

Impact study of hygiene and health counseling as a controlling measure of iron deficiency Anemia

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Abstract

Background and Aim: Anemia is a moderate to severe public health problem in India. Coverage of anemia programmes are inadequate, safe water and sanitation status is moderate or poor, open defecation rates are significant, incidence of diarrhoeal diseases are high as a results of infection. Though poor bio-availability of iron is the root cause of iron deficiency anemia (IDA) the role parasites infection such as hookworm infection also plays a major role in IDA. There is a link between poor hygiene practices –worm infection– IDA. Hence this study was undertaken to educate women of reproductive age group (WRA) about impact of IDA and how good hygiene practice can eliminate the problem to at least some extent. **Methods and Material:** Women of reproductive age group (WRA) in rural population were taken randomly for this study. They was first screened for anemia and then IDA. The ID anemic women were then randomly allocated into two groups one as experimental and another as control. Base line hematological parameters and hygiene practices were obtained from them. Only the experimental group was counselled about good hygiene practices. The final hematological parameters and hygiene practices were obtained after eighteen months and were compared for statistical significance. **Results:** At the end of the study 306 women were found to be non anaemic in experimental group while in control group it was only 78 women. Statistical significant results were obtained in hygiene practices between experimental and control group. **Conclusion:** Our study hence shows that good hygiene practice does play an important role in controlling anemia.

Keywords: Anemia, Defecation, Hand washing

Introduction

Anemia is a disorder of the blood in which a person does not have enough hemoglobin, the protein responsible for carrying oxygen throughout the body.

Globally, two billion people are anaemic, which includes 315 million (95% CI: 291–340) in the South-East Asia Region (SEAR)[1]. Iron deficiency, the primary contributor to anemia, is the most widespread nutritional disorder while other micronutrient deficiencies including folate and vitamin B12 also contribute to anemia. Recent evidence indicates a greater role for anemia of inflammation caused by parasitic infections including malaria [2]. Iron deficiency anemia (IDA) is a significant public health problem in India. The National Family Health Survey (NFHS –2)[3], India reported that anemia is a major

health problem with over half of the women of reproductive age (WRA, 15-49 years) years having the condition. It was reported that 53.9 percent among women in the age group of 15-49 years living in rural area and 45.7 percent of urban women any form of anemia[3]. In the report of data in NFHS-3 it revealed that among married women between the ages of 15-49 years, the prevalence of anemia has risen from 51.8 percent in 1998-99 (NFHS-2) to 56.1 percent in 2005-06 (NFHS-3)[4]. In Chhattisgarh state as per NFHS-3 data the percentage of rural women having any form of anemia is 59.4%[5]. Thus, it is obvious that this problem clearly requires immediate attention and intervention. There are many causes of low hemoglobin, which involve too little production or too much destruction of hemoglobin. On the production side, Nutritional deficiencies, mainly of iron, caused by inadequate diet is the predominant cause of anemia in the south east Asia region (SEAR) [6].

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However, low hemoglobin can also be caused by lack of vitamin B12 and folic acid, two nutrients necessary for the production of red blood cells. Hence it may be stated that although the primary cause of anemia is iron-deficiency, it is seldom present in isolation. More frequently it coexists with a number of other causes, such as malaria, parasitic infection, and haemoglobinopathies.

Parasites are well known to cause of anemia. Intestinal parasites cause anemia by causing blood loss in the stool, lack of appetite, increased motility of food through the intestine, competition for nutrients, and damage to the intestinal wall that lead to decreased absorption of nutrients, including iron, vitamin B12 and folic acid [7-9].

Open defecation, the practice of defecating outside without a toilet or latrine, may be an important cause of hemoglobin deficiency around the world, and particularly in South Asia. Among the world's regions, sub-Saharan Africa and South Asia continue to have the lowest sanitation coverage [10].

In addition to that hygiene practices like use of slippers during defecation regular trimming of one's nails, washing of hands before eating, washing of hand with soap after defecation or when contacted with excreta are all proper hygiene practices failing of which lead to faecal-oral route of transmission of pathogens leading to environmental enteropathy, which may permanently damage the intestine leading to poor absorption of micronutrients. In a recent systematic review of 42 studies of observed handwashing with soap in 19 countries, it was estimated that only 19% of people worldwide wash their hands after potential contact with excreta [11].

Consequences of haemoglobin deficiency- Hemoglobin deficiency has been shown to have many negative consequences. In adults, it reduces work capacity and thus productivity, and is a major cause of maternal mortality in developing countries [12-14]. Children who are hemoglobin deficient have impaired cognitive ability and physical development, and are more susceptible to disease [15-17].

Past efforts in IDA control and present aim of this study: Major approaches in battling IDA previously were medicinal supplementation with iron and folic acid although supplementation with iron is considered necessary for groups at high risk as a short-term emergency measure, it fails to address the root causes and cannot provide the overall long-term benefits of

economy and sustainability. Evaluation studies of India's nationwide and long-standing supplementation programme showed irregular supplies, non-compliance by the beneficiaries, poor counselling, etc. As such, the supplementation strategy has proved to be inadequate [18].

As per existing knowledge, there have been no randomized controlled trials of the effect of latrine or toilet provision on hemoglobin status especially in rural population especially in the state of Chhattisgarh. This study was hence undertaken with a view that such a trial would make an important contribution to the literature on the determinants of anemia among rural population where open defecation is rampant and other hygiene practices are poorly followed.

Methods and Materials

This is a longitudinal interventional study done on rural women of reproductive age (WRA) group of 14-49 years.

Place of field study: District Mungeli of state Chhattisgarh.

Period of the study: January 2014 to September 2016
With due discussion with program officers of women and child development office of the district and block medical officer, five villages were chosen for this study where anemia prevalence were suspected to be more common among women, and those places which are not endemic to malaria. With due consent of women who volunteer for the study, screening test was first done to find out the women suffering from anemia and then those found to be anemic were screened for iron deficiency anemia (IDA).

The CDC/WHO expert groups on 7th May 2004 recommended that hemoglobin and serum ferritin are the most valuable indicators of the impact program to control iron deficiency [19].

Exclusion criteria- Those women who informed that they were suffering from any diseases and which was suspected to be of inflammatory type and those suffering from any hemoglobinopathies were excluded from the study.

Also women informing having recent major surgery or hemorrhagic incident were excluded.

Inclusion criteria- Apparently healthy women of age between 14-49 years, non-pregnant and non-lactating women were taken for the study.

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A total of 2105 women of age group were screened for haemoglobin out of which 76% that is 1600 were found to be anaemic. Women who were found to be anaemic were then tested for ferritin test out of which 73% that is 1168 women were found to be suffering from IDA.

IDA was considered when haemoglobin values falls below 12.0 gm/dl of blood and ferritin value less than 15.0 ng/ml of blood [20].

At the baseline 584 IDA women from 305 household were included in the experimental group and 584 women from 310 household were included in control group by purposive random sampling.

In this study, anemia was defined according to the World Health Organization (WHO) definition as a baseline hemoglobin concentration less than 12.0 mg/dl [21].

Base line study include estimation of haemoglobin, ferritin, Total Iron Binding capacity (TIBC) estimation of women and evaluation of hygiene practices viz. use of latrine for defecation, use of slippers during defecation, trimming of nails, washing of hands before eating and washing of hands after defecation or when in contact with excreta Of both experimental and control group by interview schedule.

Haemoglobin was estimated by cyanmeth- hemoglobin-method and serum ferritin by radioimmunoassay (RIA). Serum total iron binding capacity (TIBC) was estimated by estimated by iron and TIBC kit in semiautoanalyzer, by Ferrozine method [22-23].

Our main focus was to give counselling to women in experimental group to inculcate good hygiene practices to prevent transmission of worms either by foot or by faecal-oral route. Counselling includes basic health concepts about IDA as public health problems. To educated them about sources of parasite infection and how it leads to IDA, faecal-oral route of parasite infection transmission and how better hygiene practices can be adopted for prevention of the same.

Hygiene practice that were counselled to them were use of latrine for defecation, use of slippers during defecation, trimming of nails, washing of hands before eating and washing of hands with soap after defecation or when in contact with excreta and what are their benefit in practicing in prevention of anemia. Easily available and economical tools were suggested to them so that the counselling does not become burdensome

and unacceptable to them. Interactions with the women were done in local language in very simple communicable way. Posters regarding hygiene practices were used for better understanding and for the illiterate.

Though the experimental group receives counselling the control group was reframed from such counselling from the investigator.

After baseline study the haematological and hygiene predictors thus latrine use for defecation, use of slippers during defecation were again carried out after six months for both groups (other hygiene predictors at the end of the study) and those women still found to be anaemic in experimental group was re-counselled.

The procedure was repeated again at twelve months and finally at the 18th month's data of both experimental and control group were statistically analysed to study the impact of hygiene and health counselling as a controlling measure of anemia

Blood sample collection- Blood samples were taken to perform haemoglobin to determine serum concentrations of ferritin and TIBC. Each sample consisted in 5 ml of blood taken from the antecubital vein of the arm after cleaning of the zone with isopropyl alcohol. From this, 4mL were used to obtain serum and 1 ml was treated with EDTA for haemoglobin. Serum samples were obtained by centrifugation of blood samples, within 4 hours of extraction. Serum was kept at optimum temperature and protected from light until analysis. Necessary ethical approval was taken for this study

Statistical analyses- The Kolmogorov-Smirnov test was used to assess normality of the continuous data. Since our Kolmogorov-Smirnov test results showed that our continuous data viz. haemoglobin (Hb), Ferritin and TIBC were not normally distributed we opted for non-parametric tests [24].

Man-Whitney test was conducted to compare the median and mean ranks of haematological indicators viz. haemoglobin (Hb), Ferritin and TIBC.

Chi-square test was performed for categorical variables. Binary logistic regression was run to assess the impact of the hygiene predictors on anaemic status.

All statistical tests were 2-tailed and differences were considered significant at $p < 0.05$. Statistical analysis was done by SPSS version 22 [25].

Results

Socio-Demographic profile of women- Mean age of women in experimental group is 25 years \pm 7.6 and ranging from 14 years to 45 years and for control group the mean age is 24 yrs \pm 7.8 years and ranging from 14 years to 45yrs.

As per religion all women were predominately Hindu. Nearly all the subjects were from families engaged in agriculture or agriculture labour.

At the end of the study that is after 18th months 10 women opted out of the study in experimental group and 8 women opted out from the control group.

To keep the sample size equal we kept sample size of both group at 574.

From table I it was observed that in terms of defecation in the experimental group (n=374) 65.2% women opted for latrine uses from (n=152) 26.5% baseline value, while in control group only (n=207) 36% of the women opted for latrine use from baseline value of (n=166) 28.9%

Table-I: Personal hygiene indicator in among Women

Personal Hygiene Indicators	Base line		After Six months		After Twelve Months		After eighteen months		P Value	X ² Value
	Exp.	Control	Exp.	Control	Exp.	Control	Exp.	Control		
In terms of Frequency & Percentage										
Sanitary Latrine use Frequency percentage	152 26.5	166 28.9	160 27.9	166 28.9	298 51.9	174 30.3	374 65.2	207 36.1	<0.0005	97.18
No use Of latrine Frequency percentage	422 73.3	408 71.1	414 72.1	408 71.1	276 48.1	400 69.7	200 34.8	367 63.9		
Slipper use Frequency percentage	85 14.8	77 13.4	124 21.6	83 14.5	216 37.6	86 15.0	401 69.9	89 15.5	<0.0005	346.6
Nouse of slipper Frequency percentage	489 85.2	497 86.6	450 78.4	491 85.5	358 62.4	488 85.08	173 30.1	485 84.5		

Both experimental and control group contained equal no of anaemic women (n=574)

Regarding use of slippers during defecation it has been observed that after 18th months in the experimental group (n=401) 69.9% women were using slipper from baseline value of (n=85) 14.8% whereas it is only (n=89) 15.5% in control group from baseline value of (n=85)14.8%.

As personal hygiene is concern in terms of regular trimming of nails it was found from table IIthat in experimental group there is increase from (n=259)45.1% in baseline to (n=374) 65.2% at the end of the study and in control group in baseline it was (n=274)47.7% and (n=283)49.3% at the end of study.

Table- II: Personal hygiene indicator in among Women.

Personal Hygiene Indicators		Baseline		After Eighteen months		P Value	X ² Value
		Experimental	Control	Experimental	Control		
Regular Trimming of nails	Frequency	259	274	374	283	P<0.0005	29.47
	Percentages	45.1	47.7	65.2	49.3		
No Regular Trimming of nails	Frequency	315	300	200	291		
	Percentages	54.9	52.3	34.8	50.7		
Washing of hand before eating	Frequency	179	214	480	239	P<0.0005	216.16
	Percentages	31.2	37.3	83.6	41.6		
Non Washing of hand before eating	Frequency	395	360	94	335		
	Percentages	68.8	62.7	16.4	58.4		
Washing of hand with soap after defecation	Frequency	129	145	410	154	P<0.0005	228.41
	Percentages	22.5	23.5	71.4	26.8		
Non Washing of hand with soap after defecation	Frequency	445	429	164	420		
	Percentages	77.5	74.7	28.6	73.2		

Both experimental and control group contained equal no of women (n=574)

Major changes were observed in experimental group regarding hand washing with soap after defecation or when contact with excreta.

Hand washing with soap after defecation in experimental group increased to (n=410)71.4% after 18th months from baseline value of (n=129)22.5% while in control group there is a marginal rise from (n=145)23.5 % to (n=154)26.8%.

Hand washing before taking food as observed in experimental group versus control group there is an increase from (n=179) 31.2% to (n=480)83.6% and (n=214)37.3 % to (n=239)41.6% respectively.

Statistically significant Chi-square test results $p < 0.005$ were obtained in hygiene predictors viz latrine use, slipper use during defecation, trimming of nails , washing of hand before eating and washing of hands with soap after defecation between experimental and control groups.

A Chi-square test of homogeneity was conducted to test the statistical significance of anemic status after the end of the study among experimental and control groups with an adequate sample size established according to Cochran (1954) [26].

The observed frequencies/count and percentages of anemic status among experimental and control groups are presented in the table III along with the p value and chi- square test value for 18 months.

A statistically significant result was obtained between experimental and control group among different anemic status at 18 months. $X^2(3) = 205.23, p < 0.005$.

Table- III: Shows the frequency and percentage changes in anaemic status in experimental and control groups in different stages of the study along with the chi-square test results after 18 months.

Category of anemia	Base line		Six months		Twelve Months		Eighteen Months		P Value	X ² Value
	Exp	Control	Exp	Control	Exp	Control	Exp	Control		
Mild	295	297	211	210	210	298	178	307	P<0.0005	205.23
percentage	51.4	51.7	47.2	36.6	36.6	51.9	31.0	53.5		
Moderate	260	260	291	247	151	221	90	188		
percentage	45.3	45.3	50.7	43.0	26.3	38.5	15.7	32.8		
Severe	19	17	11	12	03	04	00	01		
Percentage										
No Anemia	All anaemic	All Anaemic	82	24	210	51	306	78		
Percentage	Nil	Nil	14.3	4.2	36	8.9	53.3	13.6		

Both experimental and control group contained equal no of anaemic women (n=574)

Post-hoc analysis involving pair wise comparison using multiple Z- tests of two proportions with a Bonferroni correction was conducted to assess the significance among different anemic status. Statistical significant was accepted at p<0.0125.

There was statistically significant difference in the proportion of experimental group having mild anemia than control group (n=178, 31% versus n=307, 53%) as well as the proportion of the experimental group having moderate anemia then control group (n=90,15.7% versus n=188,32.8%). there were also statistically significant difference in the proportion of experimental group having no anemia than control group (n=306,53.3% versus n=78,13.6%), p<0.0125. While There were no statistically significant difference in the proportion of experimental group having severe anemia than control group (n=0, 0.0% versus n=01, 0.2%) p>0.0125.

A Mann-Whitney U test was conducted to determine if there were differences in the median of the haematological indicators viz. haemoglobin, ferritin and TIBC scores in between experimental and control groups. From table IV the Mann-Whitney U test results observed were as follows.

Table- IV: Mann-Whitney test output of hematological indicators after the end of the study (18th months) between experimental and control groups.

Hematological Indicators	Interventional group		Control group		Mann-Whitney	Z value	P value
	Median	Mean rank	Median	Mean rank			
Hemoglobin(mg/dl)	12.1	748.24	11.2	400.76	65010.5	-17.78	<0.0005
Ferritin (ng/ml)	28.0	772.27	9.5	376.73	51218.5	-20.21	<0.0005
TIBC (µg/dl)	446	364.49	534	784.51	44192.5	-21.63	<0.0005

Both experimental and control group contained equal no of anaemic women (n=574) P<0.0005

Median Hb scores (12.1) for experimental and Hb scores (11.2) for control group was statistically significant in experimental then in control $\mu=65010.5$, $Z=-17.78$, p<0.005

Median ferritin score (28.0), for experimental and ferritin score (9.5) for control group was statistically significant in experimental then in control $\mu=51218.5$, $Z=-20.21$, p<0.005

Median TIBC score (446), for experimental and, TIBC score (534) for control group was statistically significant in experimental then in control $\mu=44192.5$, $Z=-21.63$, $p<0.005$.

Binary logistic regression test was performed among the experimental group to ascertain the impact of the hygiene predictors on anaemic status. The test results are tabulated in table VI. The logistic regression model was statistically significant $X^2(5) = 555.92$, $p<0.005$. This model explained 82.9% (Nagelkerle R²) of the variance in anaemic status. Of the predictors all were statistically significant as shown in table V. Latrine users had 65.81 times mode odds to be non anaemic than those who do open defecation, like wise women wearing slipper during defecation have 88.82 times odds of being non anaemic, Women who regularly trim their nails have 1.671 time odds of being non anaemic, those who wash their hand before eating have times 3.97 times odds of being non anaemic and those women who wash their hands with soap after defecation or when in contact with excretahave 43.25 times odds of being non anaemic then those women who do not.

Table-V: Binary logistic regression of Hygiene predictors predicting anaemic status among women of experimental group at the end of the study.

Hygiene Predictors	B	SE	Wald	df	P	Odds Raito	95% CI for Odds	
							Lower	Upper
Use of latrine	4.187	0.75	29.91	1	<0.005	65.81	14.68	295.064
Use of slippers During defecation	4.497	1.07	18.12	1	<0.005	89.82	11.32	712.517
Regular trimming of nails	0.513	0.177	8.45	1	<0.05	1.571	1.182	2.362
Washing of hands before eating	1.379	0.616	5.008	1	<0.05	3.97	1.187	13.293
Washing of hands with soap after defecation	3.767	0.529	49.41	1	<0.005	43.25	15.35	121.90

Statistically significant results were obtained for all predictors

Discussion

Anemia remains to be a problem with multifactorial causes. However, too little progress has been made toward the global elimination of iron deficiency. Part of the reason for this lack of action is the fact that iron deficiency anemia (IDA) has few overt symptoms [27].

From the study results it is evident that personal counselling and educating women regarding their personal hygiene in terms of use of latrine for defecation and wearing slipper during defecation, regular trimming of nails, washing of hands before eating and washing of hands with soap after defecation or when in contact with excreta have a very major impact on reducing cases of anemia as evident from comparing results between experimental group and control group after the end of the study.

Personal hygiene plays a very important role in minimizing worm infection which results in loss of blood consequently leading to iron deficiency anemia.

Our study result shows that intervention in terms of hygiene and health education and counseling among WRA group turned out to be successful in controlling IDA, as evidence from parameters of the hematological test results. The study results shows that once women become aware about the negative impact of IDA and how good hygiene practices helps in reducing the same they prefer to practice good hygiene practices as evident from the study result. At the end of the study 306 women in the experimental group were non anemic while in control group it turned out to be only 78 women.

The Logistic regression results points out that the hygiene predictors positively and significantly contributes in reducing cases of anemia.

It is important to note that two randomized trials, one from India and one from Indonesia, have found an effect of sanitation programs on child height, and that

the biological mechanisms linking open defecation and height are similar to those proposed to link open defecation and hemoglobin status [28].

For long-term sustainability in prevention of IDA environmental health will be required, improving access to safe water and sanitation and improving hygienic behaviour through health and hygiene education. Since human soil-transmitted helminth (STHs) are faecal-borne infections, and transmission occurs either directly (hand-to-mouth) or indirectly (through food and water), reducing faecal contamination of soil can be achieved by promoting the use of latrines, use of slippers during defecation developing self-protection from re-infection, and promoting personal/family hygiene measures such as washing hands before taking food and after defecation or when contact with excreta.

Indeed, Center for Disease Control and Prevention (CDC) has stated: "It is well documented that one of the most important measures for preventing the spread of pathogens is effective hand washing." As a general rule, hand washing protects peoples, best against diseases transmitted through faecal-oral routes [29].

Though supplementation with iron tablets is a more common practice to counter anemia in moderate to severe cases but it hardly eliminates the root cause. In places with more open defecation, we would expect parasite medicine to be less effective because the chance of re-infection is higher. Sanitation, by contrast, is a public good, which is harder to obtain than medicine or healthy food. It involves fixed costs of construction, as well as maintenance costs. Additionally, parents in poor countries are largely unaware of the negative health impacts of open defecation [30]. Hence awareness through education is more vital.

Conclusion

Individual hygiene behaviors can be affected by many factors, including beliefs, values, habits, socio-economic and cultural factors, level of knowledge, personal preferences, family characteristics and physical and social characteristics of the work and living environments. Therefore, the hygiene habits of each individual differ; meaning that these habits are unique to individuals. Hence to achieve a goal to change individual hygiene practices it requires first to understand the individual and then to properly counsel and educate them about the negative impact of not practicing good hygiene practices like open defecation.

Highlights of our study- It is obvious from this study that personal counselling indeed proves effective in improvement of personal hygiene which ultimately helps in controlling anemia beside past efforts to only control it by way of iron and folic acid supplementation and it is hence highly recommended for the better health of individuals and society.

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