J Biochem Tech (2018) 9(4): 28-32
ISSN: 0974-2328

Studying the Bioelementary Status in Preschool Children with Neurotic Disorders

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Received: 11 June 2018 / Received in revised form: 06 November 2018, Accepted: 11 November 2018, Published online: 17 December 2018

Abstract

One of the main indicators determining the potential of a nation is the health of its younger generation. The present study was conducted in a kindergarten in Karaganda, Kazakhstan. 139 children (their age ranged from 4 years to 5 years and 5 months) were the participants of this study who were divided into two groups of children with neurosis and a group of healthy children. The results indicated that the lack of essential metals in children with neuroses explained one of the mechanisms of the pathogenesis of neurotic disorders, and was associated with a violation of the processes of their absorption in the intestine, due to chronic stress. The article discussed the results of a study aimed at identifying the bio-elemental status in children with different levels of neuroticism. Further research studies including various regions and ages are needed in order to identify the factors affecting the elemental status of normally developing preschool children.

Keywords: Preschool Children, Neurosis, Pre-Neurosis, Anxiety, Micro and Macro Elements, Imbalance.

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Introduction

One of the main indicators determining the potential of a nation is the health of its younger generation. Children are the vulnerable group in the community, their health is vital to the future of the society (Abdelrhman Mohammed,et al.2018). Due to physical, psychological and social changes, the adolescence is one of the most critical periods in a person's life, which can affect the health and future of the person. Usually, mental disorders are common among adolescent students(Sanei& Nabavi Chasmi, 2018). Today, there is a negative health existing among the children in the Republic of Kazakhstan (94.9 cases per 100 children) (Report on the status of children in the Republic of Kazakhstan. - Astana, 2017) including an increase in the prevalence of mental and behavioral disorders (601 cases per 100,000 children), i.e. every sixth child under 14 years old has a pathology on the part of the psyche and nervous system [2], which includes borderline states. Of course, this does not reflect the true picture of the prevalence of border states, since appealing statistical data in foreign (Farmer et al., 2012), Russian (Devyatova, 2005), and Kazakhstan (Katkov and Dzharbusynova, 2006) sources only indicated the registered cases. The prevalence of borderline conditions is much greater when you consider that these children do not often come into the view of the neuropsychiatric services, due to the low turnover of parents who consider these children healthy.

Border states have been understood as a group of functional disorders of higher nervous activity caused by psycho-traumatic effects, manifested in emotional and somato-vegetative disorders, called “neurosis” (Marushkin and Orudzhev, 2007).

Various sides of this problem have not yet found sufficient illumination, in particular, the current causes of neurosis in preschool children have not established physiological and psycho-physiological changes in the children's body during the time neurosis has not been identified, and the mechanism of neurosis pathogenesis in preschool children has not been fully understood. The issue of functionality i.e. the reversibility of the mental state after the elimination of the psycho-traumatic factor

and the return to the initial state (Mendelevich and Solovyova, 2002) has been debatable, as in literary sources, there have been data indicating that recovery occurs only in 65% of cases (Kisilev and Sochneva, 1988), which contradicts the criterion of the functionality.

No less important subject of discussion is the participation of trace elements in different parts of the pathology of neurosis. At the same time, the number of works devoted to the exchange of macro- and microelements with neurotic disorders is rare. In addition, most clinical studies have studied the effect of one or several elements, which does not allow for a holistic view of changes in the balance of microelements and macronutrients in the body with neurotic disorders, and therefore, the study of this issue, especially in children, remains relevant. The foregoing has led to the need to assess the relationship of impairments in neuroses in preschool children, depending on the state of their bio-elemental status.

The aim of the study was to determine the characteristics of micro and macro elements in the biomaterial (hair from the back of the head) in preschool children with different levels of neuroticism.

Materials and Methods

Subjects

The study was conducted in the kindergarten nursery number 15 "Akku", kindergarten "Tolakay" in Karaganda. In total, 139 children took part in the study. The study group was supposed to be divided into two groups: children with neurosis and a group of healthy children. According to the results of the psychological research, it was decided to add 2 more groups (the official diagnosis of the children of these two groups was not established), but the results of the conditionally named “healthy” children indicated pronounced psychological discomfort, manifested in uncertainty about children's responses, suspicion, and anxiety (Konkabayeva et al., 2016). Thus, the children were divided into four groups: 25 children with an established diagnosis of neurosis, 20 children with a pre-neurotic state, 42 children with a high degree of anxiety, 52 children developing normally. The age of the children ranged from 4 years to 5 years and 5 months. Criteria for inclusion in the study were:

1) Preschool age (4- 5.5 years);
2) Inorganic etiology;
3) The presence of psychogenic, meeting the criteria of the ICD-10, heading F 90 - F98 "Emotional disorders and behavioral disorders starting in childhood."
4) Short-term reactions in children lasting less than 1 week, including acute reactions to stress.
5) Voluntary consent of the children and their parents for research.

Children with following criteria were excluded from the study:

1. With the presence of any organic pathology.
2. Refusal of parents or children to participate in the study.

Research methods

The children's hair was a sample in this study. Hair cut from the back of the head in several places where its growth was most intense. Cut hair was placed in separate envelopes.

The study was conducted in the laboratory of engineering profile "Physico-chemical methods of research" of E.A. Buketov University, Karaganda, Republic of Kazakhstan (Accreditation Certificate No. KZ.I / 10.0745 is valid until 2020). The concentration of metals was determined on an atomic absorption spectrometer AA 140/240 of the company Varian (Australia), which allowed to display the results in terms of molecular forms (oxide, salt, etc.); and supported the multiple calibration (MultiCal) with the simultaneous use of several analytical lines (Namazbayeva et al., 2007).

Mercury was investigated on a mercury-hydride adapter VGA 77 to AA -140 (Agilent Technologies). 15 micro-and macro elements were estimated quantitatively (“essential” —Na, Mg, K, Mn, Zn, Fe, Cu, Co, Cr, Se; conditionally essential — As, Ni; “toxic” —Cd, Pb, Hg). The choice of the studied chemical elements was not accidental, but was determined by the literary data, stating the imbalance of the studied elements, which had a direct impact on the health of children (Skalny, 2003).

In evaluating the obtained results, the biologically acceptable levels of microelements and macro elements developed at the Center for Biotic Medicine (Skalny, 2002) were taken into account.

Statistical analysis

When calculating the statistical criterion, the program Statistica V.6.1 was used to carry out the statistical calculations, including in the humanities.

The choice of a specific method of statistical analysis mainly depended on the type of scales in which the results were expressed, as well as on the number of groups used for the comparison.

As already noted above, four groups were used in the study, which meant that it was necessary to focus on criteria designed to compare three or more groups. For this case, single-factor analysis of variance for independent groups was the most appropriate.

According to the results of the calculations of single-factor analysis of variance, the following results were obtained.

Results and Discussion

15 micro – and macro elements (Na, Mg, K, Cr, Mn, Fe, Co, Ni, Cu, Zn, Cd, Hg, Pb, As, Se) were quantitatively evaluated.

Significant differences were obtained not for all elements, but for Zn, Pb, Co, Cd, K, Na, Cu, Fe, Mg, Mn. In this study, only those elements that affected the central nervous system, namely: Zn, Cu, Fe, Mg, Na, were studied.

The indicator zinc revealed differences, where F = 9.59592 with p = 0.001.

The differences were due to a rather serious gap in the mean values between the "Norma" group and all the other groups, while it was obvious that in the "Neurosis" group, a significant decrease in the zinc level was found, that was 65.990 ± 31.980 µg / g. (biological permissible level (BDU) 120.0-230.0). Zinc in this group was reduced by 54.9%. In the Pre-neurosis group, the results were also lower than the reference value, and amounted to 80.780 ± 33.536 µg / g, in which there was a decrease of 32.6%.

The obtained data indicated a zinc deficiency in the above groups. According to various authors, zinc deficiency can lead to decreased memory, as well as reduced concentration, which was observed in the group of children with neuroses. Zinc deficiency in the Neurosis group can be caused by its rapid elimination from the body during stress, which was also indicated by low zinc numbers in the Pre-neurosis group. In addition, there was a high predisposition to somatic diseases of children with neurosis, as evidenced by the medical records of children. This fact indirectly confirmed the presence of zinc deficiency in children of the group under consideration.

There were children in the Anxiety group who were characterized by minimal deviations in health status, and no violations in the zinc balance have been identified (161.030 ± 41.918 µg / g).

The increase in zinc in the Norma group, almost 3-fold (398.320 ± 307.402 µg / g), seemed to be due to the unfavorable ecological situation in the region (Kazakbayeva and Abdrakhmanova, 2018), and was associated with the dominant mining and metallurgical industries. For a more visual understanding of the specifics of differences, see Figure 1.

A strong positive correlation was noted between zinc: and copper (r = 0.810); iron (r = 0.823), magnesium (r = 0.712); sodium (r = 0.593); p≤0,01, which meant the lower the concentration of zinc, the less copper, iron, magnesium in children with neurotic disorders.

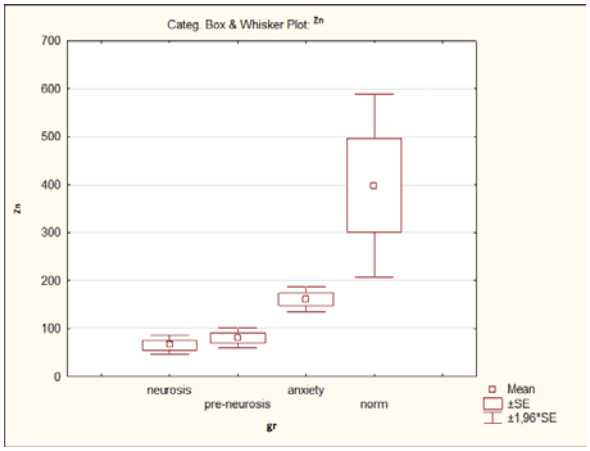

Figure 1 - Zinc content in children of different groups

The indicator of copper detects differences, where F = 3.21084 at p = 0.034317.

The copper concentration in the hair of children in the Neurosis group indicated a copper deficiency of 0.530 ± 0.250 µg / g (BDU -10.0-20.0). A similar situation was observed in the group of children with Pre-neurosis - 1,140 ± 1,607 µg / g. (Figure 2). The average copper content in children with a high level of anxiety was 22, 530 ± 7.966 µg / g, which was within the reference values.

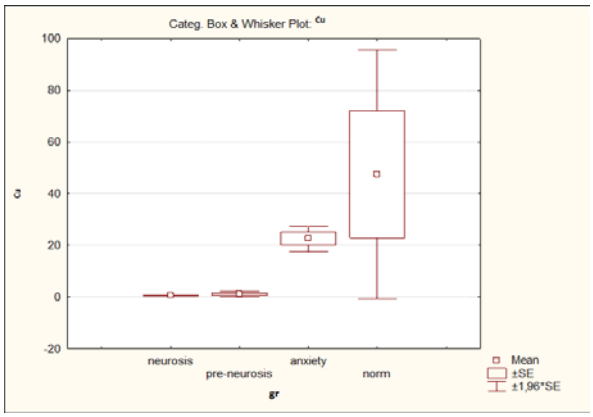

Figure 2 - Copper content in children of different groups

Quantitative indicators of copper in children without pathology were in direct proportion to their place of residence, and indicated a twofold increase in copper - 47.460 ± 77.915 µg / g.

Strong correlations were found in copper with cobalt (r = 0.495); sodium (r = 0.590); iron (r = 0.799); magnesium (r = 0,647) p≤0,01, which meant the smaller the concentration of copper in the body, the less the above elements.

In evaluating iron, the differences were found as: F = 3.52547 for p = 0.024450.

The following results indicated a decrease in iron concentrations in children in the Neurosis, Pre-neurosis groups (Figure 3).

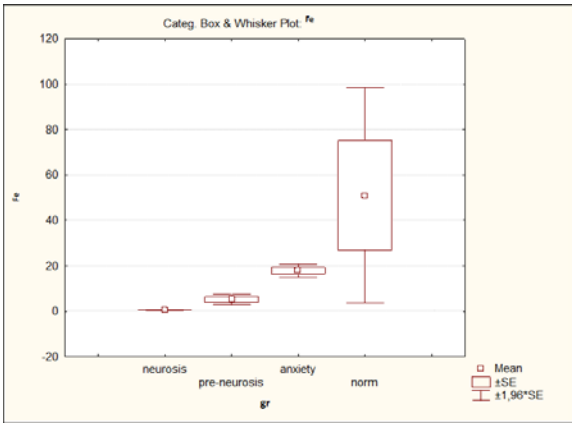

Figure 3 - Iron content in children of different groups

According to the study, the average iron content in the hair of the Neurosis and Pre-neurosis groups was 0.490 ± 0.223 and 5.100 ± 3.620 µg / g. accordingly, which was below the reference values (10.0–20.0 µg / g).

The iron content in children with a high level of anxiety was within the limits of the biologically permissible level - 17.740 ± 4.557 µg / g.

The results obtained in the "Norma" group were of interest - 50.930 ± 76.496, which were 2, 5 times as large as the BSU.

A significant correlation has been established between iron and: magnesium (r = 0.772); copper (r = 0.799) ≤ 0.01, i.e. the lower the iron concentration, the lower the magnesium and copper were.

Negative correlation of iron with lead (r = -0,339); manganese (r = -0.372; with p ≤ 0.01) indicated that a decrease in the concentration of iron led to lead and manganese.

The next essential element which was studied was magnesium, which was a component in the activation of many enzymes and metabolic processes. The results of this study determined the average concentration of magnesium in children of different groups. In children in the "Neurosis" and "Pre-neurosis" groups, its content was 7.800 ± 4.264 µg / g. and 29.160 ± 12.314 µg / g. accordingly, which was significantly lower than the reference values (72.0-500.0 µg / g) by 10.8 times in the Neurosis group and 2.5 times in the Pre-neurosis group (Figure 4).

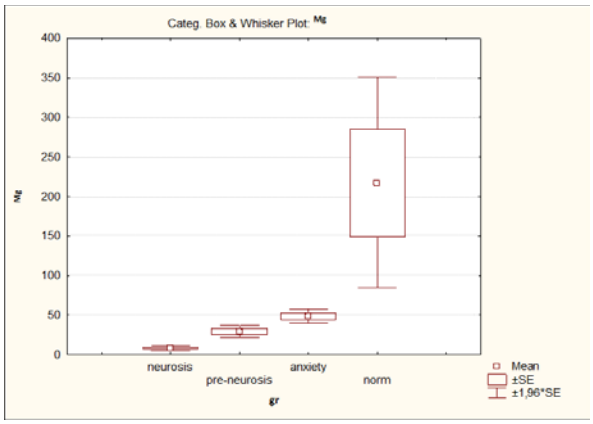

Figure 4 - Magnesium content in children of different groups

Magnesium deficiency in these two groups was characteristic due to abnormal functioning of the nervous system due to stress. Chronic stress led to an increase in magnesium demand due to the activation of the sympathetic system and excessive consumption of ATP. This led to an increase in the release of catecholamines (adrenaline and nor-adrenaline), which led to an imbalance, and contributed to the removal of magnesium from cells. A prolonged decrease in the intracellular level of magnesium led to an increase in the activity of TRPM7 protein, the subfamily TRP (transientreceptorpotential) responsible for magnesium homeostasis at the cellular level, at the same time increased the intracellular calcium, resulting in a breakdown of compensatory reactions (Miller et al., 2005). A decrease in intracellular magnesium increased its concentration in the urine (Jee et al., 2002).

The Anxiety group also illustrated magnesium deficiency, since the magnesium content was 48.260 ± 13.952 µg / g significantly lower than the reference value. It can be assumed that the risk group for the occurrence of neurosis included the children of the Anxiety group.

In the group of children "Norma", a normal distribution of values of 217.030 ± 214.899 µg / g was observed.

A positive correlation was found for magnesium with: cobalt (r = 0.590); potassium (r = 0.443); sodium (r = 0.511) with p ≤ 0.01); as well as selenium (r =, 339 with p ≤ 0.05), i.e., the lower the magnesium concentration, the lower the concentration of other micro and macro elements.

Differences were obtained when estimating sodium F = 15,39170 with p = 0.0001. In children in the "Neurosis" group (134.900 ± 90.155) µg / g. and "Pre-neurosis" (136.560 ± 61.049) showed a decrease in sodium (BDU 185.0-1000.0), which indicated an imbalance of water-salt metabolism in children of these two groups [268] and adrenal cortex dysfunction. In the "Anxiety" group - (398.050 ± 121.108) µg / g. the results were in the range of normal values, but higher in the Neurosis, Pre-neurosis, and Norma groups -121.108 ± 115.422 µg / g.

Thus, the results of a study of micro and macro elements have revealed a clear imbalance of micro and macro elements not only in children with neurotic disorders, but also in normally developing ones.

The lack of essential metals in children with neuroses explained one of the mechanisms of the pathogenesis of neurotic disorders, and was associated with a violation of the processes of their absorption in the intestine, due to chronic stress. It was stress that violated the microcirculation in the intestine, as indicated by G. Selye (Selye, 1974). In addition, a deficiency of iron and copper in the Neurosis group indicated the presence of anemia and led to a change in the work of the brain. There have been literary sources indicating the clinical manifestations of iron deficiency: muscular hypotonia (urinary incontinence when coughing, laughing, enuresis), which has been a common symptom in children with neuroses.

The excess of micro and macro elements in healthy children was associated with the place of residence (Karaganda), where there was an unfavorable ecological situation.

This study did not fully exhaust the solution of all the problems of neurotic disorders in children of preschool age. The issues of alimentary correction of the identified imbalance of micro- and macro elements need further development. In addition, the imbalance found in healthy children requires further research (regional, age) in order to identify the factors affecting the elemental status of normally developing preschool children.

Acknowledgments

The study was conducted in the kindergarten No. 15 “Akku”, kindergarten “Tolakay” in Karaganda, Republic of Kazakhstan. The authors expressed deep gratitude to Gulnara Musinovna Usenova, the head of the Tolakay kindergarten, and Alua Abilazhinovaya, the head of the Akku kindergarten, Bazarbayeva, for their help and support in conducting this scientific research.

Conflict of interest

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