CHILDHOOD OBESITY AND IRON METABOLISM

SOUSA B [1], GALHARDO J [1,2]

[1]Department of Paediatrics, - CHUP – CENTRO MATERNO INFANTIL DO NORTE, Porto

[2]Diabetes and Paediatric Endocrinology Unit, Department of Paediatrics - CHULC - HOSPITAL DE DONA ESTEFÂNIA, Lisbon

PORTUGAL

BACKGROUND

Hypoferraemia is the most common nutritional deficiency worldwide and a leading cause of potential developmental disorders in children, as well as impaired immune functions and physical performance.

Obesity seems to be associated with this condition, but it is still unclear if it is caused either by depleted iron stores, diminished availability, or both.

The aim of this study was to analyze the relationships between childhood obesity, iron metabolism and inflammation.

PATIENTS & METHODS

A six-month cross-sectional study was conducted on a convenience sample of otherwise healthy children and adolescents referred to two tertiary level Paediatric Obesity Clinics. They were compared to a sample of normal body mass index (BMI), age and sex matched individuals from a routine follow up General Paediatrics Clinic. Evaluated variables: BMI; iron intake (7-day diet record); serum iron, transferrin receptor, ferritin and high sensitivity C-reactive protein (hs-Crp). Exclusion criteria: recent bleeding and/or fever episodes, chronic inflammatory conditions, iron supplements, anti-inflammatory drugs and drugs affecting body weight. Collected data were analysed using SPSS® 16.0 for Windows. Chi-Square test, Student's t-test, covariance and multiple linear regression model were used for statistical analysis. All significance levels were set at $p < 0.05$.

RESULTS

N = 272

AGE: 9.3 (5 – 18) y | GIRLS: 51% | WHITE: 92%

LABORATORY

	Obese	Non-obese	*p*-value
	N = 57 (21%)	N = 215 (79%)	
Serum iron (ug/dl)	77.8 ± 22.1	88.4 ± 21.5	0.001
Transferrin Saturation (%)	21.4 ± 8.3	24.6 ± 8.2	0.005
Mean corpuscular volume (fl)	74.3 ± 6.2	78.2 ± 5.5	<0.001
Haemoglobin(g/dl)	11.6 ± 2.1	12.1 ± 1.5	0.71
Ferritin (ug/L)	82.5 ± 72.8	68.7 ± 53.7	0.008
Serum transferrin receptor (nmol/L)	27.6 ± 7.2	25.4 ± 7.0	0.03
Hs-Crp (mg/dl)	0.88 ± 0.53	0.45 ± 0.35	<0.001
Estimated iron intake (mg/day)	20.1 ± 10.1	22.4 ± 9.9	0.07

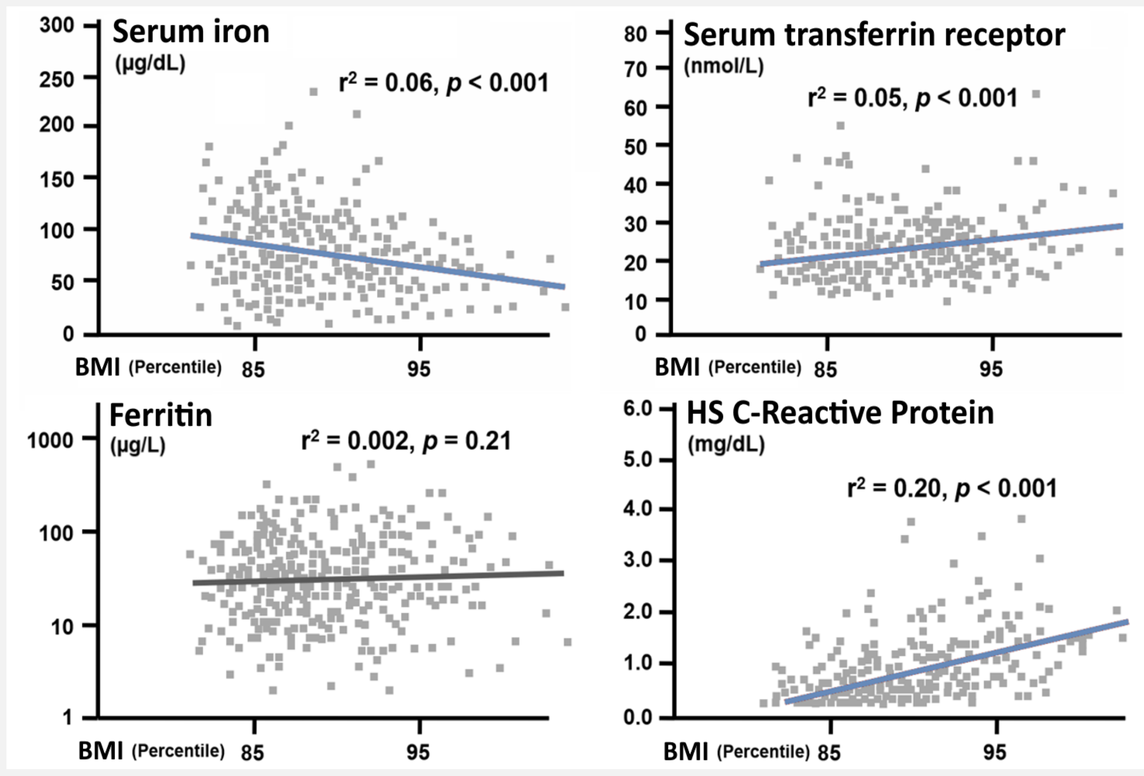
IRON DEFICIENCY PREDICTORS IN THE OBESE

Logistic Regression Model

r2 = 0.33, p < 0.001

	OR	CI 95%	*p*-value
Serum Transferrin Receptor	1.5	1.2 – 3.0	0.001
Ferritin	0.8	0.6 – 1.9	0.31

UNIVARIATED ASSOCIATIONS



SERUM IRON PREDICTORS

Multiple Linear Regression Model

$r^2 = 0.33$, p < 0.001

- Serum Transferrin Receptor → 72%
- Ferritin
- Hs-Crp

BMI was no longer an independent predictor

Iron intake was not a significant predictor

DISCUSSION

In paediatric obese patients, hypoferraemia is caused both by real iron deficiency and by inflammatory-mediated iron sequestration. Obesity induced inflammation is related to oxidative stress and release of several cytokines (TNF α, IL-1, IL-6, PAI-1) and adipokines (leptin, resistin) . Hepcidin is the key regulator of iron homeostasis. These inflammatory molecules stimulate hepcidin synthesis that decreases iron absorption and inhibit reticulo-endothelial iron release, conditioning its bioavailability in the obese.

Reducing weight and inflammation seem to be the key to interrupt this vicious circle.

REFERENCES

1. Real J. et al. Mechanisms linking glucose homeostasis and iron metabolismo toward the onset and progression of Type 2 Diabetes. *Diabetes care*.2015; 38: 2169-2176
2. Menzie CM et al. Obesity-Related Hypoferremia Is Not Explained by Differences in Reported Intake of Heme and Non-Heme Iron orIntake of Dietary Factors that Can Affect Iron Absorption. *J Am Diet Assoc*.2008;108(1):145–148.
3. Yanoff LB et al. Inflammation and iron deficiency in the hypoferremia of obesity. *Int J Obes (Lond)*. 2007; 32(9): 1412–1419.
4. Moayeri H et al. Increasing prevalence of iron deficiency in overweight and obese children and adolescents: Tehran AdolescentObesity Study. Eur J Pediatr. 2006; 165: 813 -814
5. Nead KG et al. Overweight children and adolescents: risk group for iron deficiency. Pediatrics. 2004;114:104-108.
6. Pinhas-Hamiel O et al. Greater prevalence of iron deficiency in overweight and obese children and adolescents. Int J Obes Relat Metab Disord. 2003; 27: 416 –418.
7. Guido D'Angelo. Role of hepcidin in the pathophysiology and diagnosis of anemia. Blood Research. 2013, 48 (1): 10-15