. K.

Bukhara State Medical Institute, Bukhara, Uzbekistan

**Abstract** Childhood illnesses, especially traumatic brain injury (TBI), remain a critical public health problem in Uzbekistan. TBI accounts for a significant proportion of childhood injuries and often causes severe cognitive impairment that affects quality of life. **Objective:** To determine the intellectual status of children with TBI depending on the period and severity of injury using Raven's matrices. **Methods:** The study included 125 children aged 6-9 years with various degrees of TBI. Raven's tests were used to assess cognitive functions. **Results:** Intellectual functions in children with TBI are significantly impaired in the subacute and late periods, especially in younger children. In older children, impairments are less due to brain maturity. **Conclusion:** TBI leads to intellectual impairments that may be more pronounced in the subacute period, but also have the potential for recovery.

**Keywords** Intellectual state of children, Raven matrices, Traumatic brain injury, Disabled person

## 1. Introduction

The health of children has always been and remains the most important concern of the health care of the Republic of Uzbekistan. In the structure of childhood morbidity, trauma occupies one of the first places and in almost half of its cases it is a traumatic brain injury (TBI), from which the mortality rate is very high [1,6,9].

In the structure of childhood injuries, TBI accounts for 21-55% and ranks first among all mechanical injuries. It is known that 40-60% of children who have suffered a TBI develop various residual complications; their frequency directly depends on the severity of the brain damage. TBI has not only clinical but also social significance, since more than half of the victims become disabled of varying severity every year. Subsequently, these victims become incapacitated in adulthood [2,6].

In the acute and late periods of TBI, the patient's condition may not always correspond to the severity of the injury. Often, with a mild degree of injury, persistent mental disorders appear, asthenic conditions, epileptic seizures are observed, and various somatic pathologies are added to them (disorders in the cardiovascular and respiratory systems, gastrointestinal tract) [3,5,9].

Most researchers point to a complex relationship between pathogenetic processes developing in the central nervous system, leading to cognitive impairment in TBI. To date, the study of the pathogenesis of TBI, its complications in the form of cognitive impairment and the development of

pathologically based therapy are still far from complete.

Disorders of mental and cognitive activity of the child, as a consequence of TBI, are manifested in clinical form, can manifest in acute, subacute and remote periods. Anxiety and apathy in the acute period can later be replaced by neurotic and mental disorders. It is important to timely diagnose cognitive disorders in these children [1,4,7,8,10].

One of the methods for determining the cognitive status of children at different periods of development is the Raven's Standard Progressive Matrices (SPM) test, which differentiates subjects according to their level of intellectual development [5].

**The aim of the study** is to determine the intellectual state of children using the Raven matrix depending on the period and severity of TBI.

## 2. Material and Methods of the Study

We examined 125 children who had suffered TBI: concussions, mild to moderate contusions, who were treated in the department of surgical injuries of childhood of the Bukhara branch of the Russian Scientific Center for Emergency Medicine at the age of 6-9 years. The ratio of girls to boys was 1:1.8. The test - Raven's standard progressive matrices (SPM) is used to determine the cognitive status of children at different periods of development.

Raven's Progressive Matrices are designed to determine the level of mental development in children of mental age (grades 1-4 of a comprehensive school). They can be used on subjects with any language composition and sociocultural background, with any level of speech development.

### 3. Results of the Study Discussion

Normally, the intellectual level of children is directly proportional to their age. We examined children with TBI aged 6-9 years in the intermediate and late periods (Table 1). A special problem of TBI in children is that this age group is characterized by a relatively high frequency of TBI, and, to a greater extent, the severity of subsequent complications. In infancy and toddlerhood, children usually get injured due to falling from a height. In older children, injuries from a blow to the head and street injuries are additionally added. Due to ethical considerations, we did not conduct cognitive tests on children in the acute period of the disease.

**Table 1.** Indicators of intellectual functions and mental disorders depending on age children. (average Raven test scores), points

Category of subjects	Age of children			
	6 years	7 years	8 years	9 years
Healthy children	26-35	27-35	29-35	30-35
Mental retardation (MR)	13-25	16-26	19-28	20-29
Mental retardation (oligophrenia)	0-12	0-15	0-18	0-19

Patients who received scores below the norm - 1.2-2 times, are assessed as mental retardation, i.e. they lag behind in mental development. If this indicator is even lower, then it is diagnosed as oligophrenia.

We used the Raven test in 6-9 year old children to determine their intellectual status at different periods of TBI (Table 2).

**Table 2.** Indicators of intellectual functions and mental disorders depending on age in children in the intermediate and late periods of TBI (average Raven test scores), points

Subject groups	Age of children			
	6 years	7 years	8 years	9 years
Control group	27	30	32	34
	26	32	33	33
Concussion (comparison group).	12^^	14^^	25^	29^
	15^	16^	27^	30
Mild brain contusion	12^^	13^^	17^	21^
	14^	17^	18^	23^
Moderate brain contusion	10^^	14^^	16^	20^
	13^	15^^	18^	22^

Note: The numerator indicates the results of children in the intermediate period, the denominator indicates the results in the late period. ^ - mental retardation, ^^ - oligophrenia.

It was established that older children in the late period of TBI have less impairment of intellectual function. This depended on the functional and morphological maturity of the child's brain. Damage to immature brain structures disrupts their maturation, which delays psychomotor development. Therefore, the most pronounced and reliable differences in the degree of preservation of intellectual functions were found in patients aged 8 and 9 years in the late period; the least pronounced - in the intermediate period in children aged 6 and 7 years.

### 4. Conclusions

Thus, in TBI, cerebrospinal fluid-dynamic disturbances lead to an ischemic-hypoxic state of the brain, and subsequently the child's cognitive activity suffers. In the subacute period, especially in children aged 6-7 years, intellectual functions slow down, possibly due to morpho-functional immaturity of the brain. Manifestations of mental retardation (oligophrenia) are most pronounced in moderate brain contusions in the intermediate period. In children with TBI, intellectual impairments are much more pronounced in the intermediate period than in the late period ( $P < 0.05$ ). With this pathology, cognitive impairments in children can be reversible.

With adequate treatment, restoration of mental capacity is possible, but depends on the child's age and the severity of the injury. Pedagogical assistance, support from parents and relatives play a major role in rehabilitation. The addition of any infection, the presence of other somatic diseases aggravates the child's cognitive impairment.

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