

Better Results Obtained by Daily Supplementation of Iron Drops in Toddlers with Iron Deficiency Anemia in Iran

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Abstract

Background: The "Iron Supplementation Project" for anemic toddlers in Iran has not been subject to scientific studies yet. Since daily consumption of iron drops by children could bring about physical and mental problems, the aim of this study was to determine whether weekly doses of iron drops would also improve the iron status of children significantly.

Materials and Methods: We determined the iron status of 12 to 21-month-old anemic toddlers receiving iron drops (ferrous sulfate) daily referred to health care centers in Shiraz. One hundred and four children were divided into two groups; one group receiving iron drops (1 mg/kg) daily as before, and the other group receiving iron drops weekly (3 mg/kg).

Results: After three months children showed a significant increase in hemoglobin (Hb), mean corpuscular hemoglobin (MCH), and mean cellular hemoglobin concentration (MCHC) levels. Although weekly supplementation led to a significant increase in Hb levels, daily supplementation had a significantly greater effect than weekly supplementation on the levels of mean corpuscular volume (MCV) and MCHC.

Conclusion: We generally conclude that weekly iron supplementation is not suitable for anemic children.

Keywords: Iron deficiency anemia, Supplement.

Introduction

Iron deficiency anemia is not itself a disease but a sign of an underlying disorder, and its most prevalent cause in growing children is iron deficiency in the diet.¹

Considering the importance of iron deficiency anemia in Iran, it is necessary to take effective and fundamental measures for its prevention and control. National "Iron Supplementation Project" recommends daily supplementation of 1 mg/kg of iron for 6 to 24-month-old children. It seems that if iron supplements are made available by the system of health services, the problem of anemia will be controlled. However, little is known about the methods used or the results obtained. On the other hand, the daily consumption of iron drops by the child could bring about physical and mental

problems, a fact which has raised concerns about the practicality of the current project and confirms the need for the application of a healthier approach.

Kimiagar and Kianfar performed a study on the effect of daily and intermittent doses of iron on the iron status of high school girls in the Iranian cities of Zahedan, Rasht, and Ahvaz.² The authors reported that weekly administration of iron supplements in controlling anemia is as good as daily doses; in addition weekly doses are less expensive and have fewer side effects and fewer adverse influences on the absorption of other elements such as zinc. This issue is so important that evaluation of the efficacy of weekly administered doses in preventing and curing anemia has become one of the programs of WHO and other international foundations.

The aim of this study was to determine the effect of daily and weekly doses of iron drops on hematological and biochemical parameters of iron status in anemic 12 to 24-month-old toddlers referred to health centers in Shiraz. In this study, a comparison was also made between parents satisfaction and oblivion.

Materials and Methods

The study was carried out prospectively between March and May 2002. Participants consisted of all toddlers between 12 and 21 months old at the beginning of the study who were receiving iron drops (ferrous sulfate) and did not have any blood disease or inherited disorder. Children premature at birth or with a birth weight of less than 2500 grams were excluded from the study.

At the beginning, health centers in the city of Shiraz were divided into 4 categories according to the educational district in which they were located, and one center was selected randomly from each category. From each of the 4 health centers, 26 children were selected randomly (totally 104 children) and divided into two groups; one group receiving iron drops (1 mg/kg) daily as before, and the other group receiving iron drops weekly (3 mg/kg).

Using a questionnaire; demographic data, current diet, weight, height, history of diseases, age at the beginning and period of receiving iron drops, and data on parents satisfaction with the method of supplementation were collected. Children laboratory data including serum ferritin (SF), hemoglobin (Hb), hematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean cellular hemoglobin concentration (MCHC), red blood cell (RBC) count, white blood cell (WBC) count, and platelet count were also recorded. The oxalate specimens were placed into the Sysmex apparatus to determine complete blood count (CBC). Clotted specimens, after 5 minutes of centrifugation and separation of the serum, were further analyzed to determine serum ferritin level. Then two supplementation groups (daily and weekly regimen) were matched to exclude factors which could confound the results. After 3 months of supplementation the second set of laboratory data was collected. To assess the effect of each method of supplementation, the

average amounts of laboratory parameters at the beginning of the study were compared with those at the end of the study using paired t-test for each group.

Based on the results of the first laboratory examination, the subjects of each supplementation group were divided into anemic and non-anemic subgroups. The effect of each method on the biochemical and hematological parameters of anemic children subgroups were compared using paired t-test. Anemic versus non-anemic patients were also compared using Mc Nemar test.

At the second visit, the children's parents were again asked to complete a questionnaire so that data on their satisfaction with each supplementation method and on the rate of their oblivion in administering the iron drops to their children could be collected. P-values of less than 0.05 were considered significant.

Results

The prevalence of iron deficiency in the participants, based on SF values under 12 micrograms per liter, was 23.8% at the beginning of the study. The prevalence of anemia, based on Hb values less than 10.5 grams per deciliter, was 11.4%. Hematocrit levels less than 33% was seen in 80.6% of the subjects. MCV values less than 70 fL (microcytosis) and MCH values less than 23 pg (hypochromia) were seen in 29.5% and 31.4 %, respectively.

Only 95 out of 104 subjects completed the study (48 from the daily and 47 from the weekly group). No significant difference existed between two groups in sex, age, age at the start of receiving iron drops, duration of receiving the supplement, weight, height, and parent satisfaction with the method of supplementation at the beginning of the study. The toddlers in the daily group started with an average Hb value of 11.95 g/dl and an average SF value 29.21 µg/l, while the toddlers in the weekly group started with an average Hb value of 11.81 g/dl and an average SF value of 24.13 micrograms per liter. None of the hematological parameters showed a significant difference between the two supplementation groups at the beginning of the study (figure 1). Anemic subgroups differed significantly from the non-anemic subgroups in laboratory findings before receiving iron drops (SF,

Table 1. Effects of daily iron supplementation on hematological and biochemical parameters of iron status in anemic toddlers.

Parameters	No. of subjects	Beginning of study		End of study*		P-value
		Mean	S.D	Mean	S.D	
SF	9	6.63	3.83	14.55	16.80	0.217
Hb	9	10.04	1.45	11.08	1.23	0.003
HCT	9	32.54	3.72	32.27	3.99	0.491
MCV	9	63.46	9.51	65.11	11.42	0.267
MCH	9	19.59	3.61	22.04	3.91	0.002
MCHC	9	30.75	1.22	33.31	1.02	0.000*
RCB	9	5.18	0.56	5.08	0.55	0.591

* Three months after receiving iron drops

*P < 0.001

Table 2. Effects of weekly iron supplementation on hematological and biochemical parameters of iron status in anemic toddlers.

Parameters	Number of subjects	Beginning of study		End of Study*		P-value
		Mean	St. D	Mean	St. D	
SF	9	5.09	1.81	15.75	14.81	0.062
Hb	9	10.65	0.36	11.25	0.77	0.027
HCT	9	34.50	1.90	35.34	2.87	0.388
MCV	9	64.53	4.78	64.17	5.61	0.692
MCH	9	20.30	1.79	20.44	1.74	0.661
MCHC	9	31.41	0.91	31.91	1.04	0.221
RCB	9	5.36	0.34	5.52	0.33	0.202

* Three months after receiving iron drops

Table 3. Average change of parameters of iron status after 3 months of daily and weekly iron supplementation.

Parameters	Daily group			Weekly group			P-value
	N*	Mean	S.D	N	Mean	S.D	
SF	9	+ 7.92	17.71	9	+ 10.67	14.79	0.726
Hb	9	+1.03	0.75	9	+0.60	0.33	0.213
HCT	9	+0.72	3.00	9	+0.84	2.77	0.930
MCV	9	+2.45	1.58	9	+0.14	0.95	0.002
MCH	9	+1.65	4.16	9	- 0.35	2.59	0.236
MCHC	9	+2.55	1.19	9	+0.49	1.08	0.001
RCB	9	- 0.097	0.52	9	+0.16	0.34	0.236

* Number of subjects

Hb, HCT, MCV, MCH, MCHC: $p < 0.001$; RBC: $p < 0.05$). Of 95 children who completed the study, 18 (18.9%) had iron deficiency anemia (9 children in each group).

Daily iron supplementation had a significant effect on the increase of Hb, MCH and MCHC levels of the anemic children ($P < 0.01$), but the increase in SF, HCT, and MCV, as well as the decrease in RBC count were not significant (table 1). Weekly iron supplementation had a significant effect on the

increase of Hb levels in anemic children ($P < 0.05$). Although SF level increase was conspicuous; change in SF, MCH, and MCHC levels were not significant. Also the decrease in RBC, HCT and MCV levels were not significant (table 2). Increase in MCH and MCHC levels of anemic children in daily supplementation group was significantly greater than those in weekly supplementation group ($P < 0.01$). Other factors of anemic children did not show any significant

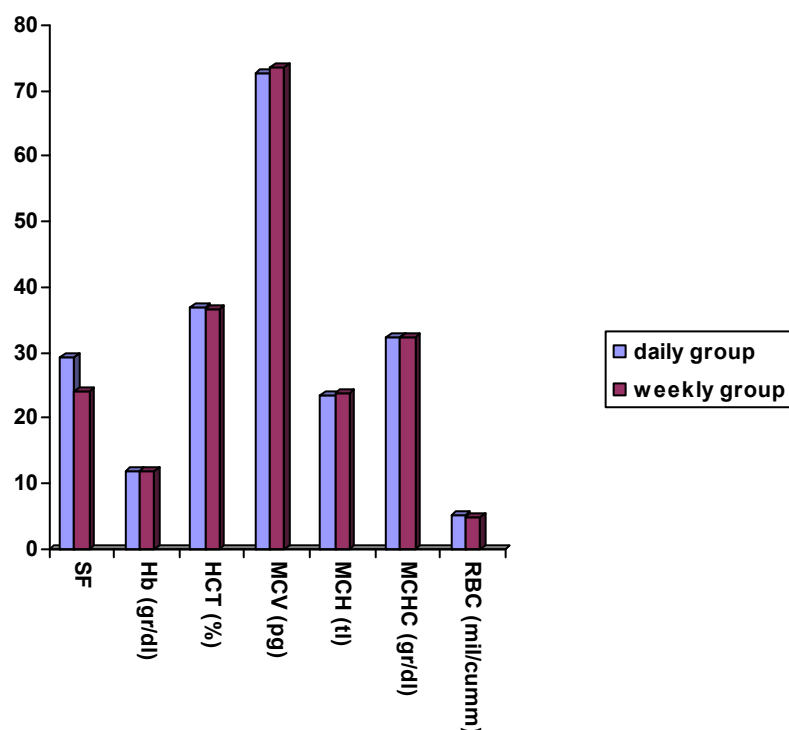


Figure 1. Average hematological and biochemical parameters of iron status in 12-21 months-old toddlers in each supplementation group at the beginning of the study.

difference between two methods of supplementation (table 3).

Figure 2 shows a comparison of parent satisfaction between the daily and the weekly supplementation group during the study period. The compliance to the regular administration of the iron drops was greater in the weekly group, but according to Pearson Chi-square statistical test, the two methods were not significantly different.

In figure 3, daily and weekly groups are compared regarding parents oblivion in giving their children the recommended iron drops during the study period. Although the rate of oblivion was lower in the weekly group, Pearson Chi-square test showed no significant difference between the groups.

Discussion

The anemic toddlers divided into two different supplementation groups started receiving iron supplement at about the same levels of iron status.

It can be seen in table 1 that daily supplementation caused a significant increase in Hb, MCH and MCHC levels in the anemic children. The increase was not significant, however, regarding SF and MCV levels. Therefore, daily supplementation had an effect on laboratory parameters related to iron status in anemic children, and this effect was particularly conspicuous regarding the levels of Hb, MCH and MCHC.

Since these children had not been in a desirable state regarding their iron status before receiving iron drops (their average Hb value was 10.04 g/dl), the iron supplements exerted their first effect on the children's Hb levels. Other studies confirm this.^{3,4}

As table 2 shows, weekly iron supplementation led to a significant increase in Hb levels in the anemic children. The effect of weekly supplementation on SF levels was also tangible, but insignificant. Therefore, we concluded that weekly supplementation was also effective in treating

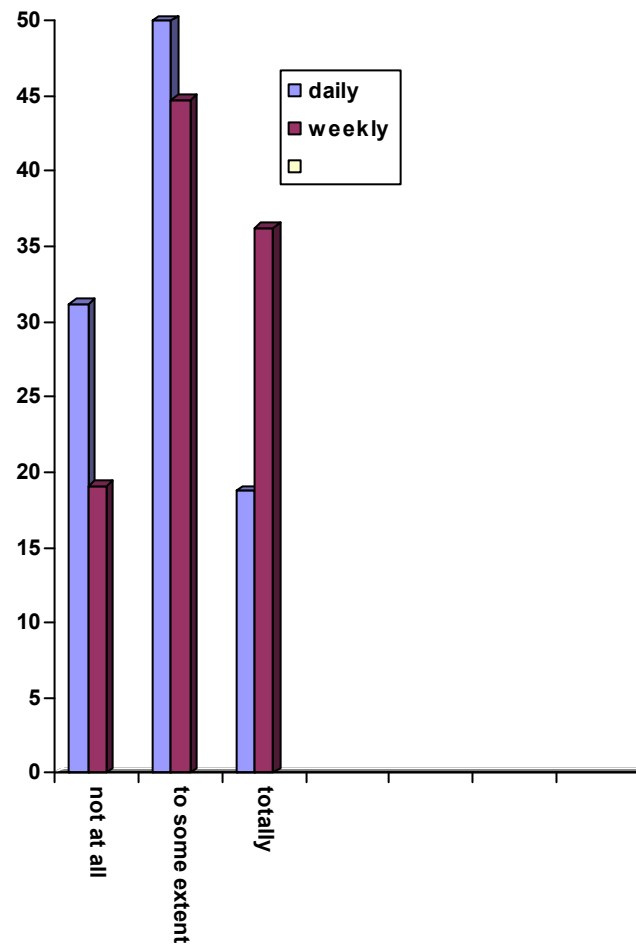


Figure 2. Comparison of parent satisfaction in the daily and weekly supplementation groups with the method of consuming recommended iron drops during the whole study period.

anemic children. The aforementioned studies also found a significant effect of weekly supplementation on the Hb levels of anemic subjects. The reason for the lack of significance in the increase of SF values in the anemic children of our study probably lies in the small number of subjects (9 children). In one of the previous studies, significant effect of weekly supplementation on SF levels of anemic children was discovered.³ Although the effect of weekly supplementation on SF level was greater than daily regimen (table 3), there was no significant difference between two methods. The effect of daily supplementation on Hb levels was greater than the effect of weekly supplementation, but again there was no significant difference between the methods. In addition, the differences

between the changes in MCH and RBC brought about by the methods were not significant.

Consequently, whenever the iron supplementation program aim at anemic children, both methods prove to be successful, but when comparing the two methods, daily supplementation leads to a more significant increase in the anemic children's MCV and MCH levels. Other studies carried out in the United States, Vietnam, and Thailand confirmed that daily iron supplementation had a better effect on the iron status of anemic children than weekly supplementation.⁵⁻⁷

It may be concluded from figure 2 that parents were more satisfied with the use of weekly iron supplementation (probably because it was easier to administer the drops only once a week). Hyder et al

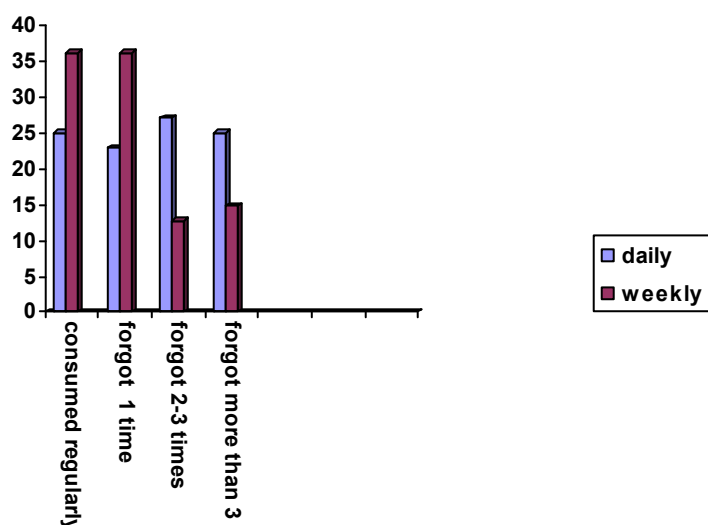


Figure 3. Comparison of the rate of oblivion in parents of children belonging to the daily and weekly groups concerning the administration of recommended iron drops during the whole study period.

also reported that a better compliance to iron supplementation can be achieved by weekly administration because of the side-effects resulting from frequent intake of the supplements.⁸ However, as figure 3 shows, in the present study there was no significant difference between both methods concerning the parents compliance to the administration of the iron drops.

Conclusion

From the findings regarding the 12 to 24-month-old toddlers with iron deficiency in the present study it can generally be concluded that although for non-anemic cases weekly supplementation is both cost effective and better tolerated; when iron supplementation programs aim at a population of anemic children, daily supplementation is more preferable than weekly supplementation.

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References

1. Suskind DL. Nutritional deficiencies during normal growth. *Pediatr Clin North Am.* 2009; 56:1035-53.
2. Kianfar H, Kimiager M, Ghaffarpour M. Effect of daily and intermittent iron supplementation on iron status of high school girls. *Int J Vitam Nutr Res.* 2000; 70: 172-7.
3. Schultink W, Gross R, Gliwitzki M, Karyadi D, Matulesi P. Effect of daily vs twice weekly iron supplementation in Indonesian preschool children with low iron status. *Am J Clin Nutr.* 1995; 61: 111-5.
4. Berger J, Aguayo VM, Tellez W, Lujan C, Traissac P, San Miguel JL. Weekly iron supplementation is as effective as 5 day per week iron supplementation in Bolivian school children living at high altitude. *Eur J Clin Nutr.* 1997; 51: 381-6.
5. Hallberg L. Combating iron deficiency: daily administration of iron is far superior to weekly administration. *Am J Clin Nutr.* 1998; 68: 213-7.
6. Nguyen XN, Berger J, Dao TQ, Nguyen CK, Traissac P, Ha HK. Efficacy of daily and weekly iron supplementation for the control of iron deficiency anaemia in infants in rural Vietnam. *Sante.* 2002; 12: 31-7.

7. Sungthong R, Mo-Suwan L, Chongsuvivatwong V, Geater AF. Once weekly is superior to daily iron supplementation on height gain but not on hematological improvement among school children in Thailand. *J Nutr.* 2002; 132: 418-22.

8. Hyder SM. Persson LA, Chowdhury AM, Kekstrom EC. Do Side-effects reduce compliance to iron supplementation? A study of daily-and weekly-dose regimens in pregnancy. *J Health Popul Nutr.* 2002; 20: 175-9.