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Sustainable effect of weekly iron Folic Acid Supplementation on growth and haemoglobin status of school children

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Abstract

Iron folic acid (IFA) supplementation is used world over for reducing the prevalence of anemia. The objective of the present investigation is to study the sustainable effect of long term weekly Iron Folic Acid supplementation along with deworming on growth and haemoglobin status of rural school children. Method: Three schools were selected for the study. One school was a control group where no intervention was given. In the second school, weekly IFA supplementation of 60 mg elemental iron was given for 30 weeks along with 400mg Albendezole (DW) once in 6 months. In the third school only 400 mg Albendezole was given every six month. Before and after the intervention, height, weight and haemoglobin by cyanmet haemoglobin method was done. After 30 weeks supplementation of IFA+DW tablet, for 6 months no intervention was given. The washout effect of the intervention was seen on same parameters. Result: The intervention did not show sustainable effect on growth parameter. The prevalence of all the 3 anthropometric indices i.e. underweight, stunting and thinness remained unaltered with withdrawal of supplementation. In the IFA+DW supplemented group, there was a significant drop ($p<0.01$) in the mean Hb levels after 6 months of supplementation but after the washout effect the prevalence of anemia reverted back to the basal values. Thus weekly IFA+DW supplementation should be an ongoing programme to reduce the prevalence of IDA among school children.

Key Words: IFA supplementation, Children, School going, Sustainable effect

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Introduction

Anemia is characterised by a low level of haemoglobin in the blood. Anemia usually results from a nutritional deficiency of iron, folate, Vitamin B12 or some other nutrients. Haemoglobin is necessary for transporting oxygen from the lungs to other tissues and organs of the body. Iron deficiency is the most common form of malnutrition in the world affecting more than two billion people [1]. In India, anemia affects an estimated 50 % of the population. NFHS III [2] reports that while 56 % of adolescent girls are anaemic, boys too are falling prey to the diseases. Iron deficiency anemia is associated with lower scores in cognitive function test, educational achievements and lower physical output and hampers the growth in school children.

Iron supplement is the practical approach to achieve the objective of increasing intake of absorbable iron and to enhance absorption of ingested iron. Iron supplementation is probably the best available option to effectively address Iron Deficiency Anemia (IDA) in young children. However some technical and practical barriers have precluded the full realization of the potential impact of iron supplementation on IDA. One such problem is the sustainability effect of iron folic acid tablets [3].

Sustainability is key to supplementation and it is more likely to be achieved if the supplement has a low cost, is simple to distribute, easy to administer and prevent deficiency. In the school setup the children have short and long term vacations coupled with high rate of absenteeism in rural areas. So the sustainability of Iron Folic Acid (IFA) supplementation effect is a big question mark. Sustainability issue has to be resolved to improve iron status as a period of negative iron balance may occur because absorption is down regulated and thus the benefits of supplements are likely to be temporary if diets are low in available balance. Still pending is a clear definition of the role of supplementation as a treatment of existing anemia or as a preventive measure to reduce the risk of acquiring it [4].

Data has shown that weekly iron supplementation is better than the daily iron supplementation. The absorption of supplemental iron is greatest when it is administered at the times of intestinal mucosal renewal, so that each dose is received by new cells. Thus inhibition of iron absorption is minimised because of the iron overload in intestinal cells, which occurs with daily iron supplementation [5].

The sustainability effect of iron supplementation has been mostly studied on pregnant women who received the IFA tablets during the period. But this supplementation has also shown only limited biological effect during this phase for reducing the iron deficiency anemia. Only isolated event in women's life have has been targeted [6]. During this phase also sufficient attention is not paid to iron status including iron reserves. School going children have also high iron demands as it is their growing phase. But at the same time, the IFA supplementation programs have operational failures, limited compliance and inadequate supplies [7].
So looking at the present scenario, there was a need to see the sustainable effect of the long term IFA supplementation after a period of 6 months.

Methodology

Three schools from the rural Vadodara were selected for the study. One school was control group where no intervention was given and standard care conditions were maintained. In the other two schools, intervention was given. In one school weekly IFA supplements (60 mg elemental iron + 0.5 mg folic acid) was given for 30 weeks. Deworming tablet (Albendezole 400 mg) was also given once in 6 months in this school. In the third school only deworming tablet (once in 6 months) was given to the children.
The study was divided into three phases. In this study data on growth and haemoglobin level were ascertained. In phase 1, height, weight and haemoglobin measurement by cyanmet haemoglobin method was taken for the children. Weight was taken with the help of digital bathroom scale with least count of 0.01 Kg. The bathroom scale was calibrated before use. Height was taken by fibre glass tape as that was the feasible method in the field level in rural area.

The class teachers were involved in the study and were given a detailed briefing on the study protocol. Each child was given one tablet every Monday by the class teacher during the roll call. If the child would be absent on that day then the tablet would be given next day. The researcher verified that the tablets were ingested. Supplements were taken with a glass of water between the meals to optimize iron absorption two hours before the Mid Day Meal in school. Few (less than 5) children reported symptoms of abdominal discomfort or nausea. If any child reported such symptoms they were encouraged to continue the study and explained the benefit of the supplementation.

The supplementation was given for 30 weeks. In phase 2 again height, weight and haemoglobin measurement were collected on the same children after 30 weeks. This was regarded as post data.
In phase 3, after the post data was collected, for 6 months no intervention was given in any of the 3 schools and then again the data on height, weight and haemoglobin measurement were taken, which was regarded as washout data. Same children were tracked for 16 months time. Thus after 16 months, the data on anthropometry for all the 3 point period was collected on 287 children. Haemoglobin data for 3 consecutive phase could be collected on 309 children.

Statistical Analysis

The data was entered into Microsoft excel spread sheet and then subjected to appropriate statistical analysis using Microsoft excel data analysis package for calculating mean and standard deviation. Anthropometric measurements were assessed by converting the corresponding parameters to Z score through epi info 6.0 [8] and WHO anthro plus package [9]. F value was calculated to check the variation between the three intervention arms while t test was used to check the significance level of intervention before and after the intervention period. The test were statistically significant at $p<0.05$.

Ethical clearance

Approval for the study was obtained from the ethical committee of the home institution ethical board. Written consent was taken from the school authorities and the parents to carry out the Study.

Results

The growth parameters as assessed by underweight, stunting and thinness did not improve after the wash out effect. On the contrary all the 3 growth indices showed a deteriorating trend as shown in Table 1.

Both the interventions i.e. IFA+DW and only DW could not sustain their effect for 6 months period. In the IFA+DW supplemented group, there was a significant drop ($p<0.01$) in the mean Hb levels after 6 months. In the DW group similar results were obtained. The drop after 6 months was more pronounced in the DW group as compared to the IFA+DW supplemented group.

Table 1. *Impact of withdrawal of weekly IFA along with Deworming and Deworming alone on the prevalence of under-nutrition for children according to WHO 2007 standards*

	Control N = 86	**IFA+D** N = 118	**DW** N = 83
Underweight (WAZ < -2 SD)			
Initial	26(50.9)	26(38.8)	21(46.6)
Final	11(21.5)	20(29.8)	12(26.6)
Washout	20(39.2)	12(17.9)	8(17.7)
Stunting (HAZ < -2 SD)			
Initial	23(26.7)	18(15.2)	15(18.0)
Final	19(22.0)	22(18.6)	11(13.2)
Washout	29(33.7)	24(20.3)	23(27.7)
Thinness (WAZ < -2 SD)			
Initial	49(56.9)	39(33.0)	53(63.8)
Final	18(20.9)	69(58.4)	55(66.2)
Washout	37(43.0)	67(56.7)	38(45.7)

Figures in the parenthesis indicate percentage

Table 2*. Impact of withdrawal of weekly IFA along with Deworming and Deworming alone on the Haemoglobin levels of the children (Mean ±SD)*

Variable	**Control**	**IFA+DW**	**DW**
Boys	(N=47)	(N=57)	(N=49)
Initial	10.6±1.2	11.6±0.8	11.4±1.2
Final	10.7±1.8	13.4±1.2	11.2±1.6
Washout	10.5±1.4	10.8±1.3	9.8±1.7
F value	0.22	7.2***	15.8***
1 Vs2	-	9.3***	0.5
2 Vs 3	-	13.0***	12.8***
3 Vs 1	-	3.9**	6.9***
Girls	(N=48)	(N=53)	(N=55)
Initial	9.9±1.3	11.4±1.1	11.3±1.1
Final	10.0±1.2	12.9±1.0	11.3±1.2
Washout	10.0±1.1	11.0±1.4	9.8±1.4
F value	0.1	3.8***	27.6***
1 Vs2	-	9.2***	0.7
2 Vs 3	-	8.0***	14.0***
3 Vs 1	-	1.8*	8.3***
Total	(N=95)	(N=110)	(N=104)
Initial	10.3±1.3	11.5±0.9	11.3±1.1
Final	10.4±1.6	13.1±1.1	11.3±1.4
Washout	10.2±1.3	10.9±1.3	9.3±1.5
F value	0.2	10.7***	41***
1 Vs2	-	13.1***	0.3
2 Vs 3	-	14.4***	19.0***
3 Vs 1	-	3.9***	10.8***

**Significant at p<0.05; ** significance at p<0.01; ***Significance at p<0.001*

Table 3. *Impact of withdrawal of weekly IFA along with Deworming and Deworming alone on the prevalence of anemia in children (n, %)*

Hb	Control (N=108)	IFA+DW (N=230)	DW (N=161)
Initial	99 (90.6)	198 (71)	122 (62.5)
Final	95 (86.4)	135 (13.7)	126 (66.4)
Washout	99 (90.6)	196 (69.1)	152 (91.4)

Figures in the parenthesis indicate percentage

Table 4. *Impact of withdrawal of weekly IFA along with Deworming and Deworming alone on hemoglobin levels of children based on the severity of anemia(Mean ±SD)*

Variable	Control	IFA+DW	DW
>12			
Initial	12.8±0.6	12.6±0.5	12.5±0.6
Final	13.3±1.2	13.4±1.0	12.9±0.7
Washout	12.5±0.7	12.4±0.7	12.8±0.4
F value	**2.3**	**20.2*** **	**3.7**
1 Vs2	-	4.3***	-
2 Vs 3	-	5.1***	-
3 Vs 1	-	1.1	-
12-10			
Initial	10.8±0.5	11.2±0.4	10.8±0.5
Final	10.6±0.6	11.6±0.4	11.0±0.5
Washout	10.6±0.5	10.9±0.5	10.8±0.8
F value	**1.7**	**8.0****	**1.7**
1 Vs2	-	**2.8****	-
2 Vs 3	-	**3.7*****	-
3 Vs 1	-	**3.3***	-
10-7			
Initial	9.3±0.6	8.8±0.7	8.8±0.7
Final	9.0±0.6	9.0±1.7	9.1±0.6
Washout	8.9±0.6	9.2±0.7	8.7±0.8
F value	**1.4**	**1.2**	**1.2**
1 Vs2	-	-	-
2 Vs 3	-	-	-
3 Vs 1	-	-	-

*Significant at p<0.05; ** significance at p<0.01; ***Significance at p<0.001

The significant fall in the mean Hb levels was similar in both the gender (Table 2).

The prevalence of Anemia during the initial, final and the washout phase is shown in **Table 3**. In the IFA+DW supplemented group, the prevalence of anemia increased to 69 % from 13.7 %. In the DW supplemented group too increase in prevalence of anemia was seen once the intervention was withdrawn. Thus the Hb levels were not sustained after the withdrawal of the supplementation. Further the overall prevalence of anemia was similar to the baseline values and in DW group it was much higher than the basal prevalence (91.4% Vs 62.5%)

In the IFA+DW supplemented group, 42 % of the children were in the mild category after the washout period as compared to only 13 % in the post intervention phase. None of the children were in moderate or severe category of anemia in the post intervention phase which **saw** a rise of 27 % in the washout period. In the deworming supplemented group too negative trend was observed. The washout effect was also looked into as per the severity of anemia. The **Table 4** shows that in IFA alongwith de-

worming group there was a drop in the Hb levels after the withdrawal of supplementation whereas the other two groups maintained their Hb levels. In the IFA+DW supplemented group the nonanemic subjects were able to maintain their mean Hb levels where as in moderate anemic group the mean Hb levels fell by 0.7g/dl.

Discussion

The period of school going children is period of rapid growth, when iron requirement for both girls and boys increases. The awareness regarding anemia and appropriate diet is also extremely poor in school going children; which is made worse by the lucrative promotional campaigns of various junk foods [10]. The minimum daily dietary iron requirements during the school going period are 12 to 15 mg/ day. There is a misconception that only girls need iron. During this phase the requirement for growing boys also jumps significantly. In this study IFA+DW supplementation was given to both boys and girls when in predata it was revealed that prevalence of anemia was same in both the gender.

Iron compounds used for supplementation or fortification will only be partially available for absorption. Once dissolved, same factors influence this iron which affects the iron from food. In the body, regulation of iron absorption is maintained through intestine. Decreasing body iron stores trigger increased iron absorption and increasing iron store trigger decreased iron absorption. For a given diet this regulation of iron absorption, however can only balance losses up to a certain critical point and beyond that iron deficiency will develop. The three main factors that affect iron balance are absorption (intake and bioavailability) of iron, losses and stored amount. In states of increased iron requirement or decreased bioavailability the regulatory capacity to prevent iron deficiency is limited [11].

In setting where there are not convenient food vehicle for fortification and the prevalence of Iron deficiency anemia is very high, supplementation is a cost effective option. But most of the analysis may have overestimated the health gains from iron deficiency control because effectiveness estimates of iron supplementation were based on data steaming from mainly small trials. There remains a significant gap between the efficiency and the effectiveness of program at controlling iron deficiency. In this study also the sustainable effect of iron supplementation has not been found effective [12].

The supplementation time in the study was for 30 weeks, which can be regarded as long term weekly supplementation and could be complementary to other preventive measures and is conceptualized as a surrogate for targeted fortification. But still after long term iron supplementation, iron status could not be sustained. The possible reason for this may be that diet is very deficient in iron. Viteri et al in their study showed that weekly supplementation of iron and folic acid for 7 months were proven effective in controlling mild to moderate iron deficiency and anemia. But how long the improvements in iron status can be achieved by weekly supplementation if the tablets are stopped is still unknown. The unacceptable result of iron sustainability is hard to interpret but similar results were obtained in the study where the plasma feritin level went low after the supplementations were stopped. The following mechanism may be implicated 1) diminished food iron absorption during and after the supplementation 2) Increased iron losses following increment in iron stores, most probably in “labile iron pool” [13].

One of the issues still to be resolved is sustainability of improved iron status, as a period of negative iron balance tends to occur because absorption is down regulated, thus benefits of supplementation are likely to be temporary if diets are low in iron. Thus role of iron supplementation as a treatment of existing anemia or as a preventive measure to reduce the risk of acquiring it is still a question [14].

The interaction between iron and infection has been also in debate. As this is a rural area the chances of infections are also high. Infections must be having negative effect on the iron stores. Thus we can see that sustainable effect of IFA tablets was not positive on growth and haemoglobin levels. Thus IFA supplementation should be a continuous process in the school setup. Along with supplementation, behaviour change communication is very important so that the children consume diet rich in iron which has more sustainable effect as far as iron pool in the body is concerned. If both the strategies are implemented together, in long run it will result in remarkable improvement in the iron status of children.

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