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THE ASSOCIATION BETWEEN METABOLIC SYNDROME AND ANEMIA IN OBESE CHILDREN OVER FIVE YEARS OLD

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ABSTRACT

Background: Obesity in children is an important public health problem and an independent risk factor for many complications such as anemia. The reduction of iron is observed in obese individuals and metabolic conditions such as metabolic syndrome. However, the dual burden of anemia and obesity in the development of metabolic disorders is challenging due to their complex interactions. **Objective:** To assess the relationship between metabolic syndrome and the severity of anemia in obese children over 5 years old. **Materials and Methods:** An observational analytic (Cross-Sectional) study included 130 obese children over 5 years old who were followed up at the Pediatric Endocrine Clinic at Tishreen University Hospital in Lattakia between March 2023 and May 2024. We used the National Cholesterol Education Program Third Adult Treatment Panel (NCEP-ATP III) definition to diagnose Metabolic syndrome. **Results:** A total of 130 obese children included 76 females (58.5%) and 54 males (41.5%), 60 children (46.2%) had Metabolic Syndrome, and 69 children (53.1%) had anemia. The range of children's ages was from 5 to 16 years. The prevalence of anemia in children with Metabolic syndrome was (50.7%), versus (41%) had Metabolic Syndrome without anemia. **Conclusion:** The study observed a direct association between Metabolic syndrome and moderate anemia in obese children. Notably, obesity appeared to be a potential risk factor for anemia, with a higher prevalence among females than males. Furthermore, microcytic anemia was the most common type among obese children.

KEYWORDS: anemia, metabolic syndrome, obesity, children.

INTRODUCTION

Obesity is defined by an excessive buildup of fat that can adversely affect health. In recent years, childhood obesity has become a major public health issue in the 21st century, with its rates increasing significantly.[1]

The World Health Organization (WHO) estimated in 2016 that over 340 million children aged 5 to 19 globally were classified as overweight or obese.[2]

For children under 10 years of age who are classified as obese, more than 35% display at least one cardiovascular risk factor or metabolic disorder, including hypertension, dyslipidemia, impaired glucose tolerance and insulin resistance (IR) is the most common and initial sign of these conditions. This situation, known as metabolic syndrome (MetS), key clinical characteristics of (MetS) include, elevated fasting glucose and triglyceride levels, hypertension, low high-density lipoprotein cholesterol (HDL-C) levels, and visceral fat accumulation.[3]

Metabolic syndrome can also occur in individuals who are not obese. In 2020, its estimated global prevalence was 2.8% among children and 4.8% among adolescents, with a notably higher incidence in low-income countries. Among obese children, the prevalence reached 40.5%.[4,5]

Anemia is identified when hemoglobin (Hb) levels drop below the normal range for a specific age and sex, resulting in decreased oxygen transport capacity.[6]

Anemia also affects 25% of school-aged children globally, representing a significant health issue for this age group. Among obese children, the prevalence rises to 28.2%.[7,8]

Studies have shown a notable link between anemia and metabolic syndrome, with obese individuals having a higher incidence of anemia compared to those who are not obese.[9] The influence of obesity on iron levels and the development of anemia has received increasing attention, with research indicating that obesity may play

a role in causing iron deficiency anemia.[10] Additionally, individuals with metabolic syndrome and obesity frequently have low vitamin B12 levels, underscoring the intricate relationship between nutritional deficiencies, obesity, and metabolic issues.[11,12]

Given the limited research on the connection between metabolic syndrome and anemia in children, it is important to further explore this relationship. If this link is substantiated, it may be necessary to perform blood tests on pediatric patients diagnosed with metabolic syndrome to identify and treat any potential anemia.

PATIENTS AND METHODS

Study population

Following approval from the local research ethics committee and the scientific research council at the university, an observational analytical cross-sectional study was carried out involving 130 obese children aged 5 to 16 years. These children were followed up at the pediatric endocrine clinic at Tishreen University Hospital in Lattakia from March 2023 to May 2024. All participants met the eligibility criteria and had complete data available.

Non-Inclusion criteria

1. Children with chronic illnesses such as cardiac, gastrointestinal, and hemolytic disorders.
2. Children who were taking supplements or medications that could affect anemia, hemoglobin levels, or metabolic syndrome.
3. Children with genetic syndromes associated with obesity, including Prader-Willi syndrome, Laurence-Moon-Biedl syndrome, and Turner syndrome.

After obtaining the informed consent from the children's parents, the following steps were implemented.

a. Taking the clinical history.
b. Measurement of weight, height, body mass index (BMI), and waist circumference (WC).
c. Blood pressure (BP) was recorded after a resting period of five minutes; a reading was considered elevated if either systolic or diastolic pressure was at or above the 90th percentile according to the American Academy of Pediatrics (AAP) guidelines.
d. Blood samples for glycemia, total cholesterol (TC), high-density lipoprotein (HDL), and triglycerides (TG) were collected after fasting for 12 hours.

Obesity was defined based on the criteria set by the Centers for Disease Control and Prevention (CDC): overweight was classified as a BMI between the 85th and 95th percentiles, obesity as a BMI at or above the 95th percentile but below the 99th percentile, and severe obesity as a BMI at or above the 99th percentile.

Metabolic syndrome (MetS) was diagnosed using the National Cholesterol Education Program (NCEP) criteria, which require the presence of at least three of the following five conditions.

1. Waist circumference at or above the 90th percentile for age and gender.
2. Blood pressure at or above the 90th percentile for age, gender, and height.
3. Fasting blood glucose levels at or above 100 mg/dL or a diagnosis of type 2 diabetes.
4. Triglyceride levels at or above 110 mg/dL.
5. HDL cholesterol levels at or below 40 mg/dL.

Statistical analysis

Continuous variables were expressed as means and standard deviations, while categorical variables were presented as frequencies and percentages. The prevalence rate was calculated, and the chi-square test was employed to examine relationships between categorical variables. A p-value of ≤ 0.05 was considered statistically significant. Statistical analysis was performed using IBM SPSS version 20.

RESULTS

The study sample comprised 130 children, including 76 females (58.5%) and 54 males (41.5%). The ages of the participants ranged from 5 to 16 years, with an average age of 10 ± 2.7 years. The age group of 8 to 12 years represented the largest portion of the sample, accounting for 49.2%.

Table 1: Number and Percentage of study sample according to BMI, the occurrence of metabolic syndrome and anemia.

		Number and Percentage
BMI	Overweight	43 (33.1%)
	Obesity	52 (40%)
	Severe obesity	35 (26.9%)
Metabolic Syndrome	positive	60 (46.2%)
	negative	70 (53.8%)
Anemia	positive	69 (53.1%)
	negative	61 (46.9%)
	Total	130 (100%)

As detailed in Table (1), 40% of the participants were classified as obese. Among these obese children, the prevalence of metabolic syndrome was found to be 46.2%. Additionally, anemia was observed in 53.1% of the obese children, with 65.2% of these cases categorized as moderate anemia; no severe anemia cases were reported.

In terms of anemia characteristics, 67.7% of the affected children exhibited a low mean corpuscular volume, while only 3.8% were identified with macrocytic anemia.

Table 2: Distribution of the study sample by the relation between metabolic syndrome and the severity of anemia.

Metabolic Syndrome	Severity of Anemia			P-value
	absent	mild	moderate	
Positive	25(41%)	8(33.3%)	27(60%)	0.04
Negative	36(59%)	16(66.7%)	18(40%)	

Table (2) illustrates a significant relationship between moderate anemia and metabolic syndrome in the obese children, with statistically significant differences noted (p-value = 0.04).

Table 3: Distribution of the study sample according to the relationship between body mass index and anemia.

BMI	Severity of Anemia		P-value
	Positive	negative	
Overweight	17(24.6%)	26(42.6%)	0.04
Obesity	33(47.8%)	19(31.1%)	
Severe obesity	19(27.8%)	16(26.2%)	

Furthermore, Table (3) indicates a significant positive correlation between the incidence of anemia and obesity in these children, confirmed by the Chi-square test with a p-value of 0.04.

DISCUSSION

Research highlights a complex interplay between obesity, metabolic syndrome (MetS), and iron metabolism that may contribute to anemia in children. Studies indicate that overweight and obese children experience a higher prevalence of iron deficiency and anemia compared to their peers with normal weight, particularly noting an increase in microcytic anemia cases.[13]

This relationship is significant since obesity has emerged as a potential risk factor for anemia in children, with inflammation associated with obesity affecting iron metabolism and potentially leading to anemia.[14]

Factors such as changes in hepcidin levels in obese children with MetS may mediate the connection between obesity, MetS, and iron deficiency. Hepcidin plays a crucial role in regulating iron absorption and metabolism, and its dysregulation in obese children with MetS could be a contributing factor to the development of anemia.[15]

Numerous studies have explored the prevalence of anemia among overweight and obese children in various regions, as well as the relationship between anemia and metabolic syndromes across different populations. For instance, Zumin et al. investigated the coexistence of anemia and metabolic syndrome in adults residing in Jiangsu, China. This research provided valuable insights into how these two health conditions intersect within a specific adult demographic.[16]

In another study, Ferenci et al. presented preliminary findings on changes in routine blood test parameters associated with obesity as part of a collaborative project aimed at enhancing understanding of obesity and its predictive indicators, particularly in adolescents.[17]

The research conducted by Umesh Kapil and Neha Sareen in 2014 focused on assessing the prevalence of anemia among overweight and obese children in the National Capital Territory (NCT) of Delhi. Recognizing the link between anemia in children and various developmental challenges, this study aimed to shed light on the severity of this health issue within this population.[18]

More recently, Abebe et al. investigated the prevalence and potential contributing factors of anemia in individuals with metabolic syndrome. Their findings indicated that anemia is frequently observed in patients with metabolic syndrome and may be associated with an increased risk of adverse complications.[19]

However, the study encountered limitations, primarily due to its cross-sectional design, which hindered the ability to establish clear causative relationships. Additionally, it did not assess the nutritional status of the obese children involved, nor did it explore other relevant blood markers due to resource constraints. It is worth noting that ferritin levels, which can indicate inflammation, are often elevated in individuals with obesity.

CONCLUSION

Our findings indicate a significant prevalence of metabolic syndrome and anemia in obese children aged over 5 years. The presence of metabolic syndrome may heighten the risk of moderate anemia, suggesting a potentially bidirectional relationship between these conditions.

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