

Physiological Mechanisms of The Relationship Between Memory, Attention, and Arousal in Children Diagnosed with Autism

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Autism, Attention, Memory, Behaviour, Depression, Anxiety Index, Psychological Testing Methods

ABSTRACT

Autism is a developmental disorder with an early onset and lifelong duration that impairs social interaction and communication, with the condition being repeatedly diagnosed. To gain scientific knowledge about autism, one must observe these patients, perform a series of investigations and examinations, and finally obtain a general title. The first stage of getting to know children diagnosed with autism is one of the most important conditions for studying their psychology and inner world. Therefore, studying the psychology of children diagnosed with autism is also considered a responsible task for psychologists. The article presents the results of assessing the level of anxiety, stress, depression, attention and memory indicators in children with autism, which is an actual problem in recent times, in different age groups.

The studies were conducted at two different locations: the Special Support, Special Training and Rehabilitation Centre (Tatvan district of Bitlis, Turkey) and the Psychological Centre Psychosocial Rehabilitation and Development Centre "PRIM" (Baku, Azerbaijan). Conducting studies in two different regions will reveal whether there is a difference between patients diagnosed with autism. The study examined children diagnosed with autism aged 6-12 years of both sexes (44 in Turkey; 51 in Azerbaijan). The results obtained in the study were compared with normal test limits. Psychological testing was conducted on an individual basis, and for the comprehensive study, the same child was tested repeatedly, with a certain frequency and with special attention. Although more boys than girls were included in the confirmed cases, since the aim was not to study gender differences, care was taken to obtain generalisable results.

The attempt to clarify a complex topic such as stress in a broad topic such as autism characterises a very complex situation. Therefore, we have endeavoured to obtain more accurate results through the use of comprehensive tests.

The main objective of the research work is to obtain certain results by using comprehensive psychological research methods in determining the level of stress and anxiety in children diagnosed with autism and to study the main characteristics of autism by comparing them with psychological indicators considered within the normal range.

The results of studies conducted in Turkey and Azerbaijan showed the presence of low levels of attention and memory processes, behavioural disorders, aggressive and depressive behaviour in all age groups against the background of increased arousal. Children diagnosed with autism exhibit similar symptoms regardless of their geographical location, indicating that this disease has common characteristics regardless of national, racial, religious, and regional peculiarities.

1. Introduction

The topic of autism spectrum disorders is vast and complex. To fully comprehend this pathology, a comprehensive approach is essential. When studying autism through literature, it is crucial to analyse the causes, results, characteristics, role in society, communication with others, and more. Additionally, it is vital to consider the impact of stress and anxiety in patients with autism. Despite the numerous scientific studies that have been conducted on the subject of stress, cognitive processes and arousal levels in children diagnosed with autism, the underlying mechanisms remain poorly understood, with numerous unresolved issues. In this context, the presented article can be considered one of the most significant scientific studies on the psychological state, behaviour and anxiety levels of children diagnosed with autism [1,3,19,28,35].

Autism is a psychological developmental disorder that affects communication, social interaction and behaviour. The interest in the early diagnosis of autism is closely related to the awareness of both professionals and families. Consequently, there are individual differences in autism, including age, gender, appearance, personality traits, etc., which enable it to be distinguished from others. In fact, a

diagnosis of autism is not a disadvantage, but a difference. Those diagnosed with autism exhibit a range of symptoms that can vary from mild to severe. These individuals also display repetitive and compulsive behaviours. Autism is considered a developmental disorder with neurobiological characteristics [6,15,32,48].

Upon analysis of opinions on the definition of autism, it becomes evident that the condition is caused by a complex interplay of genetic, social, environmental, and other factors. A comprehensive study of brain anatomy and physiology, histology, and biochemical parameters further substantiates the notion that autism is a neuropsychiatric disorder. There is substantial evidence that brain dysfunction and social impairments have a negative impact on an individual's relationships, communication skills, interests and behaviour. However, in all of these studies, it is not possible to determine with certainty which part of the brain is responsible for the observed changes in autism. The current state of knowledge regarding autism is insufficient to prevent the disorder or to provide effective treatment for its main symptoms [5,36,41,54]

The term 'autism' is used to describe a range of conditions characterised by differences in development, communication and social interaction, as well as the presence of unusual behaviours, such as repetitive behaviours or a predilection for a narrow range of interests. Autism is a disorder of brain development that begins before the age of three and persists throughout life, impairing social interaction and communication and resulting in restricted and repetitive behaviour. Early warning signs and symptoms of autism include:

- a) Deficits in social interaction and communication, limitations in behaviour, interests and activities, stereotyped and repetitive actions [43,46];
- b) Delayed or abnormal functionality of at least one of social interaction, language used in communication or symbolic/imaginative play skills before age 3;
- c) Manifesting various temptations [1,42,56].

In order to facilitate early diagnosis and intervention, it is crucial to consider the symptoms that manifest immediately after birth between the ages of 12 and 18 months. It is particularly challenging to diagnose ASP in children under the age of 24 months. These symptoms can be observed by parents or by nurses and physicians during a brief examination. It is important for parents and doctors to recognise that every child is unique and that their rate of development may vary [48,50,53]. If parents notice that their child is lagging behind the typical developmental stage and developing more slowly than their peers, they should immediately share their concerns with their paediatrician.

Early symptoms of autism in children include:

- Lack of facial expression after six months.
- Absence of response to auditory stimuli, smiles and facial expressions after nine months.
- Inability to smile, point fingers at something or a person, or make gestures like "goodbye" from the twelfth month.
- Absence of vocalisation from the sixteenth month.
- From the 24th month onwards, the child demonstrated an inability to construct simple two-word sentences, indicating a developmental delay. This was evidenced by the child no longer saying some words he had previously used or behaving in a manner that differed from his previous patterns of behaviour [71].

Another source [59], lists the early symptoms of the condition as follows:

- A. Social interaction: Failure to make proper eye contact; Lack of warm and cheerful facial expression; Lack of interest or sharing of pleasure; Lack of response when his name is called.

- B. Communication difficulties: Inability to gesture; Lack of coordination of speech communication; Unusual size (change in pitch, strange intonation, irregular rhythm, unusual sound quality).
- C. Repetitive behaviour and limited interests: Repetitive actions with objects; Body posture or repetitive movements with hands, arms or fingers [1,52,55,58].

Although deficits in social interactions, limitations in verbal and communication skills, and compulsive and impulsive behaviour are common features, the extent and cognitive characteristics of these observable features can vary from person to person, and each child with autism is unique. There are some recognised cases in the literature that are associated with the diagnosis of autism. Some special cases are mentioned below: It is known that the majority of patients diagnosed with autism [approximately 40%] have varying degrees of mental retardation and learning difficulties [2,8,14,20]. However, most of the psychological tests used are not suitable for people with autism. Consequently, it was proposed that adaptation skills should be evaluated concurrently with mental state. However, this perspective has since undergone a shift. Approximately 50% of individuals diagnosed with autism exhibit average intellectual development and, on occasion, remarkable memory, musical aptitude, and other exceptional cognitive abilities. It has been estimated that 40% of individuals diagnosed with autism are unable to utilise verbal communication skills to an adequate standard [16,24,29,38].

Behavioural problems are the most prevalent and are observed in individuals diagnosed with autism. These include self-stimulatory behaviours such as crying, screaming, aggressive behaviours that harm self or others, anger, stubbornness, tiptoeing, board tossing, hand clapping and repetitive movements. One in three children diagnosed with autism displays these behaviours. It is a common observation that individuals diagnosed with autism present with sleep problems. Similarly, feeding difficulties are also a prevalent issue in children diagnosed with autism. Behaviours such as refusal of solid food, chewing disorders, excessive food selection and, less commonly, overeating and eating inedible substances have been observed [1,4,18]. It has been demonstrated that additional psychiatric disorders are present in 40-70% of individuals diagnosed with autism. The most common diagnoses are depression, bipolar disorders, anxiety disorders, attention and memory disorders, and hyperactivity [13,27,30,42]. have also highlighted the issue of sexual development in individuals diagnosed with autism. The most significant challenge is the acquisition of appropriate social skills in relationships with the opposite sex, as well as the ability to navigate interpersonal dynamics. Behaviours such as genital touching, masturbation in inappropriate settings and contexts, touching the genitals of the opposite sex, hugging, kissing and touching are commonly observed in patients diagnosed with autism. Masturbation is more pronounced in individuals with stereotypical behaviour [1,37,45,50].

Given that autism is not a disease, its causes and manifestations are numerous. There is currently no cure [1,40,71] and the characteristics of autistic individuals can be divided into three groups:

- Deficits in social interaction,
- Inadequate verbal and communication skills
- Compulsive and unusual patterns of behaviour.

Children with social interaction deficits learn social interaction and new social skills by observing, modelling and imitating the behaviour of their peers, parents and other adults [22,26,33,49]. These skills, which usually develop naturally without any training, typically develop between 6 and 18 months of age. Children diagnosed with autism exhibit social competence and skills that differ from those of their peers with normal development. Some examples are: limited eye contact, limited attention in common interests, indifference to the actions of others, inability to socialise with desired people and peers, preference for solitude, lack of understanding of other people's feelings and thoughts, non-verbal forms of communication. such as physical touch, facial expressions, smile features such as limitations of use, limited commitment to key family members, difficulties in social interaction and social skills [3,7,10,25,34]. Children with autism who exhibit deficits in speech and communication

skills demonstrate delays and differences in developmental processes, ranging from non-verbal communication skills to the use of speech for interaction and communication. The following are the main features of this condition:

- Limitation in understanding signs such as gestures and facial expressions.
- Limited spontaneous conversation starters.
- Limited use of body language.
- Limited use of pronouns, especially “I” in the correct place.
- Limited perception and understanding of abstract and figurative words and expressions.

In addition to these characteristics, speech delay or inability to speak at all, inability to properly adjust the distance between the interlocutor and the person being spoken to, looking in different directions without making eye contact, or looking into the eyes of the interlocutor, the face is blunt and expressionless. It has been reported that approximately 50% of patients diagnosed with autism have deficits in expressive language skills [12,47,51]. These individuals tend to repeat words or sentences in a form of echolalic speech and to compose short sentences to express only one desire. In some cases, individuals with autism may develop unique speech patterns that include nonsense and special words [5,19,57]. Additionally, abnormalities in the formation of processes such as timbre, accent, rate, and rhythm of speech have been observed in the use of voice and fluency. Some patients diagnosed with autism have been known to speak as early as 4-5 years of age. However, their speech is either very loud or very quiet [9,17,39,41,44].

The literature review examined the study of autism, its principal and earliest symptoms, and the main characteristics of autism. The general result is that the earlier autistic patients are diagnosed, the faster they can be helped. With special care, it is possible to restore the social adaptation of these people and allow them to form as individuals. It is of great importance that the state pays special attention to patients diagnosed with autism, which is characterised by the disappearance of neuropsychiatric disorders and mental retardation [11,21,34]. Parental education can create conditions for early diagnosis of this disease and prevention of its complications. However, despite numerous scientific studies, the etiology and pathogenesis of autism are still not fully understood, and there are many unanswered questions [23,39]. For these reasons, the presented article is of great practical importance, and the results of the conducted experiments can be used by specialists in this field in the future.

2. Methodology

In the course of the study, psychological testing methods were employed. Thus, anxiety, depression, attention and memory were studied in all age groups diagnosed with autism. All subjects residing in Turkey and Azerbaijan were studied using the same tests. The following psychological tests were employed:

1. Tests used to measure levels of anxiety and depression:

- A. Beck Anxiety Inventory;
- B. Child Anxiety and Depression Scale (CADS-Y).

2. Tests used to measure attention and memory:

- A. Frankfurt Attention Inventory;
- B. “Shadow Matching” Attention Test;
- C. “Find the Gap” Attention Test;
- D. “Find the Different Part”;

- E. Labyrinth Test (determines attention level);
- F. “Find the Same” Attention Test;
- G. “Find 3 differences” Attention Test;
- H. “Memory by Description” - Visual Memory Level Determination

The obtained results were subjected to statistical analysis and presented in graphical form.

3. Result and Discussion

One of the primary objectives of scientific research in the field of autism is to determine the level of arousal in children with autism. To this end, two tests were employed. During the course of the testing process, all age groups under study were included, and a number of interesting findings were obtained. Thus, when applying Beck Anxiety Inventory to children diagnosed with autism living in Turkey, the following scores were obtained: 21 points for 6-year-old children, 20 points for 8-year-old children, 26 points for 10-year-old children and 24 points for 12-year-old children. The results of the arousal test for children diagnosed with autism living in Azerbaijan are as follows: 23 points for 6-year-old children, 25 points for 8-year-old children, 27 points for 10-year-old children and 25 points for 12-year-old children (Figure 1). The results for three-year-old children (Figure 1) are as follows: Despite residing in a distinct geographical region, all subjects exhibited elevated levels of anxiety. Adolescents (aged 12 years) exhibited the highest scores.

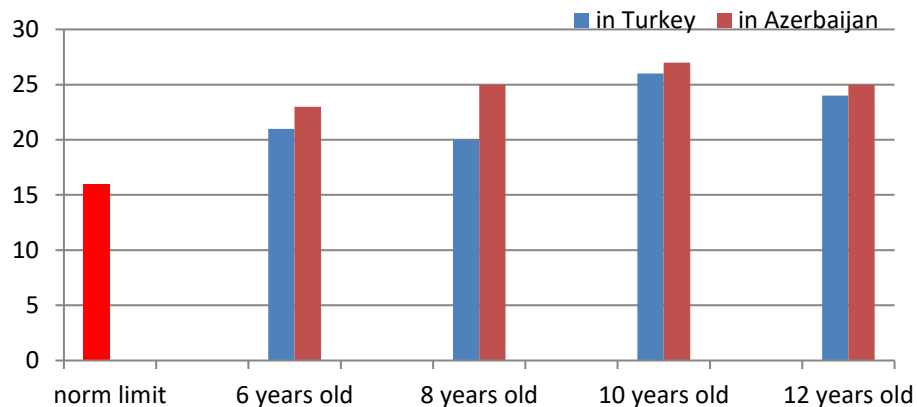


Figure 1: Beck Anxiety Test Results Applicable to Different Age Groups

The results of the Children's Anxiety and Depression Scale (CADS-Y) test are also of interest. The results of the aforementioned test conducted in Turkey revealed that the normal limit of anxiety levels in children aged six is 25 points, while those aged eight, ten and twelve exhibited anxiety levels of 27.33, 33.5 and 29.5 points, respectively. In children diagnosed with autism in Azerbaijan, the mean anxiety level was 29.05 points in 6-year-old children, 31.67 points in 8-year-old children, 35.64 points in 10-year-old children and 36.21 points in 12-year-old children.

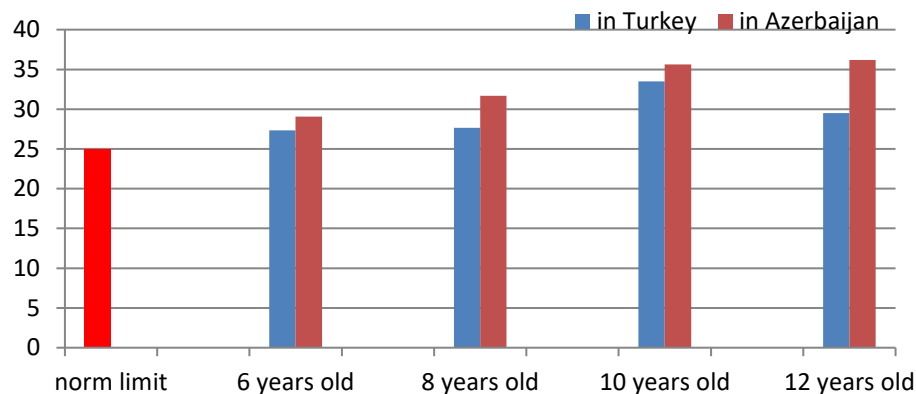


Figure 2: Results of the Child Anxiety and Depression Level (CADS-Y) Test Applied to Different Age Groups.

A comparison of the results (Fig. 2) revealed that the level of arousal was higher than normal in all age groups. This finding is consistent with the results of the Beck test, which indicated a higher level of arousal in adolescents. The observed increase in arousal may be attributed to both hormonal changes that occur during adolescence and an elevated level of cognitive activity. A high level of arousal is a prominent feature of children diagnosed with autism. It is evident that a high level of arousal can be observed in children with normal CNS and individual development, and that changes in cognitive processes and behaviour can be observed as a result. In order to determine the dependence of the studied indicators of memory and attention on the level of arousal, an attempt was made to analyse the data.

In the “Methodological Methods” section of the Article, it was noted that numerous attention and memory tests have been applied to children with autism. A significant number of these tests are designed to more accurately assess the level of attention, which is of particular importance for children with autism and is a leading factor in their mental performance.

The results of the Frankfurt Inventory also reveal interesting facts. While the limit of normality according to the literature is 33 points, 6-year-old children diagnosed with autism living in Turkey had 25 points, 8-year-olds had 26.3 points, 10-year-olds had 33.14 points and 12-year-olds had 33.5 points. The results of the Frankfurt Inventory indicate that 6-year-old children diagnosed with autism living in Azerbaijan had an average score of 21 points, 8-year-olds had an average score of 23.4 points, 10-year-olds had an average score of 30.05 points, and 12-year-olds had an average score of 30.7 points. A comparison of the results (Fig. 3) revealed that attention was observed to be weaker than normal in 6–8-year-old children, within normal limits and relatively high in 10–12-year-old children.

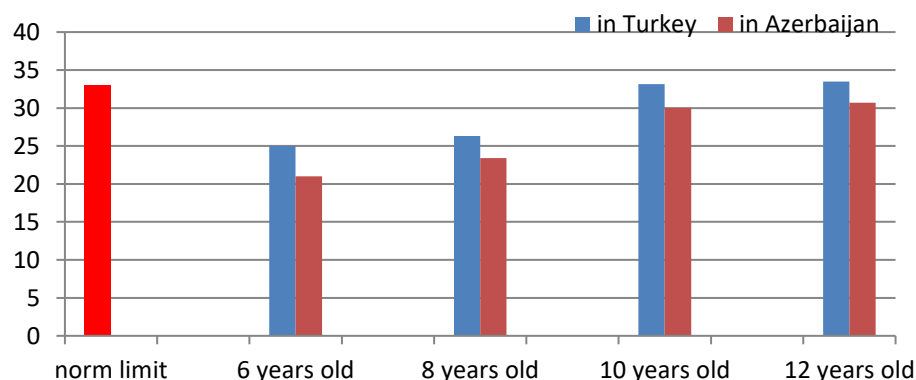


Figure 3: Results of the Frankfurt Attention Inventory Applied to Different Age Groups

The Shadow Matching Attention Test was also employed to assess cognitive abilities. In Turkey, children aged six diagnosed with autism exhibited an attention score of 2, while those aged eight demonstrated an attention score of 2.67, children aged ten exhibited an attention score of 3.41, and children aged twelve exhibited an attention score of 3.59. In Azerbaijan, the attention index level for 6-year-old children diagnosed with autism was 2 points, 8-year-old children had 2.5 points, 10-year-old children had 2.67 points and 12-year-old children had 2.9 points (Figure 4).

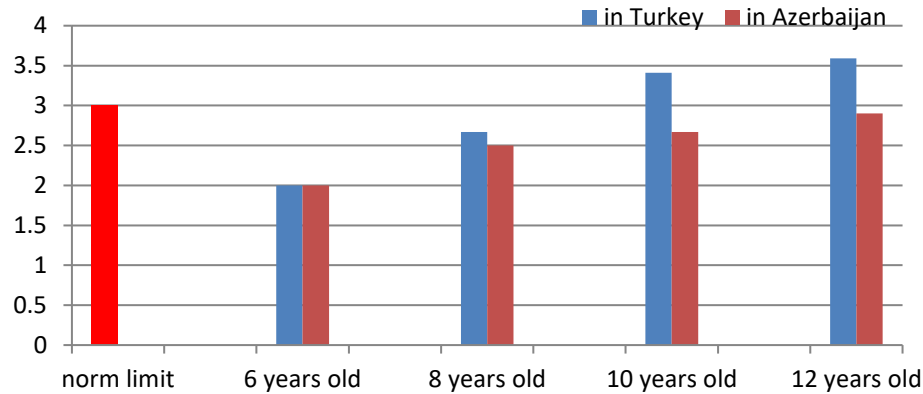


Figure 4: Results of the Shadow Matching Attention Test Applied to Different Age Groups

Given that the boundary of the norm is three points, an analysis of the results obtained revealed a low level of attention in children aged six to eight years old diagnosed with autism living in Turkey. However, this indicator was relatively higher than the norm in children aged ten to twelve years old. In contrast, the results obtained in children diagnosed with autism studied in Azerbaijan were recorded at a relatively lower level than the norm.

The results of the “Find the Gap” test were analysed in order to determine the attention level. The attention level was found to be 1.66 points for 6-year-old children diagnosed with autism living in Turkey, 3.33 points for 8-year-old children, 3.75 points for 10-year-old children and 2.25 points for 12-year-old children. In Azerbaijan, the attention index score for 6-year-old children diagnosed with autism was 1.5, 8-year-olds had an attention index score of 2.75, 10-year-olds had an attention index score of 3.6 and 12-year-olds had an attention index score of 3.08 (Figure 5). Given that the normal limit of this test is 5 points, the results obtained in all groups indicate a very low level of memory, with the results being approximately 45-50 per cent below the norm. The introduction of more complex tests in the testing process led to an increase in the number of errors, which was reflected in the results obtained.

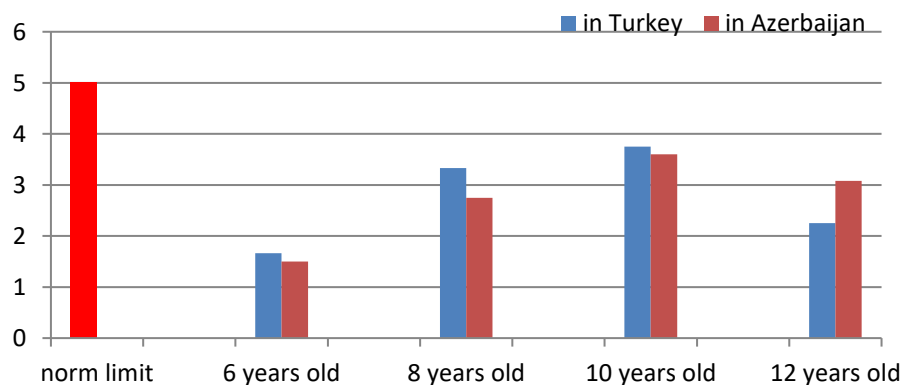


Figure 5. Results of the “Find the Gap” Attention Test Applied to Different Age Groups

The results of the “Find the Different Part” Attention Test were comparable to those of the previous stage. Consequently, given that the norm for attention levels is 4 points, the attention levels of 6-year-

old children diagnosed with autism living in Turkey are 3 points, 8-year-olds are 2.67 points, 10-year-olds are 3.5 points and 12-year-olds are 3.75 points. In Azerbaijan, the attention index for 6-year-old children diagnosed with autism was 2.5 points, 8-year-old children 2.58 points, 10-year-old children 3 points and 12-year-old children 3.54 points (Figure 6). These results indicate a subnormal level of attention, with poor attention noted in all age groups.

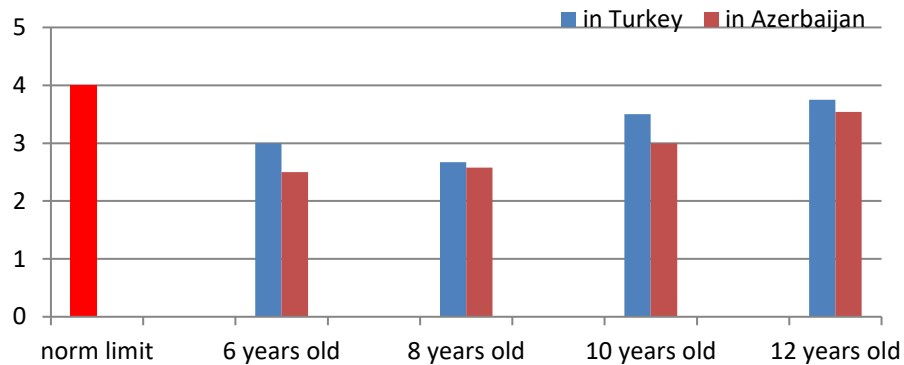


Figure 6. Results of the “Find the Differences” Attention Test Applied to Different Age Groups

One of the most intriguing tests is the “Labyrinth” Test. Upon analysing the results, it was determined that the level of attention in six-year-old children diagnosed with autism residing in Turkey was 1.67 points, eight-year-old children scored 3.33 points, ten-year-olds scored 3.75 points, and twelve-year-olds scored 3.5 points. In Azerbaijan, the level of attention index was observed in 6-year-old children diagnosed with autism, 8-year-olds (2.5 points), 10-year-olds (3.5 points) and 12-year-olds (3.5 points). These results are presented in Figure 7. Given that the norm is defined as a score of 5 points, results below this threshold of 5 points can be considered a natural phenomenon in autistic children.

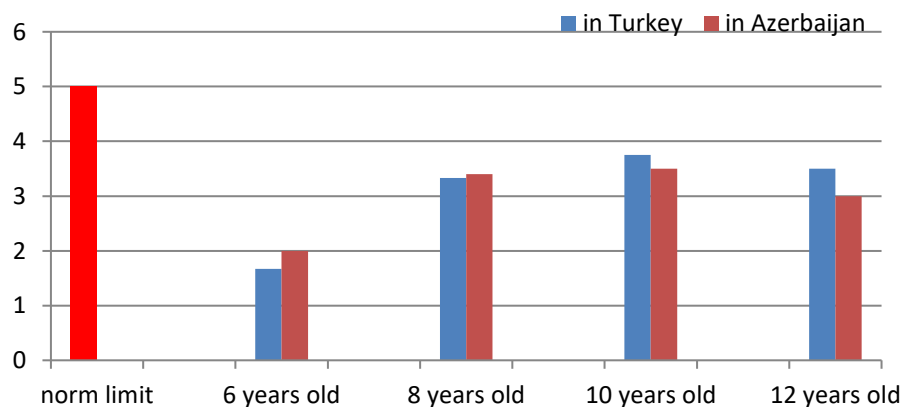


Figure 7. Results of the “Labyrinth” Attention Test Applied to Different Age Groups

The results of the subsequent test were comparable. While the typical range of the Find the Same test is 4 points, the attention level of 6-year-old children diagnosed with autism residing in Turkey was 3 points, 3.67 points for 8-year-old children, and 3.67 points for 10-year-old children. The results for 12-year-old children were 3.75 points and 3.25 points, respectively. In Azerbaijan, the observed scores for 6-year-old children diagnosed with autism were 2.5 points, 2.8 points for 8-year-olds, and 3.5 points for 10- and 12-year-olds (Figure 8). The results, although not absolute, indicate a lower than usual level of attention.

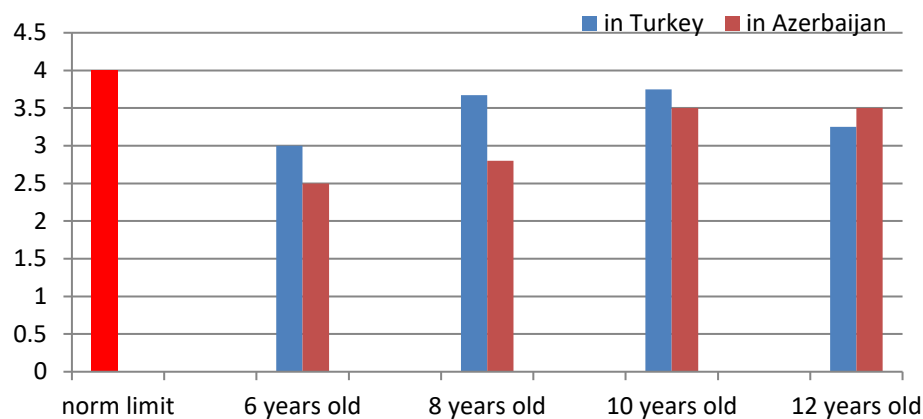


Figure 8. Results of the “Find the Same” Attention Test Applied to Different Age Groups

Similar outcomes were observed when the “Find the 3 Differences” Attention Test was administered. The results of this test, which has a norm boundary of 3 points, demonstrated a low level of attention in the participants. The mean scores for the 6-year-old children diagnosed with autism living in Turkey were 2.67 points, 2.8 points for the 8-year-old children, and 3 points for the 10- and 12-year-old children. In Azerbaijan, the level of attention in 6-year-old children diagnosed with autism was 2.15 points, 2.5 points in 8- and 10-year-old children, and 2.97 points in 12-year-old children (Figure 9).

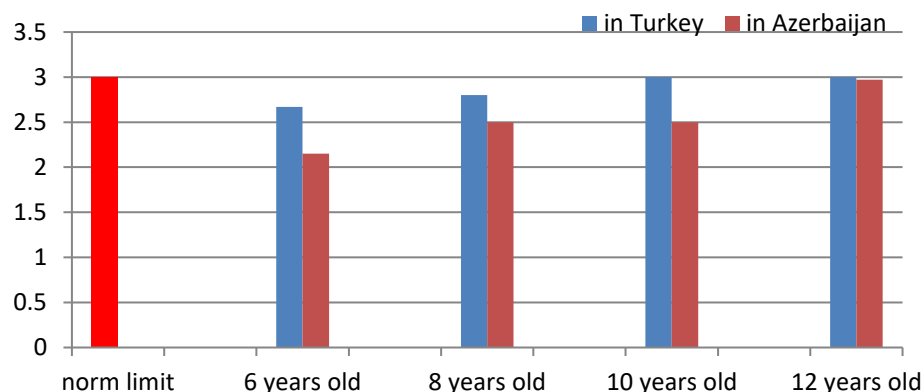


Figure 9. Results of the “Find the 3 Differences” Attention Test Applied to Different Age Groups

In the course of comparison, the results obtained complement each other. Thus, while 6-8-year-old children demonstrated a low level of attention in all tests, 10-12-year-old children exhibited a relatively low level of attention, and the results obtained in these age groups were consistent, with no significant differences observed. It is noteworthy that the results of the study on children diagnosed with autism residing in Turkey and Azerbaijan exhibited a high degree of similarity, with no discernible discrepancies. This observation serves to illustrate that the disease manifests in a uniform manner across different geographical regions.

The determination of the level of memory in autistic children of different age groups proved to be a challenging process. This is due to the fact that this group of children responds readily to tests labelled with images only. Consequently, the Memory by Image test was applied to them. At this time, it is predominantly possible to determine the level of sensory-visual memory. The standard limit of the test is 6 points. In the test, children with autism aged six years old living in Turkey scored 4 points, children aged eight years old scored 3.25 points, children aged ten years old scored 4.25 points and children aged twelve years old scored 5.05 points. Children diagnosed with autism in a study conducted in Azerbaijan had the following results: The mean scores for the 6-, 8-, 10- and 12-year-old children were 4.3, 4.2, 4.8 and 4.9, respectively (Figure 10).

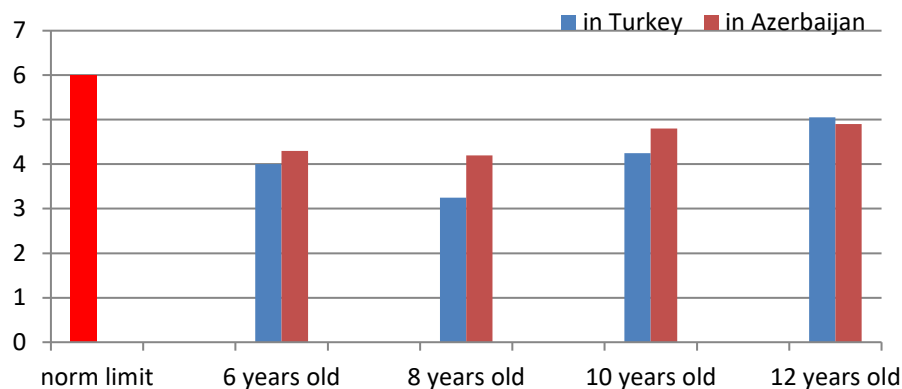


Figure 10. Results of the "Memory by Description" Test Applied to Different Age Groups

A comparison of the results obtained revealed a significantly lower memory level than the norm. The literature sources indicate that a low memory level is a characteristic of autistic children. However, there are different facts about the performance of cognitive processes depending on the level of arousal (60,62,64,70). Numerous scientific studies confirming behavioural changes in response to increased anxiety also support our findings (63,65,66,68). The tendency to depression and aggressive behaviour in autism is undoubtedly the manifestation of mental disorders (61,67,69). Numerous studies of children with autism also recommend early prevention and subsequent treatment of hyperexcitability. In the course of comprehensive studies, it was found that regional differences in patients diagnosed with autism are not observed sharply. Their behavioural disorders and other symptoms are defined as similar in nature. Patients diagnosed with autism were defined as having low levels of attention and memory scores against a background of high arousal. There was an association between increased levels of arousal and impaired attention performance. It was also noted that the increase in the level of arousal strongly depends on physiological age. Consequently, the markedly elevated arousal observed in adolescents may be attributed to hormonal fluctuations, pubertal development, and the complexity of cognitive processes. Furthermore, elevated arousal exerts a pronounced influence on the activation of cognitive processes, resulting in attention and memory processes that exhibit less deviation from the norm than observed in other age groups [31]. While there were no indications of mental retardation in children diagnosed with autism, aggressive behaviour was observed, reflecting elevated arousal and a tendency towards depression.

4. Conclusion and future scope

The obtained results have significant practical implications. Consequently, the results can be employed to elucidate the psychological characteristics of children diagnosed with autism and facilitate an early diagnosis. Furthermore, the results of a comprehensive study of children diagnosed with autism may be beneficial in the differential diagnosis of patients with other cognitive and psychiatric disorders.

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