# The Effect of Iron Intervention on the Anthropometric Parameters: Pilot Study among Egyptian Preschool Children with Iron Deficiency Anemia

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## INTRODUCTION AND OBJECTIVES

- ✓ Iron deficiency anemia (IDA) is a global public health problem affecting 1.62 billion people, with the highest prevalence in preschool children (47%) especially in third world countries [1].
- ✓ Iron affects growth by its major role in multiple metabolic processes; oxygen transport, DNA synthesis and electron transport. Iron-sulfur clusters are essential cofactors of proteins involved in enzyme catalysis, electron transport and regulation of gene expression[2]. Also, IDA affects growth through IGF-I dependent mechanism; IGF-I concentration has an important role in iron metabolism and protoporphyrin synthesis in children [3]. In IDA, plasma norepinephrine and urinary epinephrine and norepinephrine are increased in addition to elevated metabolic rate leading to slower growth rates and lower body weights of IDA patients [4].
- ✓ We aimed at investigating the iron status in preschool children with IDA and its association with the degree of growth retardation at presentation, and detecting the effect of iron supplementation on growth velocity.

## METHODS

- ➢ The records of all IDA patients and the baseline and data of follow-up visits were reviewed (the age at presentation, onset and duration of anemia, symptoms of IDA, complete clinical examination and anthropometric assessment (weight and height). Anthropometric measurements were done in DEMPU outpatient clinic using the Egyptian percentile curves for children at baseline and at follow-up visits. Measurements were recorded every 3 months for all subjects and the Growth vision computer software provided by Novo Nordisk was employed to assess length standard deviation score (SDS) and weight SDS to assess linear growth. This software also calculated GV and GV SDS during the period for both groups.
- ➢ Laboratory Investigations including CBC was performed for both groups with determination of different indices as MCV, MC, MCHC, RDW, Hb level and Hct. Serum iron and ferritin were performed for patients and controls by a colorimetric methods and ELISA respectively.
- ➢ Iron Intervention in the form of oral iron supplementation of ferrous sulfate with a dose of 6 mg/kg/day of elemental iron in 2-3 divided doses are given between meals.
- ➢ Follow up of Laboratory and Anthropometric indices were performed for all the cases every three months and for one year after starting iron therapy by measuring the blood indices Hb, Hct, MCV, MCH, and MCHC), and iron indices (serum iron, and serum ferritin) for the patient group and assessment of weight and height at each clinical visit (at 0, 3, 6, 9, 12 months, not necessarily attending the whole visits; at least 3 visits are required including essentially the first and the last visits). For controls, sampling and anthropometric measurements were only done in the first and last visits.

Figure (1): Correlation between Height SDS and Hemoglobin level among studied cases after iron therapy.

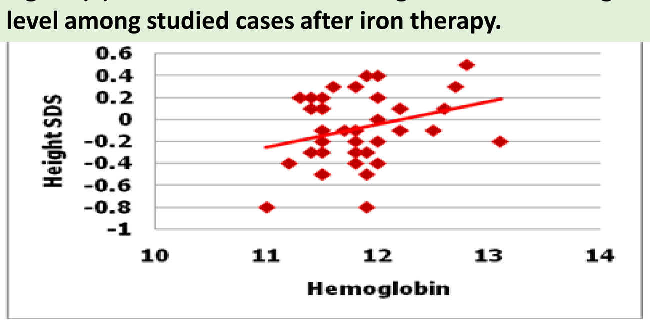



Figure (2): Correlation between Height SDS and the level of ferritin among studied cases after iron therapy.

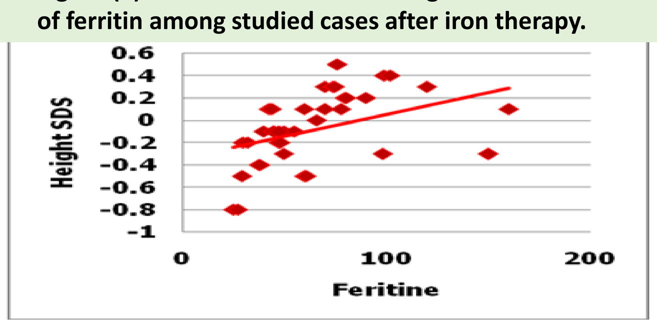



Table (3): Comparison between cases and controls as regarding one year height velocity and its GV SDS

| Variables | Cases N=40 | Controls N=40 | P value |
|---|---|---|---|
| One year height velocity (cm/y) | 12.1+1.4 | 9.9+1.5 | <0.001 |
| One year height velocity SDS (GV SDS) | 2.1+1 | 1.5+1 | <0.001 |

GV SDS: growth velocity standard deviation score. P value < 0.05 is significant

Figure (3): Correlation between serum ferritin and BMI among studied cases after iron therapy.

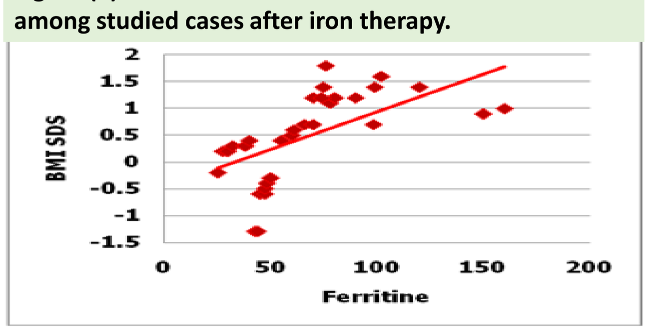
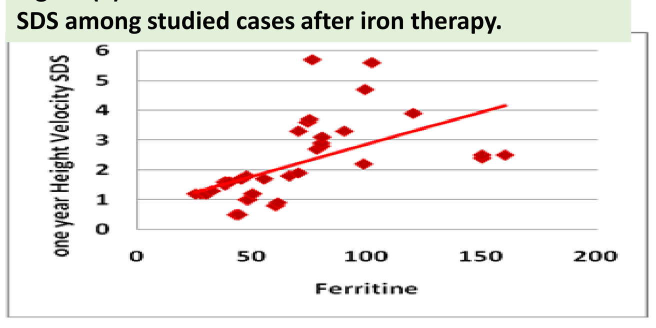



Figure (4): Correlation between serum ferritin and GV SDS among studied cases after iron therapy.




## RESULTS

- ✓ Eighty children; 40 children having IDA (34 males and 6 females) with mean age (2±0.8 years) were compared to a control group including 40 healthy clinically non-anemic, age and sex-matched subjects (mean age 2.7±1.1years; 25 males and 15 females). No statistically significant difference between both cases and control groups as regard age, sex and target height SDS (-0.76+0.9 and -0.46+0.8 respectively) thus excluding familial short stature in both groups.
- ✓ Gradual improvement in the anthropometric parameters including height SDS, weight SDS and BMI SDS, and the hematological parameters including Hb, Hct, MCV, MCH, MCHC, RDW, serum iron and serum ferritin in the subsequent visits starting from the 2nd visit to the 5th visit after treatment with significant difference in comparison to the level before treatment (1st visit). The percent of change in each subsequent visit (starting from the 2nd visit) was calculated in relation to the first visit (in which no treatment was given yet) in each subsequent visit (table 1).
- ✓ The height SDS, weight SDS, BMI SDS in 1st and last visits of the cases is significantly lower than those of the controls in corresponding visits, but the difference is narrower in the last visit. Hb levels, Hct, MCV, MCH, MCHC, RDW, serum ferritin and serum iron in 1st visit of the cases were significantly lower than those of the controls in the same visit. After treatment (in the last visit), no significant differences were found in MCHC, RDW and serum iron between both groups, however as regards Hct, MCH and serum ferritin the differences were narrower (nearly no difference) in the last visit. No significant difference between both cases and controls as regards MCV and Hb levels after treatment (table 2).
- ✓ On comparing between cases and controls as regards the GV (one year height velocity) and GV SDS of cases were found significantly higher than controls (table 3).
- ✓ At the end of the study (5th visit), a significant positive correlations between each of the height SDS and the Hb levels and serum ferritin of the studied cases were found (figure 1, 2). Also, significant positive correlations between the serum ferritin level and each of GV SDS and BMI SDS of the studied cases after the treatment were detected (figure 3, 4).

Table (1): Changes in anthropometric and hematological parameters among studied cases before and after iron therapy.

| Variable Mean ± SD (% of change) | 1st visit | 2nd visit | 3rd visit | 4th visit | 5th visit | p-value |
|---|---|---|---|---|---|---|
| Height SDS | -1.2±0.3 | -0.84±0.3 (33%) | -0.5±0.2 (58%) | -0.29±0.2 (75%) | -0.07±0.2 (94%) | <0.001 |
| Weight SDS | -1.08±0.4 | -0.94±0.35 (10%) | -0.79±0.35 (25%) | - 0.69±0.38 (40%) | -0.53±0.37 (53%) | <0.001 |
| BMI SDS | 0.3±0.5 | 0.4±0.6 (22.4%) | 0.5±0.7 (35.9%) | 0.6±0.8 (38%) | 0.7±0.8 (25.2%) | <0.001 |
| Hb% gm/dl | 8.6±0.4 | 9.9±0.5 (11.6%) | 10.6±0.6 (23.6%) | 10.8±1.7 (23%) | 11.8±0.4 (35%) | <0.001 |
| Hct | 27.9±1.6 | 31±2.1 (15%) | 32.3±2 (18%) | 33.7±1.8 (22%) | 34.7±1.8 (26%) | <0.001 |
| MCV fl | 64.5±5 | 68.2±4 (6%) | 72.2±5 (13%) | 74.5±4 (15%) | 76.7±2.6 (19%) | <0.001 |
| MCH pg | 20.3±2.6 | 22.3±2.4 (10%) | 24.5±1.5 (21%) | 25.1±1.3 (25.5%) | 26.6±1.4 (32.5) | <0.001 |
| MCHC g/dl | 30±1.3 | 31.4±1.4 (4%) | 32.8±0.9 (7.61%) | 33.1±2 (12.7%) | 34.6±1.4 (16.8%) | <0.001 |
| RDW % | 22.1±2 | 19.4±2 (14.6%) | 18±2.6 (18%) | 16.3±1.6 (27.2%) | 15.1±1.2 (31.8%) | <0.001 |
| Serum iron µg /dl | 13.5±6 | 29.2±13 (120%) | 42.2±20 (220.8%) | 63±31 (340.6%) | 80.6±31 (531.8%) | <0.001 |
| Serum ferritin pg/l | 10.4±3 | 20.8±10 (130.6%) | 32.7±10 (210.8%) | 45.3±14 (330.6%) | 66.8±31 (521.8%) | <0.001 |

Table (2): Comparison between cases and controls as regards anthropometric and hematological parameters in 1st and last visit (5th visit).

| Variable Mean ± SD | 1st visit | | 5th visit | | p-value |
|---|---|---|---|---|---|
| | Cases (1) N=40 | Controls (2) N=40 | Cases (3) N=40 | Controls(4) N=40 | |
| Height SDS | -1.2±0.3 | 0.5±0.4 | -0.07±0.2 | 1±0.4 | 1 vs 2 (<0.001) 3 vs 4 (<0.001) |
| Weight SDS | -1.08±0.4 | 0.06±0.8 | -0.53±0.37 | 0.4±0.6 | 1 vs 2 (<0.001) 3 vs 4 (<0.001) |
| BMI SDS | 0.3±0.5 | 0.5±1.1 | 0.7±0.8 | 0.8±0.7 | 1 vs 2 (<0.001) 3 vs 4 (<0.05) |
| Hb% | 8.6±0.4 | 11.5±0.4 | 11.8±0.4 | 11.6±0.3 | 1 vs 2 (<0.001) 3 vs 4 (>0.05) |
| Hct | 27.9±1.6 | 34.8±1.9 | 34.7±1.8 | 34.8±1.6 | 1 vs 2 (<0.001) 3 vs 4 (<0.05) |
| MCV | 64.5±5 | 76.6±3.5 | 76.7±2.6 | 76.3±3 | 1 vs 2 (<0.001) 3 vs 4 (>0.05) |
| MCH | 20.3±2.6 | 25.7±1.2 | 26.6±1.4 | 25.3±1.3 | 1 vs 2 (<0.001) 3 vs 4 (<0.05) |
| MCHC | 30±1.3 | 33.2±1.2 | 34.6±1.4 | 33.3±1.2 | 1 vs 2 (<0.001) 3 vs 4 (>0.05) |
| RDW | 22.1±2 | 15.3±1.1 | 15.1±1.2 | 15.4±1.2 | 1 vs 2 (<0.001) 3 vs 4 (>0.05) |
| Serum iron | 13.5±6 | 78.2±32 | 80.6±31 | 80.4±26 | 1 vs 2 (<0.001) 3 vs 4 (>0.05) |
| Serum ferritin | 10.4±3 | 83.6±39 | 66.8±31 | 75.7±35 | 1 vs 2 (<0.001) 3 vs 4 (<0.05) |

% of change: the percent of change is calculated in relation to the first visit (in which no treatment was given yet) in each subsequent visit., SD: standard deviation, SDS: standard deviation score, BMI: body mass index, Hct %: hematocrit percent, Hb %: hemoglobin percent in gm/dl, MCV: mean corpuscular volume in fl, MCH: mean corpuscular, hemoglobin in pg, MCHC: mean corpuscular hemoglobin concentration in g/dl, RDW %: red cell distribution width percent. All data are presented as mean ± standard deviation, P value < 0.05 is significant,

## CONCLUSIONS

- ➢ This study showed that iron therapy resulted in gradual improvement in the different anthropometric parameters namely height SDS, weight SDS BMI SDS and GV as well as, the hematological parameters including Hb, Hct, MCV, MCH, MCHC, RDW, serum iron and serum ferritin in a preschool Egyptian cohort group suffering from IDA.
- ➢ One important observation of this study was the significant positive correlation between serum ferritin and both of GV SDS and BMI SDS, as well as a significant positive correlation between height SDS and each of Hb level and serum ferritin levels (after one year of treatment). Thus, IDA during the first 6 years of life, when growth is fast, adversely affects both linear growth and weight gain which is reversible with iron therapy, hence, adequate iron status is crucial for normal growth (both height and weight).

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