Ferritin Index with Metabolic Changes in Obesity in Adolescents

Introduction. Overweight accounts for about 1.9 billion people worldwide, of whom 650 million have been identified. While obesity is approved by WHO (2018), according to WHO, even among children, overweight was 5 million by 2016. 340 million in 19-year-olds, girls accounted for 18% and boys for 19% of children. One of the contributors to the metabolic syndrome that has a major impact is the brain. The neurological and autonomic changes that develop in obesity during adolescence, especially the risk of developing iron deficiency is higher in overweight children, which is of great interest to many professionals. Impaired attention and thought processes caused by the metabolic syndrome can lead to a reduced quality of life in the individual, even in cases of dementia and impaired social adaptation.

Study objective: to investigate the relationship between metabolic changes in obesity and ferritin levels in adolescents.

Abstract: Today obesity has become not only a systemic public health problem but also a social and even more so an economic problem among children and adolescents. The relationship between metabolic changes and iron metabolism, especially a seemingly unrelated one, continues to be controversial among many scientists. This study analyses the clinical neurological, autonomic and attention disorders observed in adolescents with metabolic changes and their relation to the amount of ferritin, an index of iron metabolism in the blood.

Keywords: adolescents, metabolic changes, autonomic, neurological changes, attention deficit, ferritin.

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Materials and method of study: the results of anamnestic, clinical, neurological and laboratory analyses of 180 children and adolescents were studied in our study. For the 9-17 year olds, the selection criteria were waist circumference of cm in boys and cm in girls, and the criteria for deviation were hereditary, organic endocrinological and neurological acute and chronic diseases. A total of 140 adolescent children who came for examination by an endocrinologist with excessive body weight were selected for the main group, based on the selection and deviation criteria, and 40 adolescent children with normal body weight were selected for the control group. Anthropometric, anamnestic, clinical, neurological, vegetative and focal examinations, paraclinical examinations such as electroencephalography, transcranial dopplerography and blood sugar, lipid metabolism and ferritin levels were carried out in all teenagers with parents' and teachers' permission. We divided our main group into an active and an inactive group on the basis of blood fat and carbohydrate values. In our active group there were 54 (38.6%) children with fat and carbohydrate abnormalities and in the inactive group there were 86 (61.4%) children with obesity and fat and carbohydrate abnormalities. We divided the metabolically inactive group into 2 subgroups: MS 21ta (41.18%) and MS 33ta (58.82%). The primary autonomic state of the autonomic nervous system was assessed with the Wein questionnaire, autonomic reactivity with the Daniel Aschner reflex, and attentional stasis with the Schulte table.

Body weight in adolescents in the main group

Obesity was detected in 46 (53.49%) of grade I, 36 (41.86%) of grade II and 4.65% of grade III (n = 4). Depending on adolescence, early adolescence 9 - 14 years (n = 80) was differentiated by 57.1% and late adolescence 15 - 18 years (n = 60) by 42.9%.

Consistent with this, complaint rates, particularly in the younger children with metabolic syndrome in the core group, were almost 3-4 times higher than in the control group. As a factor leading to obesity we investigated and analysed the effect of obesity on the forehead in our groups. Accordingly, only his mother had a predominance of 64 (46%) in the core group compared with 27 (19%) in the control group. Obesity in both parents was 39 (28%) in the main group and 4 (3%) in the control group, only the father had 29 (21%) in the main group and 14 (37.5%) in the control group, and absence in both parents was 21 (15%) in the main group and 16 (40%) in the control group.

In children who were found to be obese during the neurological examination, we did not observe overt signs of migraine. Only diffuse microsymptomatology was found in the neurological status (Table 1).
It can be seen that the neurological examination of the children in the main group mainly revealed changes associated with autonomic dysfunction, especially when these signs were predominant in the main group, manifested by symptoms such as muscle hypotonia, finger tremors and hyperhidrosis. The initial vegetative state was assessed using the Vein Autonomic Nervous System Questionnaire and the results from the groups were analysed. This questionnaire consists of a comprehensive questionnaire response and helps in the broad coverage of the autonomic nervous system. Sympathetic changes manifested as inability to tolerate heat (73.57%), varai condition (58.57%), white, pink dermographism (79.29%), thirst (45.71%), increased appetite (56.42%), reduced salivation (75%), polyuria (79.29%), sleep disturbance (64.29%). Personality changes (69.5%) were manifested by hypersensitivity to pain, mood swings, short-temperedness, quick absent-mindedness, increased physical activity. Parasympathetic changes manifested as redness of skin (56.42%), wet sweating (79.29%), inability to tolerate cold (55.71%), accelerated salivary discharge (37.86%), epigastric pains (46.9%), decreased physical activity (65%), somnolence combined with a deep sleep (31.4%). We compared the results of the baseline autonomic status between the two groups, the main group and the control group (Table 2).

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Main</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Violation of convergence</td>
<td>17,14%</td>
<td>2.5%</td>
</tr>
<tr>
<td>Nasal lab asymmetry</td>
<td>35,71%</td>
<td>7.5%</td>
</tr>
<tr>
<td>Distributed muscle hypotonia</td>
<td>37,86%</td>
<td>7.5%</td>
</tr>
<tr>
<td>Tremor on the fingers</td>
<td>71,42%</td>
<td>12.5%</td>
</tr>
<tr>
<td>Revitalization of reflexes</td>
<td>17,86%</td>
<td>5%</td>
</tr>
<tr>
<td>Hyperhidrosis</td>
<td>47,88%</td>
<td>10%</td>
</tr>
</tbody>
</table>

As can be seen from the above table, in children in the group with primary obesity the primary autonomic state was found to be sympathicotonic in 74% of cases and in the control group in 39%; vagotonia was found in children in our main group in 11% and in the control group in 31%; and normostenia in 15% and 30% of cases in both groups. The RR i.e. we used the eye-cardiac Dyney-Ashner reflex in all children to assess the body’s response to recoil in the calm state (Table 3).

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Main</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normostenia</td>
<td>21 (15%)</td>
<td>13 (32.5%)</td>
</tr>
<tr>
<td>Sympathicotonia</td>
<td>103 (73.57%)</td>
<td>12 (30%)</td>
</tr>
<tr>
<td>Vagotonia</td>
<td>16 (11.43%)</td>
<td>15 (37.5%)</td>
</tr>
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</table>

According to the analysis of the results of this study, we found that backward responsiveness was predominant in children in the Asian group with 70.71%, while in the control group the figure was 20%. In the control group, normal responsiveness was shown by a slowing of the heart rate by 10 - 12
in response to exposure, showing 45%. In the main group, this was found in 10% of cases. Overreactivity was expressed in 6.43% and 32.5% in the main and control groups.

In all children who were found to be obese, the urine stasis status was checked using the Schulte test and the analysis of the results obtained was assessed on the basis of the time taken to perform and the number of gross and non-cross errors that were made.

Teens in the main group outperformed children in the control group in terms of the number of errors in the time taken to complete a task. Accordingly, the average time for children in the main group was 74-76 s, there were 11 gross errors, on average, and 15 gross errors. In the control group, the average time to complete a task was 46.01 seconds. For example, the number of errors that were not gross was 4 and the number of errors that were gross was 3. As we see, the time needed to complete a task was long in the main group and the number of gross errors was 3 to 4 times that of the control group.

From the laboratory tests we determined the amount of ferritin, which is considered to be an indicator of iron metabolism in the blood serum of all children (Table 4).

**Intergroup comparison of ferritin amounts**

<table>
<thead>
<tr>
<th>Ferritin indicator (mg/l)</th>
<th>Control (n = 40)</th>
<th>Maen (n = 140)</th>
<th>Metabolically inactive (n = 86)</th>
<th>Metabolic asset MS(n=21)</th>
<th>M risk (n = 33)</th>
</tr>
</thead>
<tbody>
<tr>
<td>~81.4</td>
<td>~56.8</td>
<td>~25.2</td>
<td>~37.5</td>
<td></td>
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</tr>
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</table>

We found that according to the analysis of the results obtained, the average ferritin content in the metabolic inactive risk subgroup of the main group among adolescents was ~56.8, and in the metabolic syndrome subgroup in the metabolic active risk group, this index was ~25.2 µmol/l, and in the metabolic risk subgroup it was ~37.5 µmol/l. And in children of the control group the serum ferritin content was ~81.4 µmol/l.

**Conclusion:** This study showed that neurological changes in obesity in adolescents have diffuse microsymptoms, while the autonomic nervous system is predominantly dominated by the sympathetic nervous system. In addition, metabolic changes in adolescents were characterised by impaired attention. Serum ferritin content is defined as an inverse correlation with metabolic changes, assessed as another associated condition that leads to more profound neurological changes, such as attention disorders, which develop as a result of metabolic changes, and should certainly be considered in the treatment measures undertaken.

**LITERATURE:**


