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Correlation between Serum Lipid Profile and Iron Deficiency Anemia in Children in Southeast of Iran

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ABSTRACT

Background: Iron deficiency, is a common worldwide complication, especially in preschool children. Iron deficiency anemia (IDA) is associated with changes in the mental and motor development, defects of immune system, cardiovascular, diseases and disruption of lipid profile. In IDA, the occurrence of dyslipidemia is controversial. We aimed to investigate the association between IDA and serum lipid concentration.
Methods: In this comparative cross-sectional study, 41 children with confimed IDA and 39 healthy children were evaluated. Hemoglobin, Hematocrit, serum ferritin level, triglyceride (TG), total cholesterol (TC), low density lipoprotein (LDL), high density lipoprotein (HDL) and anthropometric indices including weight, height, and body mass index were assessed.
Results: The mean±SD age of children with IDA and control group were 10.7±3.5 years and 9.5±3.2 years, respectively (P=0.45). Mean±**SD** serum lipid profile in control vs IDA groups were as follows: TG (86.1±36.9 vs 88.6±33.5 mg/dl), TC (151.7±28.7 vs 148.9±29.2 mg/dl), LDL (78.4±29.1 vs 88.1±**22.6** mg/dl) and HDL (54.2±13.1 vs 52.5±10.1 mg/dl). The results showed no statistically significant difference between IDA and control groups. Slightly increased but not significant TG and LDL levels were observed in the IDA group compared with the control group.
Conclusions: Theses findings indicated that there was no significant difference between IDA and control group in terms of serum lipid concentrations.

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Introduction

Anemia is defiend as the reduction of concentration of hemoglobin in the body to less than the normal level.[1] Iron deficienciy anemia (IDA) is a common worldwide disease afflicting about 1.62 billion (24.8%) people worldwide. In preschool-age children, anemia with an incidence of 47.4% is more prevalent and has affected 293 million children globally.[2] Iron depletion, iron deficient erythropoiesis, and IDA are mild, moderate and severe classifications of iron depletion, respectively.[3] Iron has many functions in the body such as oxygen transport, neurological function, enzymatic reaction, neurotrasmitter metabolism, changes in the mental and motor development, defects of immune system, cardiovascular diseases and disruption of the lipid profile.[4,5] Hyperlipidemia increases susceptibility to coronary heart disease (CHD) as the major cause of morbidity and premature mortality.[5] Although many studies have indicated that serum lipid concentrations increase following iron consumption, dyslipidemia in IDA is controversial.[4] Increasing serum lipid levels

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lead to increasedlipid oxidation and atherosclerotic diseases.[3,6] Plasma fatty acid metabolism and cell membrane composition are different in various iron states. Malnutrition in children is associated with decreased serum concentration of polyunsaturated fatty acid. In vegetarian adults low iron status disrupts fatty acid metabolism by decrease in the activities of **Δ9, Δ6,** and **Δ5** desaturases.[7,8] Some studies have reported that hypocholesterolemia and atherosclerosis is associated with anemia,[9] although it is controversial.[10] There is evidence that severe anemia in girls is associated with lower concentration of total cholesterol and triglyceride than subjects with high hemoglobin level.[3] We aimed to investigate the association between IDA and serum lipid concentrations.

Material and Methods

A comparative cross-sectional study was conducted on children with IDA and control group. Forty-one children with IDA (23 boys and 18 girls) aged 10.7±3.5 years (range 4.5–16 years) were selected as the IDA group and 39 healthy children (21 boys and 18 girls) aged 9.5±3.2 years (range 4-15 years) that were referred for check-up were included in the study as control group. Informed consent was obtained from the parents of the children. The diagnosis of IDA was made when the following criteria were met: Hemoglobin <11 g/dL for ages between 2-4 yr, <11.5 g/dL for 5-7 yr, <12 g/dL for 8-11 yr, and in females <12 g/dL for ages between 12-17 yr, in males <12.5 g/dL for 12-14 yr and <13 g/dL for 15-17 yr; and ferritin level <12 ng/mL for age <5 years and < 15 ng/mL for age <17 years.[11] Ethical aspects of the study were approved by the Ethics Committee of The School of Medicine.

Anthropometric indices, including weight (to the nearest 0.1 kg) and height (to the nearest 0.1 cm) were measured without shoes and wearing light clothing by a trained staff. Body Mass Index (BMI) was calculated by weight (Kg) divided by height squared (m^2). Subjects with acute infectious diseases, any anemia except IDA, malabsorption, maternal lipid metabolism disorder, familial hyperlipidemia and coronary heart disease before the age of 40 and those with history of inflammatory disease among the parents were excluded from the study.

Venous blood samples were drawn over a minimum 12 hours overnight fasting period. Red Blood Cells (RBC), Hemoglobin (Hb), Hematocrit (HCT), Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH) and Mean Corpuscular Hemoglobin Concentration (MCHC), Red Cell Distribution Width (RDW), Platelet (PLT) were measured using SysmeKX-21N cell counter device(Japan). Plasma ferritin was measured by ELISA method. Triglyceride (TG), Total cholesterol (TC), High Density Lipoprotein (HDL) and Low Density Lipoprotein (LDL) were determined enzymatically by using commercial analytical kits form BioMerieux (RCS Lyon, France).

Statistical Analysis

Statistical analysis was performed using version 16 of the Statistical Package for the Social Sciences (SPSS Inc., Chicago IL, USA). The data were presented as the mean ± standard deviation (SD) for continuous variables. Student's t-test was used to compare the mean values of the two groups (with normal iron and iron-deficiency status). Data normal distribution were assessed by Kolmogorov-Smirnov test before further analyses. All statistical tests were two-sided at the P<0.05 significance level.

Results

The study group consisted of children with IDA (18 girls and 23 boys) agd 4.5-16 years. Thirty nine healthy sex-matched children (18 girls and 21 boys) within the same age group were enrolled as the control group. The two groups were matched based on their sex, age, weight, height and BMI in the control and IDA groups. Demographic characterestics of IDA and control groups are shown in table 1.

Hematologic characteristics are shown in table 2. As expected, mean of RBC, HB, HCT, MCV, MCH, MCHC and Ferritin level were lower, but RDW and PLT were higher in the IDA group. This difference between two groups were significant (P<0.05).

The Kolmogorov-Smirnov test showed all data have normal distribution. The results showed no statistically significant difference (P. value > 0.05) between IDA and control groups in terms of serum lipid profile (table 3) including Triglyceride (TG), Total Cholestrol (TC), Low Density Lipoprotein (LDL) and High Density Lipoprotien (HDL).

Discussion

Anemia is a very common disease and is estimated that one-quarter of the world's population suffer from it. Preschool children and women are more susceptible to develop anemia. This problem dramatically increases in people who live in Asia and Africa. About two-thirds of preschool-aged children living in Africa are anaemic.[12] In this study, we investigated the association between IDA and serum concentrations of TG, TC, HDL cholesterol and LDL cholesterol. The findings showed there was no

Table 1: Demographic and anthropometric indices of IDA and control groups

Parameter	IDA group (N=41)	Control group (N=39)	P value
Male gender	23(56.1%)	21(53.8%)	0.84
Age(year)	10.7±3.5	9.5±3.2	0.45
Weight(kg)	30.1±11.9	30.2±**13.7**	0.97
Height(cm)	133.3±**20.6**	132.9±19.7	0.95
BMI(kg/m²)	16.2±1.1	16.2 ± 3.3	0.95

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Table 2: Comparison of hematologic parameters between IDA and control groups

Parameter	IDA group (N=41)	Control group (N=39)	P value
RBC (10^6/mm^3)	4.56±0.43	4.96±0.33	<0.0001
Hb (g/dL)	10.9±0.63	13.5±1.08	<0.0001
HCT(%)	33.1±2.9	40.6±2.8	<0.0001
MCV (fl)	73.1±4.2	81.1±3.5	<0.0001
MCH (pg)	23.8±1.9	26.9±1.7	0.001
MCHC(%)	31.8±2.1	33.1±1.3	0.001
RDW	15.1±1.2	12.9±0.7	<0.0001
PLT(10^3/mm^3)	379±79	286±59	<0.0001
Ferritin (ng/ml)	10.1±3.3	53.6±29.2	<0.0001

Table 3: Comparison of the lipid profile between IDA and control groups

Parameter	IDA group (N=41)	Control group (N=39)	P value
Triglyceride (mg/dL)	88.6±33.5	86.1±36.9	0.50
Cholesterol (mg/dL)	148.9±29.2	151.7±28.7	0.90
LDL (mg/dL)	88.1±22.6	78.4±29.1	0.80
HDL (mg/dL)	52.5±10.1	54.2±13.1	0.70

significant difference between anemic and control groups in the mean serum lipid concentrations. Iron deficiency in human and animal studies has demonstrated contradictory lipid changes. Although some studies showed lower serum cholesterol levels in the IDA patients,[13] others mentioned that the mean total cholesterol (TC) and low density lipoprotein cholesterol (LDL-C), LDL-C/high density lipoprotein cholesterol (HDL-C) and TC/HDL-C ratios of the IDA group were significantly lower than the control and triglyceride and apolipoprotein B (apoB) values showed no difference between patient and control groups, while HDL-C level were higher in patient group.[5] Others have claimed that IDA does not have any effect on developmentof hyperlipidemia.[14,15]

Our results are in agreement with another study in which mild iron deficient and non-anemic groups were compared. Although in that study anemic girls (14–18 years) with Hb lower than 8.0 g/dL showed significant difference in concentrations of TC and TG, but not in HDL-C and LDL-C. Moreover, significant increase in serum TC and TG were observed when anemic girls received iron supplementation.[3] On the other hand, another study showed that IDA led to an increase in serum lipids. They mentioned that disruption in carnitine metabolism and reduction of serum free carnitine concentration was the reason for increased serum lipids. Finally, they concluded that there is a negative correlation between serum free carnitine and total triglyceride levels in iron deficient patients and hence hyperlipidemia could be a risk factor for premature cardiovascular disease.[4]

Although serum cholesterol level is affected by many factors,[16] diet is the most common determining factor.[17] Studies in rats have shown that poor iron diet (9 mg iron/kg) leads to increased concentrations of triacylglycerols of VLDL and LDL, whereas triacylglycerol concentration of HDL remained unchanged.[18]

Although Copra and et al. study showed that there was a direct association between serum iron and ferritin levels to CHD risk factors,[19] whether hypolipidemia found in diets deficient in energy, protein, and other nutrients, which are sometimes associated with IDA, has either protective effects in development of CHD is ambiguous.

Conclusion

lipid profile of serum is affected by many factors, hence the variations of lipid concentration in IDA may not be related to iron deficiency by itself. In our study, TG showed no statistically significant difference among two groups, while a slight increase in TG and LDL was observed in the anemic group comparing to the control group.

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Conflict of Interest: None declared.

References

1. Ghosh K. Non haematological effects of iron deficiency-a perspective. Indian J Med Sci. 2006;60(1):30-7. PubMed PMID:16444088.
2. Benoist BD, McLean E, Egll I, Cogswell M (Editors). Worldwide prevalence of anaemia 1993-2005: WHO global database on anaemia. 2008.
3. Choi JW, Kim SK, Pai SH. Changes in serum lipid concentrations during iron depletion and after iron supplementation. Ann Clin Lab Sci. 2001;31(2):151-6. PubMed PMID: 11337904.
4. Tanzer F, Hizel S, Cetinkaya O, Sekreter E. Serum free carnitine and total triglyceride levels in children with iron deficiency anemia. Int J Vitam Nutr Res. 2001;71(1):66-9. doi:10.1024/0300-9831.71.1.66. PubMed PMID: 11276925.
5. Ece A, Yigitoglulu MR, Vurgun N, Guven H, Iscan A. Serum lipid and lipoprotein profile in children with

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iron deficiency anemia. Pediatr Int. 1999;41(2):168-73. PubMed PMID: 10221021.

6. Gackowski D, Kruszewski M, Jawien A, Ciecierski M, Olinski R. Further evidence that oxidative stress may be a risk factor responsible for the development of atherosclerosis. Free Radic Biol Med. 2001;31(4):542-7. PubMed PMID: 11498287.
7. Smuts C, Tichelaar H, Van Jaarsveld P, Badenhorst C, Kruger M, Laubscher R, et al. The effect of iron fortification on the fatty acid composition of plasma and erythrocyte membranes in primary school children with and without iron deficiency. Prostaglandins Leukot Essent Fatty Acids. 1995;52(1):59-67.
8. Krajcovicová-Kudlácková M, Klvanová J, Dusinská M. Polyunsaturated Fatty Acid Plasma Content in Groups of General Population with low vitamin B6 or low iron serum levels. Ann Nutr Metab. 2004; 48(2):118-21. doi:10.1159/000077068. PubMed PMID: 14988642.
9. Dabbagh AJ, Mannion T, Lynch S, Frei B. The effect of iron overload on rat plasma and liver oxidant status in vivo. Biochem J.1994;300(3):799-803. PubMed PMID: 8010963. PubMed Central PMCID: PMC1138237.
10. Dabbagh AJ, Shwaery GT, Keaney JF, Frei B. Effect of iron overload and iron deficiency on atherosclerosis in the hypercholesterolemic rabbit. Arterioscler Thromb Vasc Biol.1997;17(11):2638-45. PubMed PMID: 9409237.
11. Kliegman RM, Stanton BF, Geme JS, Schor NF, Behrman RE. The anemias. In: Lerner NB. Nelson text book of pediatrics. 20th ed. Philadelphia, USA: Saunders Elsevier; 2015:2309-12.
12. McLean E, Cogswell M, Egli I, Wojdyla D, De Benoist B. Worldwide prevalence of anaemia, WHO vitamin and mineral nutrition information system, 1993–2005. Public Health Nutr. 2009; 12(4): 444-54. doi:10.1017/S1368980008002401. PubMed PMID: 18498676.
13. Au PY, Schilling RF. Relationship between anemia and cholesterol metabolism in 'sex-linked anemic' (gene symbol, sla) mouse. Biochim Biophys Acta. 1986; 883(2):242-6. PubMed PMID: 2874831.
14. Guthrie HA, Froozani M, Sherman AR, Barron GP. Hyperlipidemia in offspring of iron-deficient rats. J Nutr.1974; 104(10):1273-8. PubMed PMID: 4413733.
15. Amine EK, Desilets EJ, Hegsted D. Effect of dietary fats on lipogenesis in iron deficiency anemic chicks and rats. J Nutr. 1976;106(3):405-11.
16. Aydin E, Yigitoglu MR, Vurgun N, Guven H, Iscan A. Serum lipid and lipoprotein profile in children with iron deficiency anemia. Pediatr Int. 1999;41(2):168-73. PubMed PMID: 10221021.
17. Kannel WB, Dawber TR, Friedman GD, Glennon WE, Mcnamara PM. Risk factors in coronary heart disease: an evaluation of several serum lipids as predictors of coronary heart disease: The Framingham Study. Ann Intern Med. 1964;61(5_Part_1):888-99. PubMed PMID: 14233810.
18. Stangl GI, Kirchgessner M. Different degrees of moderate iron deficiency modulate lipid metabolism of rats. Lipids. 1998;33(9):889-95. PubMed PMID: 9778136.
19. Chopra S, Lal AK, Huria A, Dhar M. Relationship between body iron status and cardiovascular risk factors in patients with coronary artery disease. J Cardiovasc Dis Res.2015;6(1):18-22.