Research Journal of Biological Sciences 2 (3): 263-267, 2007

Relation Between Iron Deficiency and Anemia Whit School Success, Weight and Height in Schoolgirls Aged 12 Year Old in Ardebil Province of Iran, 2005

[1]A. Nemati, [2]M. Barak, [3]M.H. Dehghan, [1]H. Alimohammadi, [1]G.H. Ettehad,
[1]Naghizadeh Baghi, [1]J. Arvin, [1]R. AliPanah Mogadam and [3]N. Abbasgholizade
[1]Department of Baisic Sciences, [2]Department of Pediatrics,
Faculty of Medicine, Ardebil University of Medical Sciences, Ardebil, Iran
[3]College of Health, Ardebil University of Medical Sciences, Ardebil, Iran

Abstract: Iron Deficiency Anemia (IDA) in children has been associated with retardation in growth and the cognitive development. IDA affecting the general health and wellbeing of millions in the world. The main purpose of this study was to determine the prevalence of iron deficiency anemia and relation between of it with height, weight and school success in schoolgirls aged 12 years in Ardebil. Cross sectional study was carried on 170 schoolgirls aged 12 years in Ardebil province of Iran during 2005. The anthropometric measurements included Weight (Wt), Height (Ht). Blood samples were collected for iron status parameters such as Hemoglobin (Hb), Hematocrit (Hct), Mean Corpuscular Volume (MCV), Total Iron Binding Capacity (TIBC) and ferritin. Educational progression for school girls and parental educational levels were recorded. Results were analyzed by t-test statistics method. The prevalence of IDA, Iron Deficiency (ID) and anemia was performed. Our results showed that the prevalence of IDA, anemia and ID was 1.7, 3.5 and 23.5%, respectively. There was height significant between anemic and non anemic girls ($p = 0.001$). Weight and height had not significant different between anthropometric factors and ID and IDA. The mean of average score test in two groups of negative and positive IDA and anemia was significantly different in $p = 0.021$ and $p = 0.001$, respectively but was not significant average score test in two groups of ID. Relation between Hb and height, weight and average test score was positively significant ($p<0.05$). No statistically significant difference was found between IDA, ID, anemia and level of parental education. This show the prevalence of IDA, ID and anemia are low in school girls aged 12 years and could affect on education progress and some of anthropometric measurement.

Key words: IDA, ID, anemia, student, girl

INTRODUCTION

Iron Deficiency Anemia (IDA) is one of the most prevalent nutritional disorders worldwide. It is known to affect the health and cognitive ability of children and adolescents (Abalkhail and Shawky, 2002).

Anemia due to iron deficiency is still a widespread problem (Kurniawan *et al*., 2006). Iron deficiency anemia in children has been associated with retardation in growth and the cognitive development (Bandhu *et al*., 2003). Among adolescent girls, it will bring negative consequences on growth, school performance, morbidity and reproductive performance (Kurniawan *et al*., 2006).

IDA affecting the general health and wellbeing of millions in the world. The prevalence of anemia in the developing countries is three to four times higher than that in the developed countries (Foo *et al*., 2004). Anemia is estimated to affect one-half of school-age children in developing countries (Stoltzfus *et al*., 1997). Iron deficiency is the most prevalent hematological disorder in childhood (Dallman *et al*., 1984). Micronutrient status can affect cognitive function at all ages. Deficiencies of iron, iodine and zinc can affect the learning abilities and cognitive function of children (Manger *et al*., 2004). Study the shows that teenage girls are more likely to have iron deficiency than males (Shaw, 1996). High prevalence's of anemia have been reported amongst infants, young children and women of childbearing age (Foo *et al*., 2004). Anemia was reported among 20.5% of school students. Anemia was more prevalent among students of at least 12 years as compared to the younger age group (Abalkhail and Shawky, 2002). One of the most concerning consequences of iron deficiency in children is the alteration of behavior and cognitive performance (Lansdown and Wharton, 1995; Booth and Aukett, 1997; Aukett *et al*., 1986). There are fewer published data,

Corresponding Author: A. Nemati, Department of Baisic Sciences, Faculty of Medicine, Ardebil University of Medical Sciences, Ardebil, Iran

however, on cognitive achievement in iron-deficient school-aged children and adolescents; thus, the relationship between iron status and cognitive functioning for older children is less clear (Groner *et al*., 1986; Bruner *et al*., 1996; Webb and Oski, 1973; Soemantri *et al*., 1985; Pollitt *et al*., 1985, 1989). Iron deficiency is nutritional concern in Iran. A 1972 survey in rural areas of southern Iran noted that 30% of children were anemic despite an intake of Fe greater than recommended (Haghshenass *et al*., 1972). The impact of iron deficiency on the cognitive functioning of older children and, particularly, adolescent girls who are at highest risk for iron deficiency, requires clarification The objective of this study was to determine the prevalence of iron deficiency anemia and relation between it with school success, weight and height in school children at aged 12 years old in Ardebil province of Iran.

MATERIALS AND METHODS

Research was carried out by way of a cross sectional study, including 170 schoolgirls from 5 primary school at aged 12 years in Ardebil province of Iran, 2005.

Anthropometric measurements: The anthropometric measurements were included weight, height. Height and weight were obtained using a portable digital scale and portable stadiometer following standard techniques. Blood sampling were obtained by venepuncture by medical professional. Blood samples were analyzed in a laboratory at the Ardebli University of Medical Sciences for the Hemoglobin (Hb), Hematocrit (Hct), Mean Corpuscular Volume (MCV), total iron binding capacity and ferritin. Ten percent of samples were examined for control. Weight under 32.5 and height under 143 cm were taken under weight and stunting, respectively (Shils *et al*., 1999). The prevalence of IDA, Iron Deficiency (ID), anemia was calculated.

Independent variables: Independent variables were Hemoglobin (Hb), Hematocrit (Hct), Mean Corpuscular Volume (MCV), total iron binding capacity and ferritin.

Definitions of iron deficiency and anemia: Anemia was taken as Hb less than 11.5 g dL^{-1}. An individual with iron-deficient was considered if ferritin was less than 12 μg L^{-1}. The definition of iron deficiency anemia was based on the 2 laboratory tests of iron status and serum ferritin (Hb less than 11.5 g dL^{-1} and ferritin less than 12 μg L^{-1} (Greer *et al*., 2004).

Score measures: Educational progression including average test score of base class primary school for school girls. The average test score (out of 20) between 10-15, 15.1-20 were taken low and high educational progression, respectively. Parental education was recorded.

Analysis: Average scores test were compared, using independent t-test statistics for means and pearsons correlation test for measurement of relation between Hb, Hct, MCV, ferritin, iron and TIBC with height, weight and average score test and ANOVA analysis for study of difference between level of parental education and Hb, Hct, MCV, ferritin, iron and TIBC and average test score.

RESULTS

Among the 170 schoolgirls aged of 12 years included in the sample, 1. 7, 23.5 and 3.5% had IDA, ID and anemia, respectively. Comparison between with positive IDA, ID and anemic and negative children revealed that the weights, heights were lower in positive than negative children.

In comparison of height and weight and average test score, between anemic and non anemic girls, the mean of height in 2 groups of negative and positive anemia was significantly different ($p = 0.014$), but weight in two groups was not significant ($p>0.05$) and the mean of average test score in 2 groups was significant ($p = 0.001$) (Table 1).

In comparison of height and weight and average test score, between 2 groups of negative and positive ID, the mean of height and weight and average test score in two groups was not significantly different ($p>0.05$) (Table 2).

The mean of height and weight in two groups of IDA was not significantly different ($p>0.05$), but the mean of average score test in two groups of negative and positive IDA was significantly different ($p = 0.021$) (Table 3).

Relation between Hb and height, weight and average test score was positively significant ($p<0.05$) (Table 4).

Table 1: The mean of weight, height, Hb, Hct, MCV, TIBC, iron, ferritin and mean score in positive and negative anemia

Variable	Positive (X±SD)	N	Negative (X±SD)	N	Sig. (2-tailed)
Hb (g dL^{-1})	10.9±0.4	6	13.2±0.7	164	*
Hct (%)	35.3±1.1	6	39.4±2.6	164	*
MCV (fl)	69.6±6.2	6	81.9±4.6	164	*
TIBC (μg dL^{-1})	428.7±13.4	6	355.1±46.9	164	*
Fe (μg dL^{-1})	32.5±8.6	6	54.8±11.2	164	*
Ferritin (μg L^{-1})	8.9±5.6	6	21.4±12.5	164	*
Height (cm)	136.0±8.8	6	142.9±6.6	164	*
Weight (kg)	31.8±3.8	6	36.2±5.7	164	-
Mean score	14.9±1.3	6	17.4±1.9	164	*

* Different is significant at the 0.05 level (2-tailed)

Table 2: The mean of weight, height, Hb, Hct, MCV, TIBC, iron, ferritin and mean score in positive and negative iron deficiency

Variable	Positive (X±SD)	N	Negative (X±SD)	N	Sig. (2-tailed)
Hb (g dL^{-1})	12.8±0.9	40	13.2±0.8	130	*
Hct (%)	38.2±2.9	40	39.5±2.5	130	*
MCV (fl)	78.8±5.4	40	82.4±4.9	130	*
TIBC (µg dL^{-1})	397.1±41.9	40	345.5±43.2	130	*
Fe (µg dL^{-1})	42.7±11.1	40	57.5±9.7	130	*
Ferritin (µg L^{-1})	11.8±8.1	40	23.8±12.3	130	*
Height (cm)	142.3±6.9	40	142.7±6.7	130	-
Weight (kg)	35.7±6.1	40	36.2±5.6	130	-
Mean score	17.1±1.9	40	17.4±1.8	130	-

Mean score* Different is significant at the 0.05 level (2-tailed)

Table 3: The mean of weight, height, Hb, Hct, MCV, TIBC, iron, ferritin and mean score in positive and negative iron deficiency anemia

Variable	Positive (X±SD)	N	Negative (X±SD)	N	Sig. (2-tailed)
Hb (g dL^{-1})	10.8±0.5	3	13.1±0.8	167	*
Hct (%)	35.3±0.6	3	39.3±2.6	167	*
MCV (fl)	65.2±5.9	3	81.8±4.8	167	*
TIBC (µg dL^{-1})	430.7±5.5	3	356.3±47.5	167	*
Fe (µg dL^{-1})	33.3 ±3.8	3	54.4±11.6	167	*
Ferritin (µg L^{-1})	6.3±2.1	3	21.3±12.4	167	*
Height (cm)	136.7±10.4	3	142.7±6.7	167	-
Weight (kg)	32.0±5.3	3	36.2±5.73	167	-
Mean score	14.8±	3	17.4±1.9	167	*

* Different is significant at the 0.05 level (2-tailed)

Table 4: Correlation between height, weight and average test school with blood factors

		Height	Weight	Average test score
Hb (g dL^{-1})	Pearson correlation	0.288(**)	0.196(*)	0.171(*)
	Sig. (2-tailed)	0.000	0.010	0.026
Hct (%)	Pearson correlation	0.260(**)	0.137	0.054
	Sig. (2-tailed)	0.001	0.074	0.486
MCV (fl)	Pearson correlation	0.112	0.030	0.164(*)
	Sig. (2-tailed)	0.146	0.695	0.033
Fe (µg dL^{-1})	Pearson correlation	0.177(*)	0.075	0.124
	Sig. (2-tailed)	0.021	0.333	0.108
TIBC (µg dL^{-1})	Pearson correlation	-0.123	-0.100	-0.125
	Sig. (2-tailed)	0.111	0.195	0.104
Ferritin (µg L^{-1})	Pearson correlation	0.174(*)	0.158(*)	0.112
	Sig. (2-tailed)	0.024	0.040	0.146

**Correlation is significant at the 0.01 level (2-tailed), *Correlation is significant at the 0.05 level (2-tailed)

DISCUSSION

The results of the present study show that the prevalence of IDA, ID and anemia are low in schoolgirls aged 12, but iron deficiency was high almost similar was showed by Sarraf *et al.* (2005) in a village children school in southern Iran, 22% of children and adolescents were anemic and 57% were stunted (Sarraf *et al.*, 2005). Iron deficiency anemia appears to be prevalent among school students. At age 12 years and above, low social class and menstruating girls constitute the high-risk groups (Abalkhail and Shawky, 2002). Soekarjo showed that anemia prevalence was 25.8% among girls. Socio-economic status, indicated by type of school attended, was an important factor determining the risk of anemia (Soekarjo *et al.*, 2001). Spodaryk showed the prevalence of iron deficiency in the investigated sample of children aged from 10 to 12 years was 12.7% (Spodaryk, 1999). In study of Keskin *et al.* (2005) iron deficiency prevalence was 20.8% among girls 12-13 years old (Keskin *et al.*, 2005). The general prevalence of anemia was 16.6% among the schoolchildren; 75.5% of the affected children, had iron-deficiency anemia (Keskin *et al.*, 2005). Growth retardation was detected in 6.2% of children according to height for age, 4.0% weight for age and 3.0% weight for height (Santos *et al.*, 2002). The study indicated that anemia might have adverse effects on the growth and development of children (Sheng and Jiu, 2001). In this study IDA and ID was decreased in comparison the previous study in Iran. Increase of hygiene, knowledge of people and well being of nutritional status may play important role in decreasing of IDA and ID in school girls.

Only a few studies have considered the effect of iron deficiency on cognitive performance among older children and adolescents (Aukett *et al.*, 1986; Groner *et al.*, 1986; Bruner *et al.*, 1989; Webb *et al.*, 1996; Soemantri *et al.*, 1985; Pollitt *et al.*, 1985, 1989). Initially, Webb and Oski observed lower achievement test scores (including a math component) among school-aged children in Philadelphia who had a microcytic anemia. Although in the study of them raised the possibility that iron deficiency affected academic performance, iron deficiency was not established as the cause of the microcytic anemia and potential confounding variables, such as poverty and race, were not considered (Webb and Oski, 1973). In this study, we evaluated data from sample of primary school at aged 12 year old with and without iron deficiency and found lower mean scores among children with iron deficiency, iron deficiency anemia and anemia. A few studies have noted a possible association between iron deficiency and obesity. Pinhas-Hamiel *et al.* (2003) showed ID is common in overweight and obese children. A significantly greater proportion of obese than normal-weight children have IDA (Pinhas-Hamiel *et al.*, 2003). Nead *et al.* (2004) showed overweight children demonstrated an increased prevalence of iron deficiency (Nead *et al.*, 2004). The percent study weight and height in negative girls studying were more than positive girls, which was significant in anemic girls.

CONCLUSION

The results of the present study show that the prevalence of IDA, ID and anemia are low in school girls aged 12 years and could affect on education progress and some of anthropometric measurement.

ACKNOWLEDGMENT

The authors wish to thank the research council ofAradabil University of Medical Sciences for providing the fund and useful guidance throughout the work. Furthermore, we are indebted to Dr. Dehghan for his excellent guidance in reviewing and writing the manuscript.

REFERENCES

Aukett, M.A., Y.A. Parkes, P.H. Scott and B.A. Wharton, 1986. Treatment of iron increases weight gain in psychomotor development. Arch. Dis. Child., 61: 849-857.

Abalkhail, B., S. Shawky, 2002. Prevalence of daily breakfast intake, iron deficiency anemia and awareness of being anemic among Saudi school. Int. J. Food Sci. Nutr., 53: 519-528.

Bruner, A.B., A. Joffe, A.K. Duggan, J.F. Casella and J. Brandt, 1996. Randomized study of cognitive effects of iron supplementation in non-anemic iron-deficient adolescent girls. Lancet, 348: 992-996.

Booth, I.W. and M.A., Aukett, 1997. Iron deficiency anemia in infancy and early childhood. Arch. Dis. Child., 76: 549-553.

Bandhu, R., N. Shankar and O.P. Tandon, 2003. Effect of iron on growth in iron deficient anemic school going children. Indian J. Physiol. Pharmacol., 47: 59-66.

Dallman, P.R., R. Yip and C. Johnson, 1984. Prevalence and causes of anemia in the United States, 1976-1980. Am. J. Clin. Nutr., 39: 437.

Kurniawan, Y.A., S. Muslimatun, E.L. Achadi and S. Sastroamidjojo, 2006. Anemia and iron deficiency anemia among young adolescent girls from the peri urban coastal area of Indonesia. Asia Pac. J. Clin. Nutr., 15: 350-356.

Foo, L.H., G.L. Khor, E.S. Tee and D. Prabakaran, 2004. Iron status and dietary iron intake of adolescents from a rural community in Sabah, Malaysia. Sia. Pac. J. Clin. Nutr., 13: 48-55.

Groner, J.A., N.A. Holtzman, E. Charney and E.D.Mellits, 1986. A randomized trial of oral iron on tests of short-term memory and attention span in young pregnant women. J. Adolesc. Health Care, 7: 44-48.

Greer, J.P., J. Foerster, J.N. Lukens, G.M. Rodgers, F. Paraskevas and B. Glader, 2004. Wintrobe´s Clinical Hematology. (11th Edn.), Lippincott Williams and Wilkins, pp: 948-989.

Haghshenass, M., M. Mahloudji, J.G. Reinhold and N. Mohammad, 1972. Iron-deficiency anaemia in an Iranian population associated with high intakes of iron. Am. J. Clin. Nutr., 25: 1143-1146.

Keskin, Y., G. Moschonis, M. Dimitriou, H. Sur, B. Kocaoglu, O. Hayran and Y. Manios, 2005. Prevalence of iron deficiency among schoolchildren of different socio-economic status in urban Turkey. Eur. J. Clin. Nutr., 59: 64-71.

Lansdown, R. and B.A. Wharton, 1995. Iron and mental and motor behavior in children. In: Iron Nutrition and Physiological Significance: Report of the British Nutrition Foundation Task Force. London, England: Chapman and Hall, pp: 65-78.

Manger, M.S., P. Winichagoon, T. Pongcharoen, S. Gorwachirapan, A. Boonpraderm, J. McKenzie, R.S. Gibson, 2004. Multiple micronutrients may lead to improved cognitive function in NE Thai schoolchildren. Asia Pac. J. Clin. Nutr., 13: S46.

Nead, K.G., J.S. Halterman, J.M. Kaczorowski, P. Auinger and M. Weitzman, 2004. Overweight children and adolescents: A risk group for iron deficiency. Pediatrics, 114: 104-108.

Pollitt, E., A.G. Soemantri, R. Yunis and N.S. Scrimshaw, 1985. Cognitive effects of iron deficiency anemia. Lancet, 1: 158.

Pollitt, E., P. Hathirat, N.H. Kotchabharkdi, L. Missel and A. Valyasevi, 1989. A. Iron deficiency and educational achievement in Thailand. Am. J. Clin. Nutr., 50: 687-697.

Pinhas-Hamiel, O., R.S. Newfield, I. Koren, A. Agmon, P. Lilos and M. Phillip, 2003. Greater prevalence of iron deficiency in overweight and obese children and adolescents. Int. J. Obes. Relat Metab. Disord., 27: 416-418.

Soemantri, A.G., E. Pollitt and I. Kim, 1985. Iron deficiency anemia and educational achievement. Am. J. Clin. Nutr., 42: 1221-1228.

Shaw, N.S., 1996. Iron deficiency and anemia in school children and adolescents. Formos Med. Assoc., 95: 692-698.

Stoltzfus, R.J., H.M. Chwaya, J.M. Tielsch, K.J. Schulze M. Albonico and L. Savioli, 1997. Epidemiology of iron deficiency anemia in Zanzibari schoolchildren: The importance of hookworms. Am. J. Clin. Nutr., 65: 153-159.

Shils, M.E., J.A. Olson, M. Shike, A. Ross and C.A. Modern, 1999. Nutrition in Health and Disease. Lippincott Williams and Wilkins, (9th Edn.), pp: A93-A94.

Spodaryk, K., 1999. Disparity between dietary iron intake and iron status of children aged 10-12 years. Arch. Physiol. Biochem., 107: 361-366.

Sheng, W. and Y. Jiu, 2001. The present study indicated that anemia might have adverse effects on the growth and development of Children, 30: 373-375.

Soekarjo, D.D., S. de Pee, M.W. Bloem, R. Tjiong, R. Yip and W.H. Schreurs, 2001. Muhilal. Socio-economic status and puberty are the main factors determining anemia in adolescent girls and boys in East Java, Indonesia. Eur. J. Clin. Nutr., 55: 932-939.

Santos, C.D., L.M. Santos, J.N. Figueiroa, P.M. Marroquim and M.A. Oliveira, 2002. Anemia in public school first graders in the city of Maceio, Alagoas, BrazilCad Saude Publica, 18: 1757-1763.

Sarraf, Z., D. Goldberg, M. Shahbazi, K. Arbuckle and M. Salehi, 2005. Nutritional status of schoolchildren in rural Iran. Br. J. Nutr., 94: 390-396.

Webb, T.E. and F.A. Oski, 1973. Iron deficiency and scholastic achievement in young adolescents. J. Pediatr., 82: 827-830.