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Effect of Directly Observed Iron Therapy (DOIT) in Anaemia & Productivity – A Community Based Intervention Study in Dibrugarh, Assam

KEYWORDS: Anaemia, tea garden population, directly observed iron therapy (DOIT), productivity, Dibrugarh, Assam

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ABSTRACT *Title of the article: Prevalence of anaemia and associated factors amongst tea pluckers and the effect of directly observed iron therapy(DOIT) in Anaemia and Productivity in Dibrugarh District, Assam – An Action Research.*

Introduction - There is convincing evidence that iron deficiency and anaemia causes impaired growth, developmental delay, decreased physical activity, behavioural abnormalities and impairs cognitive function. Anaemia is rampant amongst tea garden community. Therefore this study is undertaken to estimate magnitude of anaemia and associated factors among permanent workers of tea estates and to assess difference in productivity amongst working women (tea pluckers) after giving directly observed iron therapy.

Materials and Method: A cross sectional study followed by quasi-experimental, interventions study. In baseline, 1168 permanent workers, included. 150 anaemic women from each tea estates selected randomly, where directly observed iron therapy (DOIT) given to one tea estate and conventional treatment to other one and assessed after three month of intervention. Productivity was compared.

Results: Prevalence of anaemia was 88% and 45.7% were underweight. Majority practiced open air defecation (96.1%) and were illiterate (99.7%). Helminthiasis was common in 63.6%. Sickle cell anaemia was prevalent amongst 9.72%. DOIT improved haemoglobin level to 1.44 gm/dl from baseline after three month of intervention. ($p<0.05$)

Conclusions: Directly observed iron therapy improved significantly the haemoglobin level and productivity. There is a need to address multifactoral causation of anaemia by integrated approach.

Introduction:

Anaemia is a global public health problem affecting both developing and developed countries and is an indicator of poor nutrition and health with major consequences for health, social and economic development of a population. Worldwide, at any given moment, more individuals have iron-deficiency anaemia than any other health problem.[1] Nutritional anaemia is one of the major public health problems in India affecting almost 90% poor children, adolescent girls and women, considered as "female disease "causing red alert for Indian women[2]. Lower haemoglobin values and anaemia (< 12 g/dl) were associated with both lower labour productivity and more days of sickness and absenteeism. Taller women with greater arm circumference were able to pluck more green leaves, earn higher wages and were absent less often 3. The major causes of Anaemia in India are low intake of Iron through the diet coupled with low bioavailability, high level of parasitic infestations and frequent infections [3].The workers of tea plantation industry migrated to Assam from states like Madhya Pradesh, Bihar, Orissa and Andhra Pradesh in the latter part of nineteenth to early twentieth century [4]. These migrant workers involved in tea plucking, typically reside in the periphery of the tea estate in what is known as labour lines. Tea garden population represent 17% of Assam's population and 27% of Dibrugarh District. Almost half of the girls were stunted and most of them were thin. Factors typical to underdeveloped society; contribute to the moderate to high prevalence of under nutrition among the girls working in these Tea Gardens [5]. Almost 96% of pregnant mothers and 100% of adolescent girls are anaemic (mild to severe); similarly 55% of mothers and 46% of girls are with low BMI[6].

With this background in this field concerning tea garden workers indulged us to contemplate the present study with an objective to estimate the magnitude of anaemia among permanent workers of tea estates and to assess the difference in productivity amongst working population (tea pluckers) after giving directly observed iron therapy.

Materials and Methods:

Setting – Dibrugarh District, also known as tea Capital of Assam is selected as this is the most tea intensive District having highest number of tea estates. Two tea estates were selected from a list of 169 tea estates of the District using computerised random number.

Study design: A baseline, cross sectional study was carried out, in two tea estate populations of Dibrugarh District of Assam. Human subject recruitment was done after getting clearance from Institutional ethical committee. A predesigned, pretested format, covering demographic characteristics, socioeconomic status, general physical examination, laboratory investigation of blood for Haemoglobin (by cyanomethhaemoglobin method) and stool examination for helminthic ova along with dietary survey using 24 hour recall method was used.

This was followed by a quasi-experimental, intervention study. In the Intervention tea estate, directly observed iron therapy was given using iron-folic acid (IFA) tablets six days in a week by a drug provider (supervisor), who supervised the consumption of tablets by direct observation and also did recording of tea leaves plucked from the registered, to 150 anaemic women by giving 100 mg of Govt supplied tablets and in the control tea estate the selected population of 150 anaemic women were informed about their anaemic status and advice to take conventional treatment from tea garden outpatient department. Both the group were sensitized for

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health promotion and dietary diversification and anti - helminthic administration was done twice 14 days apart using Albendazole 400mg tablet. Total study period was for two years starting from Jan 2011 to Dec 2012.

Sampling design and sample size for Baseline study:
Taking prevalence of anaemia as 85%[2,3] with 5% relative precision and 99% CI, the required sample size was 470. To avoid design effect it was doubled to get a minimum sample size of 940. Taking a non response rate of 10% and rounding up, sample size became 1050. To get the required sample size two tea estates were randomly selected. All consenting permanent workers of the both tea estates included in the study.

Sampling design and sample size for intervention study: Assuming a directional hypothesis (a positive result from intervention) one sided Z values were considered. Presuming overall prevalence of anaemia as 85%(π1)[2,3] and a minimum 25% reduction (d^-) was required to detect the change i.e. the prevalence among the experimental group would be 60%(π2), with 95% power and 0.05% relative error the required sample size is 123. Assuming 20% drop out; and rounding up, a total of 150 participants, selected from both groups for the intervention study after ruling out haemoglobinopathy. Permission from tea garden authorities was taken. Haemoglobin estimation was done using cyanomethaemoglobin method. Stool examination for helminthic ova and cyst was done in 10% of the samples.

Follow up intervention study - After completion of baseline study, listing of anaemic women were made and 150 women from each tea estate, selected using computerised random numbers. In one intervention group having 150 women from one tea estate directly observed iron therapy was given and in another 150 women of control group from the other tea estate, conventional treatment by supply of I FA tablets from tea garden hospitals was given, which was unsupervised.

Evaluation was done twice by the same two investigators in the same way they did initially during the period of intervention and after completion of three months of intervention. At the end of the study all the remaining anaemic participants of both tea estates were provided treatment as per recommendations.

Productivity measurement procedures – Productivity was measured by weighing of tea leaves plucked per person per day; individual recording of weight of leaves plucked per day by each study participant was recorded in a register, which was a routine procedure. To avoid seasonal variation of productivity last one year's average of each selected workers was taken as pre-intervention productivity and one year average was taken as post-intervention productivity.

Cut off point used for diagnosis of anaemia was adult male 13gm/dl, adult non pregnant female 12 gm /dl and adult pregnant women 11gm/dl7. Body mass index was calculated from height and weight of each individual and classified using WHO classification. 7

Results of baseline study
The mean age of a study participant was 39 years (18 - 58 years). Average family size was five. Majority 1162 (99.5%) had monthly income ranging between Rs.1000 to Rs. 2000. Hindu was the major religion 95.5%, followed by Muslim 3.8% and Christian 0.7%. Literacy rate was only 0.3% i.e., 1164(99.7%) tea garden workers were illiterate. Only 4 out of 1168 participants were literate. 1031 (88.3%) permanent working population lived in Kutcha Pucca houses i.e., in most cases though the walls were made up of brick, the floor was kutcha and all extensions were kutcha. Majority 1122 (96.1%) practiced open field defecation; but in most cases the toilet facility was there, but they were not using it. They used the toilet as storehouse for keeping fire wood or livestock. 1121 (96.0%) had their own tube wells but the platforms were in broken stage in most of them with unhygienic cone of filtration.

Baseline study revealed significantly higher prevalence of different grades of anaemia amongst women workers compared to men (x2=12.35; p=0.006). Hindus were suffering more from anaemia compared to other religion like Christian and Muslim (x2=10.23, p= 0.017).

Findings of anthropometric examination: According to body mass index 534(45.7%) were underweight, while 618 (52.9%) were of normal weight and 16 (1.4%) were overweight. On an average 47.1% males were underweight, while 45.2% females were underweight.

Distribution of anaemia - A total of 1028 (88.0%) of the studied permanent worker population were anaemic i.e., Hb % below 12 gm/ dl. Prevalence of soil transmitted helminthiasis was 63.6%. Anaemia was found amongst 89.3 % women workers, while 84.2% men workers were anaemic. Haemoglobinopathy (sickle cell anaemia) was prevalent amongst 9.72% anaemic women

Findings from dietary survey - Mean Calorie intake was 2014.7+ 331.8 for men and 1940.7 + 322.1 for women. Average protein intake was 43.5 + 9.2 gm/day for men and 41.9 + 8.3gm/day for women. Iron intake for men was found as 38.9 + 12.4 mg /day and that for women was 37.5 + 12.6 mg/day. Average salt intake was 41.8 gm.

Result of the intervention study: Distribution of socio-demographic determinant along with different grades of anaemia before intervention is presented in table 1. There was no significant difference in mean age of study participant of both intervention and non-intervention group (p=0.727; CI 1.454-2.081). Prevalence of different grades of anaemia amongst both group were also similar (x2 =4.217; p = 0.118). Comparison of Haemoglobin level in intervention tea estate i.e., amongst the 150 anaemic women given DOIT showed significant raise in mean haemoglobin level by 1.44 gm per dl after three months of intervention (p=0.000). Comparison of Haemoglobin level in non intervention group also showed significant raise in mean haemoglobin level by 0.19 gm per dl (p=0.000). The IFA tablets given under direct observation significantly improved the plucking productivity of anaemic workers in intervention group with mean difference of 10.22 kg (p=0.000). (Table -2 &3)). In the intervention tea estate; 99.3% (149) women showed increased Haemoglobin level which ranges from 0.16 - 4.61gm/dl, while only 20.0% (30) women showed increased haemoglobin level in non-intervention group ranging from 0.03 -2.36 gm/dl. Scatter plot also showing comparatively strong positive correlation between haemoglobin level and productivity in intervention group. (Figure 1)

Table 1: Distribution of socio-demographic determinant along with different grades of anaemia before intervention

	N	N (Percentage)					
		Normal	Mild anaemia	Moderate anaemia	Severe anaemia	Chi-Square	p-value
Intervention TE							
Size of the family							
Small family (members<5)	69 (46.0%)	5 (7.2%)	39 (56.5%)	17 (24.6%)	8 (11.6%)	3.404	0.333
Large family (Members≥5)	81 (54.0%)	2 (2.5%)	44 (54.3%)	28 (34.6%)	7 (8.6%)		

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Age							
20 – 29	30 (20.0%)	1 (3.3%)	15 (50.0%)	13 (43.3%)	1 (3.3%)	12.691	0.177
30 – 39	71 (47.3%)	2 (2.8%)	37 (52.1%)	23 (32.4%)	9 (12.7%)		
40 – 49	35 (23.3%)	2 (5.7%)	21 (60.0%)	7 (20.0%)	5 (14.3%)		
50 – 59	14 (9.3%)	2 (14.3%)	10 (71.4%)	2 (14.3%)	0		
Non-Intervention TE							
Size of the family							
Small family (members<5)	58 (38.7%)	1 (1.7%)	35 (60.3%)	20 (34.5%)	2 (3.4%)	2.087	0.555
Large family Members≥5)	92 (61.3%)	5 (5.4%)	50 (54.3%)	31 (33.7%)	6 (6.5%)		
Age							
20 – 29	18 (12.0%)	1 (5.6%)	10 (55.6%)	5 (27.8%)	2 (11.1%)	4.666	0.862
30 – 39	67 (44.7%)	3 (4.5%)	35 (52.2%)	25 (37.3%)	4 (6.0%)		
40 – 49	45 (30.0%)	1 (2.2%)	26 (57.8%)	16 (35.6%)	2 (4.4%)		
50 – 59	20 (13.3%)	1 (5.0%)	14 (70.0%)	5 (25.0%)	0		

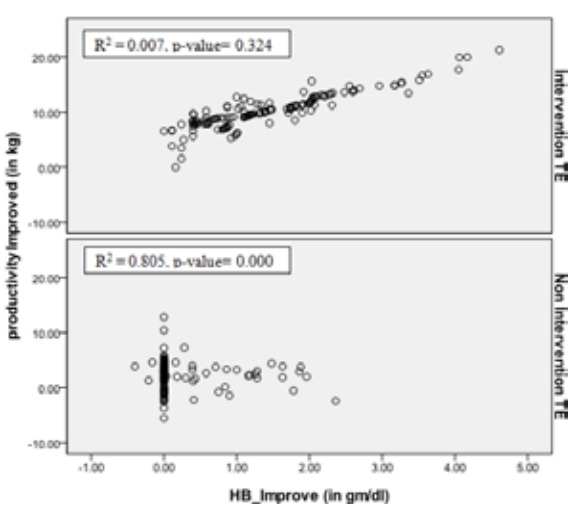
Table – 2 : Comparison of different grades of anaemia before and after intervention

	N	N (Percentage)					
		Normal	Mild anaemia	Moderate anaemia	Severe anaemia	Chi-Square	p-value
Before							
Interventional TE	150	0	35 (23.3%)	93 (62.0%)	22 (14.7%)	4.217	0.118
Non-intervention TE	150	0	41 (27.3%)	98 (65.3%)	11 (7.3%)		
After							
Interventional TE	150	40 (26.7%)	81 (54.0%)	27 (18.0%)	2 (1.3%)	77.037	0.000
Non-intervention TE	150	0	58 (38.7%)	81 (54.0%)	11 (7.3%)		

Table - 3: Comparison of mean haemoglobin level and productivity before and after intervention with directly observed Iron therapy of both the tea estates.

		Interventional TE				Non-Interventional TE			
		Mean± SD	Mean Differences	95% CI	p-value	Mean± SD	Mean Differences	95% CI	p-value
HB level	Before	8.26±1.06	1.44	(1.284 – 1.588)	0.000	8.53±0.91	0.19	(0.117 – 0.273)	0.000
	After	9.70±1.02				8.72±0.93			
Productivity	Before	21.14±4.02	10.22	(9.692 – 10.734)	0.000	20.75±3.66	2.25	(1.947 – 2.712)	0.000
	After	31.36±6.23				23.01±3.55			

Figure-1 Scatter plot showing correlation between haemoglobin level and productivity amongst both intervention and non – intervention group



Discussion –

Study population was mostly illiterate with poor living condition, 88.0% having anaemia and 45.7% had under nutrition. Mean Calorie intake for men and women was significantly lower than recommended values (i.e., for men moderate worker recommendation is 2875 kcal/day and for women moderate worker 2225 kcal/day; while for heavy worker men 3800 and for women 2925 [8]) (p=0.001). Average protein intake was also significantly lower than the requirement i.e., 60 gm/d for men and 50 gm/d for women [8] (p=0.000) in both groups. Iron intake was significantly higher than the recommended i.e., 28 mg/day for adult male and 30 mg/day for adult non pregnant women and 38 mg /day for pregnant women [8,9] (p=0.000). This indicates that despite the high intake of iron rich food, the burden of anaemia was very high, which may be because of poor bioavailability and infection and infestations. Finding of higher iron intake may also be due to limitation of 24 hour recall method in assessing micronutrient intake. ICMR data in the same districts also reported 90.1% adolescent girls with anaemia (7.3% having severe anaemia); these findings suggest continuation of anaemia throughout life in women. [10] Average salt intake was 41.8 gm which was eight times higher than the recommended daily allowance i.e., 5 gm/day[11] (p=0.000). In both the intervention and non intervention tea group the raise in haemoglobin level was significant (1.44g/dl vs 0.19 g/dl) after 3 months of intervention (p=0.000), but the rate of improvement was 7.5 times higher amongst DOIT group compared to unsupervised group. This indicates that even by letting people know about their anaemic status, imparting health education, supply of albendazole tablet and conventional treatment facility can improve the anaemia status of women but at a slower rate.

The IFA tablets given under direct observation significantly improved the plucking productivity of anaemic workers in the intervention tea estate by 10.22 kg (p=0.000); while in the control group getting unsupervised treatment also showing significant improvement of 2.25kg(p=0.000); but four times less than the DOIT group.

Anaemia causes impaired cognitive function leading to poor educational performance [12,13,14,15,16]. Therefore, anaemia may be the major causative factor of poor literacy level in our study and vice versa.

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Though nutritional iron deficiency is regarded as commonest cause of anaemia, high prevalence of worm infestation (63.6%) suggest multi-factorial causal hypothesis of anaemia for Tea-Garden workers.

The survey done by ICMR also revealed high magnitude of under nutrition and infectious diseases among tea garden population of Assam[5,17.] Poor nutrition probably makes them vulnerable to infectious diseases and vice versa. Presence of household toilet reduces orofecally-transmitted diseases [17]. However, high prevalence even among toilet holders may be because of contaminations of surroundings due to open field defecation by large numbers of other community members and poor maintenance of toilet facilities.

Anaemia is recognized to be a major public health problem and both nutritional (such as iron and other mineral and vitamin deficiencies) and non nutritional (such as infection, infestation and haemoglobinopathies) factors contribute to the onset of anaemia and iron deficiencies. Among variant haemoglobins, Haemoglobin E (Hb E) and sickle cell anaemia were widely prevalent in this part of the country. In South East Asia and the Indian Subcontinent, Hb E has been considered as a common disorder of blood posing a major genetic and public health problem [18]. Haemoglobinopathies, particularly HbE and sickle cell haemoglobin (HbS) and thalassemia are considered to be the other contributing factor in occurrence of anaemia in this part of the country. The other variant haemoglobin prevalent in Assam is Hb S and is reported to be mostly restricted to the tea garden community of Assam [19].

Conclusion -

Directly observed iron therapy was found beneficial in improving haemoglobin level and productivity among anaemic female pluckers in a tea estate of Dibrugarh. Though there is significant increase in haemoglobin level of 1.44 gm after three month of giving directly observed therapy, other factors like environmental modification and behaviour change communication needs further attention to address the multifactoral causation and requirement of multidimentional approach for lowering the burden of anaemia in this community.

Therefore, though IFA showed beneficial effect there is a need to explore the feasibility of other intervention influencing the burden of anaemia in this community like environmental modification and food supplementation by integrated approach of ICDS and Tea garden welfare system.

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