



Interrelation of essential microelement metabolism in adolescents with neurocirculatory dystonia living in iodine-deficient conditions

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Abstrak. This article analyzes the relationship between essential microelement metabolism in adolescents living in iodine-deficient conditions and those with neurocirculatory dystonia. During the study, it was studied how a deficiency or imbalance of microelements such as iodine, iron, zinc, and copper in the body affects the activity of the cardiovascular system and the state of the autonomic nervous system. It has been established that due to the activity of metabolism and the strong growth process of the body in adolescence, a deficiency of microelements can cause the development of various functional disorders, in particular, neurocirculatory dystonia. It is also substantiated that the interaction between microelements and maintaining their physiological balance are important in strengthening the health of adolescents. The research results have important scientific and practical significance in assessing the health of adolescents in areas with iodine deficiency, developing preventive measures, and improving treatment methods.

Keywords: iodine deficiency, neurocirculatory dystonia, adolescent health, microelement metabolism, autonomic nervous system, cardiovascular system, iron and zinc balance, metabolic processes.

1. Introduction

The balance of microelements in the human body is one of the important biological factors in maintaining health. A sufficient amount of microelements in the body of adolescents, especially in the period of growth and development, plays an important role in the proper course of metabolic processes, the functioning of the endocrine system, and the stable functioning of the cardiovascular system. Modern scientific research shows that micronutrient deficiencies cause various functional disorders among adolescents. In particular, the problem of iodine deficiency is assessed as a pressing medical and social problem in many countries, including the Central Asian region[1].

Iodine is one of the important microelements necessary for the human body and is the main substrate for the synthesis of thyroid hormones - thyroxine (T4) and triiodothyronine (T3). These hormones play an important role in the regulation of metabolism in the body, the development of the nervous system, the activity of the cardiovascular system, and the processes of general energy metabolism. According to the World Health Organization, approximately 1.9 billion people worldwide live in areas at risk of iodine deficiency. Also, about 30% of school-age children have various clinical or subclinical conditions associated with iodine deficiency. This can have a serious impact on the health of the younger generation[2].

The territory of Uzbekistan, due to its natural and geographical conditions, is also one of the regions with iodine deficiency. According to the results of epidemiological observations conducted in the republic, in some regions, 40-50% of the population have various degrees of thyroid dysfunction associated with iodine deficiency. The low iodine content in soil and drinking water,



especially in mountainous and inland continental regions, contributes to the widespread occurrence of this problem. Therefore, the study of diseases associated with iodine deficiency, the determination of their pathogenesis, and the development of preventive measures are of great scientific and practical importance[3].

One of the most common functional disorders among adolescents in recent years is neurocirculatory dystonia. This condition is associated with impaired autonomic nervous system function and manifests as changes in heart rate, instability of arterial pressure, dizziness, fatigue, and increased autonomic reactions. According to statistics, the incidence of neurocirculatory dystonia among adolescents reaches 15-25 percent. This indicator is especially observed during periods of intensive growth, hormonal restructuring, and increased psycho-emotional load[4].

Various factors play an important role in the development of neurocirculatory dystonia. Among them, hereditary predisposition, functional immaturity of the autonomic nervous system, hormonal changes, stress conditions, and disorders of microelement metabolism are of particular importance. Recent scientific research confirms that the imbalance of microelements such as iodine, iron, zinc, and copper in the body negatively affects the mechanisms of vegetative regulation. In particular, iodine deficiency leads to a decrease in the synthesis of thyroid hormones, which directly affects the activity of the central nervous system and cardiovascular system. In addition, there is a complex biological interaction between microelements, and the deficiency of one of them can also affect the metabolism and biological activity of others. For example, iron deficiency can inhibit the activity of thyroid enzymes, while zinc is an important component of many enzyme systems involved in hormone synthesis. Therefore, an imbalance between microelements affects the general functional state of the body, causing various disorders in the system of vegetative regulation[5].

Adolescence is one of the most important biological stages for the body. During this period, rapid growth of the body, reformation of hormonal systems, and acceleration of metabolic processes are observed. As a result, the need for microelements increases. If the body is not adequately supplied with the necessary trace elements during this period, the likelihood of developing various functional disorders, including vegetative dysfunction and neurocirculatory dystonia, increases. From this point of view, the study of the interrelationship of microelement metabolism in adolescents living in conditions of iodine deficiency is of great scientific importance. In-depth study of this issue not only contributes to a more accurate understanding of the pathogenesis of neurocirculatory dystonia, but also makes it possible to develop methods for early detection, prevention, and effective treatment of this disease[6].

Therefore, the main goal of this study is to determine the relationship between the metabolism of essential microelements in adolescents with neurocirculatory dystonia living in areas with iodine deficiency, as well as to scientifically analyze their influence on the activity of the vegetative and cardiovascular systems. The results of this study are expected to be of great importance in the development of scientific research in the field of protecting adolescent health, preventing diseases associated with micronutrient deficiencies, and forming a healthy generation.

2. Literature review

The endocrine system is one of the important physiological systems that regulate the processes of metabolism, growth, and development in the human body. As noted in the scientific literature, changes in the activity of endocrine glands directly affect the activity of various systems of the body. In the studies of D. K. Mamatkulov, it is emphasized that diseases of the endocrine system, in particular, thyroid dysfunction, are closely related to metabolic processes and hormonal balance. The author notes that environmental factors, lack of microelements, and improper nutrition play an important role in the development of endocrine diseases. Also, special attention is paid to preventive measures, and the adherence of the population to a healthy lifestyle, proper nutrition, and



strengthening medical control are indicated as important factors in the prevention of endocrine diseases[7].

The body of children and adolescents is more sensitive to environmental factors due to their physiological growth and developmental stage. In his research, S. S. Akhmedov provides detailed information about the role of hygiene in healthy development of children and adolescents. The author emphasizes that in the correct formation of a young organism, it is important to observe the rules of nutrition, living conditions, physical activity, and sanitary and hygienic requirements. In particular, it was noted that a deficiency of microelements, including iodine deficiency, can negatively affect the health of children and adolescents, slowing down the processes of their physical and mental development.

Therefore, scientific sources emphasize the importance of applying hygienic requirements, proper nutrition, and preventive measures that support the functioning of the endocrine system in maintaining the health of children and adolescents. This approach has important scientific and practical significance in strengthening the health of the younger generation and preventing various endocrine diseases[8].

3. Research Methodology

This study was conducted to determine the features of microelement metabolism associated with neurocirculatory dystonia among adolescents living in areas with iodine deficiency. The study was based on observation and comparative analysis methods, in which a total of 120 adolescents aged 12-16 years participated. The participants were divided into two groups: the main group consisting of 60 adolescents diagnosed with neurocirculatory dystonia and the control group consisting of 60 adolescents assessed as healthy. During the study, the clinical condition of the participants was assessed by general pediatric examination, determination of arterial pressure and heart rate.

During laboratory studies, the content of such important trace elements as iodine, iron (Fe), zinc (Zn), and copper (Cu) in blood serum was determined using modern biochemical methods, and the obtained results were compared. For statistical analysis, methods of variational statistics were used, and the average values of the indicators and their interrelationships were assessed through correlation analysis. The obtained results made it possible to determine the relationship between microelement metabolism and the activity of the autonomic nervous system and the cardiovascular system.

4. Result and Discussion

In the course of the study, the metabolism of important microelements in the body of patients with neurocirculatory dystonia (NCD) was studied among adolescents aged 12-16 years living in areas with iodine deficiency. A total of 120 adolescents were involved in the study. Of these, 60 were analyzed as the main group with neurocirculatory dystonia, and 60 as the conditionally healthy control group. In all participants, the content of iodine, iron (Fe), zinc (Zn), and copper (Cu) in blood serum was determined by laboratory methods, and the obtained results were statistically compared[9].

The results of the study showed that the content of microelements in adolescents with neurocirculatory dystonia was significantly lower than in the control group. A particularly significant decrease in iodine and zinc indicators was noted. This condition can directly affect the activity of the autonomic nervous system and the functional state of the cardiovascular system[10].

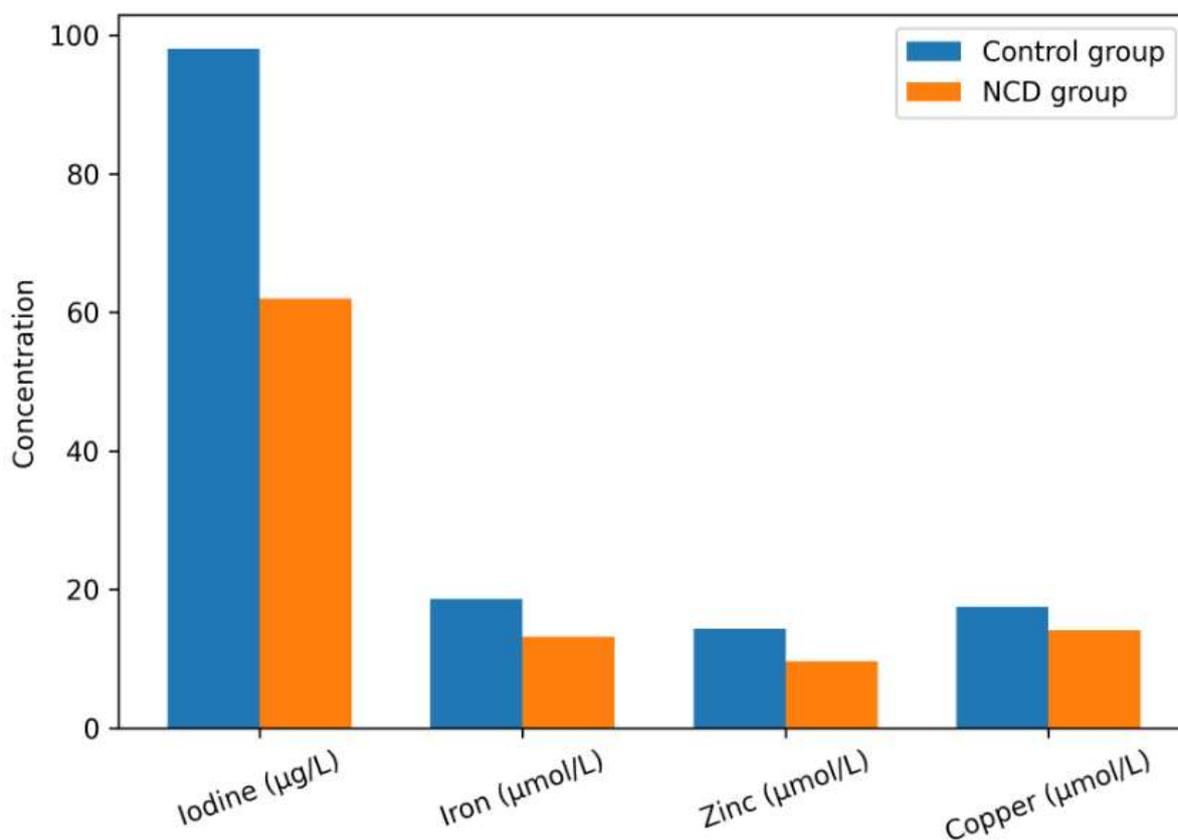
Table 1. Average indicators of the level of microelements in adolescents with neurocirculatory dystonia.



Mikroelement	Nazorat guruhi (n=60)	NCD guruhi (n=60)	Farq (%)
Yod ($\mu\text{g/L}$)	98.4 ± 4.2	61.7 ± 3.8	-37.3 %
Temir ($\mu\text{mol/L}$)	18.6 ± 1.1	13.2 ± 0.9	-29.0 %
Rux ($\mu\text{mol/L}$)	14.3 ± 0.8	9.6 ± 0.7	-32.8 %
Mis ($\mu\text{mol/L}$)	17.5 ± 0.9	14.1 ± 0.8	-19.4 %

As can be seen from the table data, in adolescents with neurocirculatory dystonia, the content of all examined trace elements decreased. The greatest difference was observed in the indicators of iodine (37.3%) and zinc (32.8%). This indicates that the imbalance of microelements can be an important factor in the development of pathological processes associated with vegetative dysfunction in iodine-deficient regions.

1. Diagramma.O'smirlarda mikroelementlar miqdorining guruhlar bo'yicha taqqoslanishi





As can be seen from the diagram, the indicators of all microelements in the main group were significantly lower than in the control group. A particularly sharp decrease in iodine and zinc levels may be associated with disorders in the autonomic nervous system.

During the study, it was established that the clinical signs observed in adolescents are also associated to a certain extent with a deficiency of trace elements. Rapid fatigue was observed in 68% of adolescents with NCD, dizziness in 54%, increased heart rate in 47%, and arterial pressure instability in 41%. It was noted that these symptoms are more common in adolescents with low levels of iodine and zinc[11].

According to the results of statistical analysis, an inverse correlation was revealed between the iodine content in blood serum and the vegetative disorder index at the level of $r = -0.62$. This indicates that as the amount of iodine decreases, the dysfunction of the autonomic nervous system increases. A moderate correlation was also found between zinc and iron indicators and heart rate ($r = -0.48$).

Disorders of microelement metabolism in adolescents living in iodine-deficient regions can manifest as an important pathogenetic factor in the development of neurocirculatory dystonia. In particular, a decrease in the amount of iodine leads to a decrease in the synthesis of thyroid hormones, which causes a slowdown in metabolic processes in the body. This, in turn, affects the regulatory mechanisms of the autonomic nervous system[12].

Against the background of iodine deficiency, a decrease in microelements such as iron and zinc also weakens the activity of enzyme systems in the body. Zinc is an important element in many enzymes and plays an important role in nerve impulse transmission and hormonal regulation processes. Iron is the main element in providing tissues with oxygen. Deficiency of these microelements can lead to functional changes in the cardiovascular system[13]. The results of the study also showed the presence of a biological relationship between microelements. For example, under conditions of iodine deficiency, iron metabolism can also be disrupted, since iron plays an important role in the activity of thyroid enzymes. Therefore, a deficiency of one microelement is likely to affect the metabolism of others[14].

Many researchers have noted an imbalance of microelements in adolescents with vegetative dysfunction. It is especially noted that iodine and zinc deficiency can lead to the destabilization of the autonomic nervous system. Therefore, it is important to monitor the health of adolescents in areas with iodine deficiency, enrich their diet with products rich in microelements, and strengthen preventive measures. This approach serves not only to prevent the development of neurocirculatory dystonia, but also to strengthen the overall health of the younger generation. The results of the study show that a comprehensive assessment of microelement metabolism can serve as an important diagnostic criterion for the early detection of vegetative disorders in adolescents and the development of a strategy for their effective treatment[15].

5. Conclusion

Adolescence is one of the most important stages of development of the human body, during which metabolic processes are activated and various systems of the body are rapidly formed. Therefore, maintaining the balance of microelements during this period is of particular



importance for the health of adolescents. In this study, the relationship between the metabolism of essential microelements in adolescents living in iodine-deficient conditions and those suffering from neurocirculatory dystonia was analyzed.

In adolescents with neurocirculatory dystonia, the content of such important microelements as iodine, iron, zinc, and copper in the body was significantly lower than in the control group. The decrease in iodine and zinc indicators was especially pronounced. It was established that this condition is associated to a certain extent with disorders of the autonomic nervous system and destabilization of the functional state of the cardiovascular system. The obtained results show that disruption of the balance of microelements can contribute to the development of vegetative dysfunction in the body of adolescents.

Another important aspect is that there is a biological relationship between microelements. It was observed that iron and zinc metabolism can also be disrupted under conditions of iodine deficiency. This increases the likelihood of disruption of thyroid hormone synthesis, enzyme system function, and metabolic processes. As a result, the activity of the autonomic nervous system is disrupted, leading to clinical signs such as changes in heart rate, instability of arterial pressure, fatigue, and dizziness.

The results of the study also showed the need for regular monitoring of the health of adolescents living in areas with iodine deficiency. Assessment of microelement metabolism allows for early detection of vegetative disorders and prevention of their development. Therefore, enriching the nutrition of adolescents with products rich in microelements, especially iodized salt and biologically active substances, is important from a preventive point of view.

The results of the conducted research showed that disorders of microelement metabolism are one of the important factors in the development of neurocirculatory dystonia in adolescents living in iodine-deficient conditions. Maintaining the balance of microelements plays an important role in stabilizing the activity of the vegetative and cardiovascular systems of the adolescent body. Therefore, in the future, it is advisable to conduct more extensive clinical and laboratory research in this area, improve preventive programs, and develop scientific and practical measures aimed at strengthening the health of adolescents.

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