Impaired Iron Status in Severely Obese Bariatric Surgery Candidates is Multifactorial

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Introduction

It is established that obese individuals have poorer iron status compared to their normal weight counterparts; the cause of which is unknown. Potential theories have implicated inflammation, poor nutrition, increased physiological iron requirements, deprivation, and increased incidence of other pathology that may cause iron depletion.

Aims:

- **To determine the prevalence of iron deficiency and anaemia in a severely obese cohort of bariatric surgery candidates**
- **To explore underlying associations with markers of nutrition and inflammation**

Methods

In a retrospective review of 703 consecutive patients presenting for bariatric surgery assessment, 656 were evaluated after exclusions for haemoglobinopathy and missing data.

Assessment included:

- Clinical history: comorbidities, current medications, multivitamin use, smoking, alcohol
- Basic anthropometry: weight and height used to calculate indirect measures of adiposity; body mass index (BMI) and percentage body fat via the CUN-BAE equation
- Blood tests: haemoglobin (Hb), serum iron, total iron binding capacity, iron binding saturation, ferritin, vitamin B_1, vitamin B_{12}, folate, white cell count (WCC), and C-reactive protein (CRP)

Definitions:

- Anaemia; men: Hb<13g/dl, or women: Hb<12g/dl
- Iron deficiency; an abnormality in two or more measures of iron status

Results

Anaemia and iron deficiency were present in 9.9% and 11.4% of patients, respectively. Anaemia was more common in females than males (11.6 vs 8%), an expected observation; however the rate of anaemia in this population of men was much higher than that seen in the general population (1.3%) estimated from the National Diet and Nutrition Survey.[1]

Iron status of candidates was associated with BMI, as seen in Figure One.

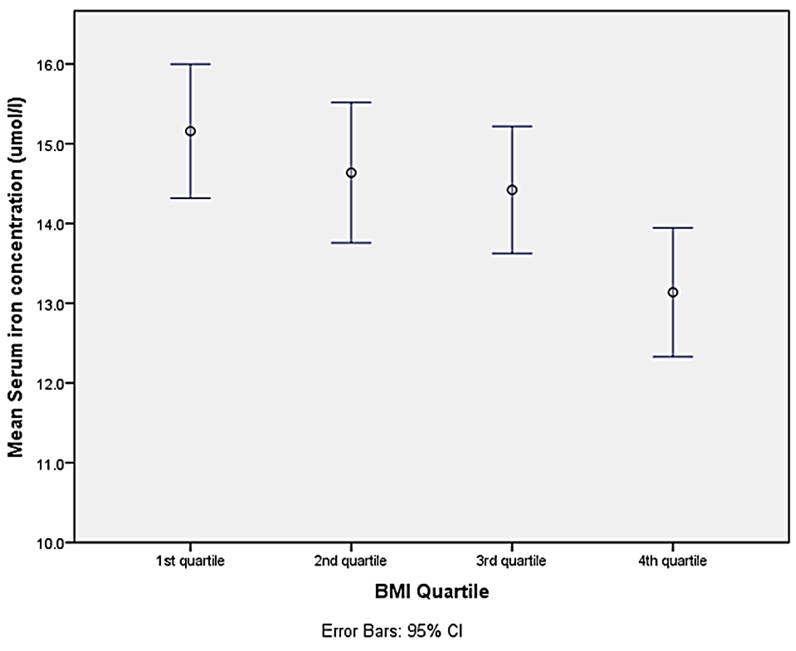


Figure One: Mean serum iron concentrations of obese bariatric surgery candidates according to BMI quartile.

ANOVA confirms a significant difference (p=0.006).

BMI was also related with proxy measures of inflammation; Figure Two.

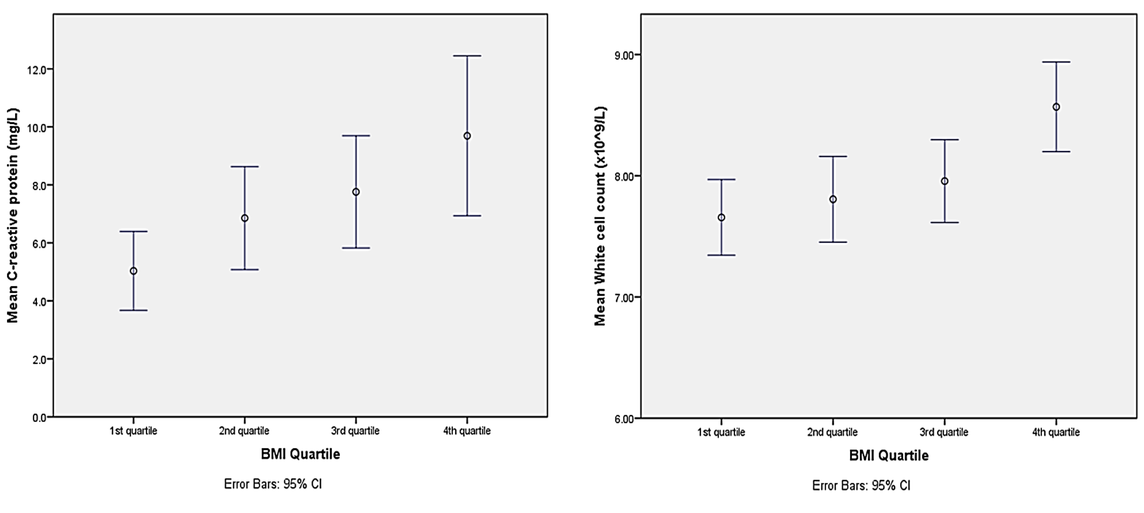
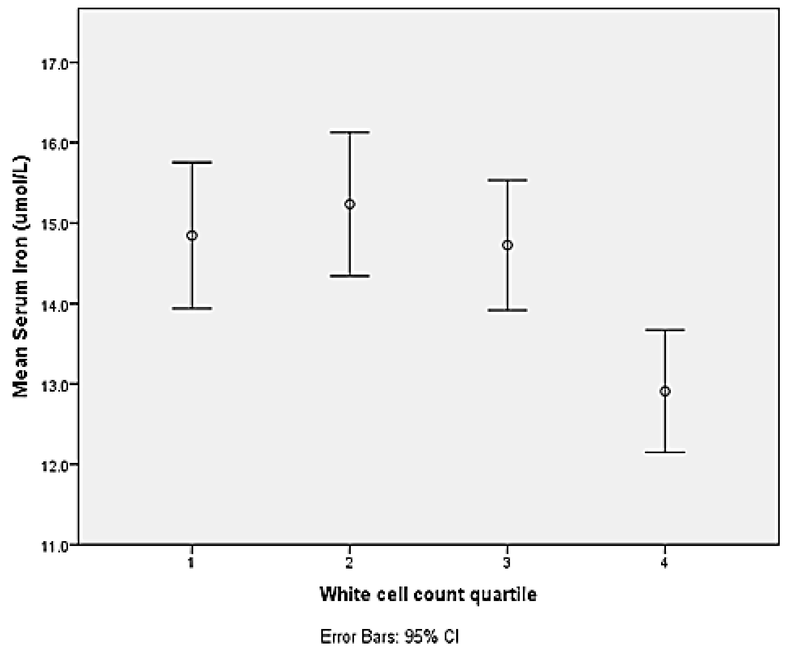
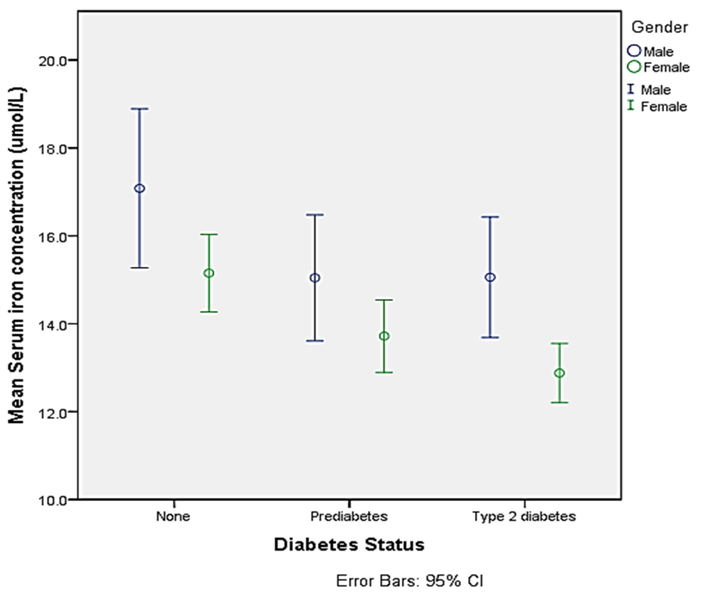


Figure Two: Proxy measures of inflammation (CRP and WCC) according to BMI quartile. ANOVA proves significance; p=0.013 and p=0.003 respectively.

Serum iron concentration is also associated with markers of inflammation. Dividing the cohort into quartiles of white cell count data shows that those that had the higher rates of inflammation had lower mean serum iron concentration (ANOVA; p=0.001), Figure Three.

Figure Three: Mean serum iron concentration according to quartile of white cell count.





Examining relationships between iron deficiency and other nutritional deficiency with chi-squared tests revealed no association.

Diabetes status was found to have an association with serum iron concentration, as seen in Figure Four. Patients with type 2 diabetes and prediabetes have lower mean serum iron concentrations than those with no history of diabetes.

Figure Four: Mean serum iron concentration according to diabetes status and gender.

Stepwise regression was performed with independent predictors of serum iron concentration – age, gender, BMI, BF%, index of multiple deprivation, diabetes status, number of comorbidities, WCC, CRP, folate, vitamin B_{12}, and use of multivitamins, metformin, insulin, non-steroidal anti-inflammatory drugs (NSAIDs) or proton pump inhibitors.

This revealed a highly significant association between serum iron concentration and CRP (R^2=0.227, p=0.001) . Of 656 patients analysed, unfortunately only 24% (n=156) had CRP measurements. Thus, this may not reflect the relationship among the whole cohort.

Excluding CRP from the regression analysis revealed that WCC had the largest independent effect on serum iron concentration. In this model, NSAIDs, gender and diabetes status also contributed (R^2=0.076, p<0.001). Although this model exhibited a significant association, it was much weaker than that found between serum iron and CRP.

Limitations

- This was a retrospective observational study so causality cannot be determined.
- Although the cohort was large, some biochemical data was not available for all patients.
- As these were only severely obese individuals, relationships with BMI or BF% may not be observed correctly due to the limited range
- Hepcidin has been acknowledged to have an important role in iron homeostasis, and it is suggested that it plays a role in the iron deficiency of obesity. Hepcidin is not measured routinely prior to bariatric surgery in our patients, thus this data is lacking.

Conclusions

Anaemia and iron deficiency are relatively common in severely obese individuals. This investigation has shown that the relationship between obesity and poor iron status is complicated by many factors. The strong associations observed between serum iron concentration and CRP suggests that inflammation has a significant role, however only 20% of the variation is explained from this variable, hence a multifactorial aetiology is likely.

References:

1. Bates, B., Lennox, A., Prentice, A., Bates, C., Swan, G., (2012). "National diet and nutrition survey: Headline results from years 1, 2, and 3 (combined) of the rolling programme (2008/2009-2010/2011)". Department of Health. Available at: http://transparency.dh.gov.uk/2012/07/25/ndns-3-years-report/, date visited: 01/03/13.