Original Article

# *Dhatri Lauha* in the management of iron deficiency anemia: A prospective open-label single-arm multi-center trial

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## Abstract

**Background:** The burden of iron-deficiency anemia (IDA) remains persistently high in India due to the poor tolerability of oral iron supplementation. Therefore, more focus is required to explore traditional medicine for safe and effective options for managing IDA. **Aim:** To assess the clinical safety and efficacy of *Dhatri Lauha* in patients with IDA. **Materials and methods:** An open-label, prospective, single-arm, multi-center trial was conducted at 12 centers with a sample size of 40 participants per study site. Patients with IDA aged 18-60 years with hemoglobin levels in the range of 6-10gm/dl, mean corpuscular volume (MCV) <80 fl, mean corpuscular hemoglobin concentration (MCHC) <34 µg/dl, serum ferritin <30 µg/dl and serum iron <50 µg/dl were included in the study. *Dhatri Lauha* 500 mg capsule was administered twice daily with lukewarm water after meals for 45 days. The primary outcome measure was the change in hemoglobin (Hb%) level from baseline to day 45. Secondary outcome measures included the change in MCV, MCHC, serum iron and ferritin levels, incidence of adverse events, and change in safety parameters (liver and kidney function tests). The mean (statistical) change in outcome measures from baseline to day 45 was compared using a paired sample t-test. **Results:** Out of 458 participants enrolled in the study, 400 contributed to the final analysis. A significant difference was observed in the outcome parameters such as Hb%, MCV, MCHC, serum ferritin, and serum iron levels ($P < 0.001$) after 45 days of treatment. Mean Hb% changed from 8.46 ± 1.14 g/dl at baseline to 9.18 ± 1.61 g/dl on day 45 ($P < 0.001$). LFT and KFT were within the normal limits after the study period. No participant withdrew from the study due to adverse events. **Conclusions:** *Dhatri Lauha* is a safe intervention and can be expected to improve hemoglobin levels, red blood cell parameters, and iron stores in patients with IDA. Future RCTs with a larger sample size, standard care as control and a longer follow-up may produce more accurate and reliable results.

**Keywords:** *Dhatri Lauha,* hemoglobin, iron-deficiency anemia, nutritional disorder, *Pandu Roga*

## Introduction

Anemia is one of the most prevalent nutritional deficiency disorders affecting developed as well as developing nations. It is an indicator of poor nutrition and significantly impacts people's health, and social and economic growth. In 2019, anemia was responsible for 58.6 (40.14–81.1) million years lived with disability.[1] According to the National Family Health Survey-5 done in 2019-2020, anemia affected 57.2% of females aged 15-49 years in India.[2] The Global Burden of Diseases, Injuries, and Risk Factors study (2013) reported that iron deficiency is the most significant contributor to the onset of anemia.[3] As per the WHO report (2001), there are about two billion anemia cases globally, of which half is iron-deficiency anemia (IDA) affecting 30% of the population worldwide.[4,5] Because anemia is a late symptom of iron deficiency in the human body, iron deficiency is predicted to be 2.5 times more common than anemia.[4,6] The incidence of IDA is comparatively high in developing countries such as India compared to developed countries.[7] The common causes of IDA in developing countries include chronic blood loss, poor dietary iron intake, frequent pregnancy, and parasitic infections such as hookworm infestation. IDA is associated with fatigue, weakness, difficulty in concentration, cold intolerance, and

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dyspnea on exertion, which leads to impairment in quality of life and work productivity.[6,8-10] IDA during pregnancy is associated with adverse outcomes such as maternal mortality, preterm labor, low birth weight, and infant mortality.[11] IDA also has an impact on children's cognitive and motor development, as well as their susceptibility to infections.[12]

The primary treatment for IDA is oral iron replacement therapy, which is convenient, affordable, and effective in the management of stable IDA patients.[13-15] It rapidly improves hemoglobin levels, but it is often poorly tolerated over time due to associated nausea, vomiting, constipation, and abdominal discomfort.[6,14] In a meta-analysis comparing oral and intravenous iron therapy, gastrointestinal adverse events were reported in 32% of the participants receiving oral iron supplementation.[16] The poor tolerability of oral iron supplementation may compromise its good compliance and, in turn, leads to the persistence of IDA.[15] Hence, it is imperative to explore traditional medical systems for interventions with comparable efficacy to oral ion supplementation, with no or minimal adverse event/adverse drug reaction (AE/ADR), and better tolerability.

Many Ayurveda interventions indicated in the management of *Pandu Roga* which is symptomatically similar to the presentation of IDA, contain *Lauha*/*Mandoora Bhasma*. *Lauha*/*Mandoora Bhasma* are natural sources of iron and the herbal ingredients in these interventions improve digestion and metabolism, thereby enhancing the bio-availability of nutrients. Further, *Lauha Bhasma* exhibits significant hematinic and cyto-protective activity in experimental studies.[17,18] The evidence on the safety and efficacy of many Ayurvedic interventions is available in the public domain.[19-22]

*Dhatri Lauha* is a herbo-mineral preparation commonly prescribed by Ayurveda physicians to manage *Pandu Roga* in routine clinical practice. It has been found safe and no significant change was observed histo-pathologically and in hematological and biochemical parameters in acute and sub-acute toxicity studies.[23] Few clinical studies are available on *Dhatri Lauha* in IDA, but these studies have limitations such as small sample size, selective population, and limited outcome parameters. This multi-center study was planned in a diverse population across India with an adequate sample size and clinically relevant objective outcome measures to generate tangible evidence regarding the clinical safety and efficacy of *Dhatri Lauha* in IDA.

# Materials and methods

## Study design

This study was an open-label, prospective, single-arm, multi-center trial to explore the clinical efficacy and safety of *Dhatri Lauha* in patients with IDA. A task force consisting of experts from contemporary medicine, Ayurveda and biostatistics developed the study protocol for this multi-center trial.

## Study setting

This multi-center study was conducted from 2007 to 2009 at 12 centers viz. 11 institutes under the Central Council for Research in Ayurvedic Sciences (CCRAS) viz. Central Ayurveda Research Institute at New Delhi, Bengaluru, Bhubneshwar; National Ayurveda Research Institute, Cheruthuruthy; Regional Ayurveda Research Institute at Lucknow, Jaipur, Gwalior, Patna, Jammu, Mandi, Gangtok and Mahatma Gandhi Ayurved College Hospital and Research Centre under Datta Meghe Institute of Medical Sciences, Wardha, Maharashtra, India. The study participants were recruited at the OPD level from the participating institutes.

## Participants

After obtaining written informed consent in their native language, patients with symptoms of IDA were screened for eligibility to participate in the study. Patients of either sex aged 18-60 years, having hemoglobin level 6-10gm/dl, mean corpuscular volume (MCV) <80 fl, mean corpuscular hemoglobin concentration (MCHC) <34 µg/dl, serum iron < 50 µg/dl, serum ferritin < 30 µg/dl, and peripheral blood smear showing hypochromic/microcytic anemia were included in the study. Patients with dimorphic anemia, the presence of any other disease requiring active treatment apart from an oral iron supplement, co-morbidities such as cardiovascular disease, liver disease, chronic kidney disease, pulmonary disease, active carcinoma and pregnant or lactating women were excluded from the study.

## Study intervention

*Dhatri Lauha* 500 mg capsule was administered twice daily with lukewarm water after meals to the study participants for 45 days. Deworming (with Albendazole 400 mg stat) was done one week before the trial drug administration in all the study participants.

*Dhatri Lauha* is a classical Ayurveda formulation comprising *Dhatri* (*Emblica officinalis* Gaertn.), *Lauha Churna* (calcined iron), *Yastimadhu* (*Glycyrrhiza glabra* Linn.), and *Amrita* (*Tinospora cordifolia* Willd. Miers.). It was procured from Central Ayurveda Research Institute Kolkata, under CCRAS, Ministry of AYUSH, Government of India (Batch no.:701; Manufacturing date: October 2007; Expiry date: September 2010). Quality control and safety parameters of the ingredients and the formulation complied with the limits prescribed in the Ayurveda Pharmacopoeia of India. The composition details and quality standards of the trial drug are given in Tables 1 and 2.

## Outcomes measures

### *Primary outcome measure*

The primary outcome measure was the mean change in hemoglobin level (assessed by the Cyanmethemoglobin method) from baseline to day 45.

### *Secondary outcome measures*

The secondary outcome measures included mean change in the MCV, MCHC, serum iron, and serum ferritin levels after 45 days of treatment with *Dhatri Lauha*. The incidence of

ADR/AE and any change in liver function test and kidney function test at the end of the treatment period were also included as secondary outcome measures.

Clinical assessment of the study participants was done during the follow-up visits, scheduled on day 15, day 30 and day 45 of the study whereas laboratory investigations were done on baseline and day 45.

### Sample size

As this was a phase II exploratory trial, it was planned to recruit 40 participants from each of the 12 selected study centers.

### Ethical consideration

The study was conducted in accordance with the ICMR's National Ethical Guidelines for Biomedical and Health Research on Human Participants. The study was reviewed, approved, and monitored by the Institutional Ethics Committee of the host institutes. Participants were recruited after providing written informed consent to participate in this study. The study was monitored by the Data and Safety Monitoring Board. As per the GCP guidelines, short-term training was provided to all the study investigators and involved laboratory personnel before the commencement of the trial to ensure uniform methodology and data collection at all the study sites.

**Table 1: Composition of *Dhatri Lauha***

| Name of the ingredient | Botanical name | Part used | Quantity |
|---|---|---|---|
| *Dhatri* (*Churna*) | *Emblica officinalis* Gaertn. | Pericarp | 4 part |
| *Lauha-churna* (*Bhasma*) | Calcined Iron | --- | 2 part |
| *Yashtimadhu* (*Churna*) | *Glycyrrhiza glabra* Linn. | Root | 1 part |
| *Amrita* (*Kwatha*) | *Tinospora cordifolia* Willd. Miers. | Stem | Q.S. for *Bhavana* (trituration) |

**Table 2: Specifications for Quality Control Analysis of *Dhatri Lauha***

| Test Parameters | Normal limits |
|---|---|
| Loss on drying | 2.215% |
| Total-ash | 32.68% |
| Acid-insoluble ash | 1.30% |
| Water- soluble ash | 0.34% |
| pH | 3.92 |
| Assay of element total iron content | 20.38% |
| Heavy/Toxic Metals | |
| Mercury | Below detection limit (<0.001 ppm) |
| Cadmium | Below detection limit (<0.001 ppm) |
| Arsenic | Below detection limit (<0.001 ppm) |
| Microbial contamination | |
| Total aerobic count (IS: 5402-2002) | 31 cfu |
| Total *Enterobacteriaceae* (IS/ISO: 7402) | Absent |
| Total fungal count (IS: 5403-1999) | Absent |
| Specific Pathogen | |
| *Escherichia coli* [IS: 5887 (Part I)-1976] | Absent |
| *Salmonella sp.*[IS: 5887 (Part III)-1976] | Absent |
| *Staphylococcus aureus* [IS: 5887(Part III)-1976] | Absent |
| *Pseudomonas aeruginosa* [IS: 13428 (Part II)] | Absent |

### Statistical analysis

The categorical data on baseline characteristics were summarized as numbers (percentages). Continuous data have been represented as mean (standard deviation). The outcome measures were analyzed as mean change in the response from baseline to day 45 using paired sample t-test. $P<0.05$ was considered statistically significant. Data analysis was performed using the Statistical Package for Social Sciences (SPSS) version 15.0 (SPSS 15.0 for Windows, Chicago, Illinois, USA).

## Results

### Patient Enrolment

A total of 733 participants with clinical presentation of IDA were screened for study eligibility as per the selection criteria from the outpatient department of the study centers. After excluding 275 patients [reason: co-morbidities (n = 102); hemoglobin level below 6 g/dl (n = 52); dimorphic anemia (n = 02); serum ferritin more than 30 µg/dl (n = 88), serum iron more than 50 µg/dl (n = 12); unwillingness to participate in the study (n = 19)], 458 participants were enrolled for this multi-center trial within the stipulated time period. Fifty-eight participants dropped out of the study as they did not attend the scheduled follow-up. Therefore, 400 participants contributed to the final analysis. Patient flow from screening to analysis is depicted in Figure 1.

### Baseline characteristics of study participants

The baseline characteristics of the study participants, such as age, gender, socio-economic status, addiction, clinical features, etc., are

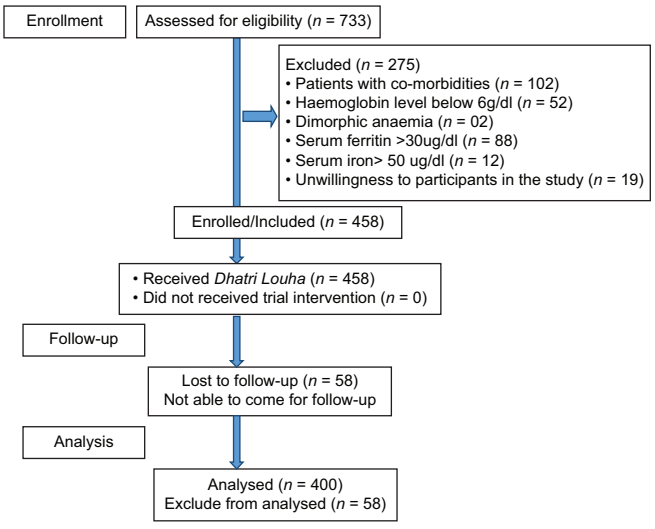


**Figure 1:** CONSORT chart of study

depicted in Table 3. The enrolled participants were homogenous in terms of age, gender and baseline hemoglobin concentration at all the study centers. The majority of participants were females in the age group of 21-50 years with low socio-economic and education status. The majority of the participants were either *Vata-Pittaja* or *Pitta-Kaphaja Prakriti*. Participants having hemoglobin concentration in the range of 6.0-7.9 g/dl and 8.0-10.0 g/dl were 30% and 70% respectively. Weakness, fatigue, palpitation, effort intolerance and shortness of breath were the major symptoms observed in the study participants.

**Table 3: Demographic characteristics of the study participants**

| Demographic profile ($n=400$) | *n* (%) |
|---|---|
| Sex | |
| Male | 37 (9.25) |
| Female | 363 (90.75) |
| Age (in years) | |
| 18-20 | 75 (18.75) |
| 21-30 | 90 (22.5) |
| 31-40 | 115 (28.75) |
| 41-50 | 86 (21.5) |
| 51-60 | 34 (8.5) |
| Education status | |
| Illiterate | 106 (26.5) |
| Under matriculation | 123 (30.7) |
| Matriculation | 93 (23.3) |
| Graduation | 54 (13.5) |
| Post-Graduation and above | 24 (6.0) |
| Socio-economic status | |
| Below poverty line | 233 (58.25) |
| Above poverty line | 167 (41.75) |
| Occupation | |
| Deskwork | 32 (8.0) |
| Field work | 44 (11.0) |
| House wife | 213 (53.2) |
| Student | 74 (18.5) |
| Others | 37 (9.3) |
| Addiction | |
| Alcohol | 10 (2.5) |
| Tea/Coffee | 83 (20.8) |
| Tobacco | 25 (6.2) |
| Diet | |
| Vegetarian | 168 (42.0) |
| Non-vegetarian | 232 (58.0) |
| *Prakriti* | |
| *Vataja* | 18 (4.5) |
| *Pittaja* | 21 (5.3) |
| *Kaphaja* | 9 (2.3) |
| *Vata-Kaphaja* | 36 (9.1) |
| *Vata-Pittaja* | 197 (48.7) |
| *Pitta-Kaphaja* | 119 (30.1) |
| Hemoglobin concentration | |
| 6.0 – 7.9 g/dl | 120 (30) |
| 8.0 – 10.0 g/dl | 280 (70) |

Values have been represented as *n* (%)

## Efficacy Outcomes

### *Change in Hemoglobin concentration*

Mean hemoglobin concentration changed from 8.46 ± 1.14 g/dl at baseline to 9.18 ± 1.61g/dl on day 45 follow-up. A mean difference of 0.72 g/dl observed in the hemoglobin concentration was statistically significant ($p < 0.001$).[Table 4] Further, the mean change observed in Hb% was 0.66 g/dl and 0.74 g/dl in the participants having 6.0-7.9 g/dl and 8.0-10.0 g/dl Hb% respectively at baseline.

### *Changes in red blood cell (RBC) parameters*

Significant improvement ($p < 0.001$) was also observed in the MCV and MCHC levels [Table 4]. On day 45, the mean change in the MCV level was 4.42 ± 2.32 fL. MCHC level had increased from 29.48 g/dL at baseline to 30.63 g/dL at the end of the study period.

### *Iron Metabolism Parameters*

A significant difference ($p < 0.001$) was observed in the mean change in serum ferritin level from baseline (11.47 µg/L) to the day 45 follow-up (17.76 µg/L). The mean change in serum iron was also found to be statistically significant ($p < 0.001$) on day 45. [Table 4].

### *Clinical improvement*

Weakness was present in 99.25% of the participants at the baseline which resolved in 35.7% by day 45. Significant improvement was observed in the complaint of fatigue, which was resolved in nearly half of the participants (47.4%). A good proportion of participants also showed improvement in the complaints like palpitation (67.9%), effort intolerance (75.7%), and shortness of breath (79.1%) by day 45. The results were statistically significant ($p < 0.001$) on day 45 [Table 5].

## Safety Outcomes

The drug was well tolerated by most of the participants enrolled in the study during the 45 days of administration. However, in a few participants, burning sensation in the abdomen (8.5%), nausea (4.5%), skin rashes (2.5%), and diarrhea (2.0%) were observed. All these adverse events were self-limiting and no participants withdrew from the study because of adverse events. No serious adverse event (SAE) was observed or reported during the study. The change in liver function tests and kidney function after the study period was statistically insignificant and the values were within the normal reference range during the study [Table 6].

# Discussion

The study findings demonstrate that the study participants who were administered the Ayurvedic intervention, *Dhatri Lauha* have demonstrated an improvement in the level of hemoglobin, other RBC-related parameters, and iron metabolism parameters in patients with IDA.

The study participants demonstrated a significant clinical improvement compared to the baseline in this study. As hemoglobin concentration is an indicator of blood's

oxygen-carrying capacity, clinical symptoms of IDA are mostly related to quantitative and qualitative reductions in hemoglobin concentration and insufficient oxygen supply to body tissues. The intake of *Dhatri Lauha* is associated with increased hemoglobin concentration, resulting in appropriate oxygenation of body tissues and alleviation of IDA symptoms.

In individuals with anemia, the RBC parameters MCV and MCHC are more sensitive to assessing treatment response.[24] The mean size of RBCs is measured by MCV, whereas MCHC measures the average hemoglobin concentration in RBCs. Both MCV and MCHC values are lower than normal in IDA patients. In this clinical study, the improvement in MCV and MCHC from baseline to day 45 was statistically significant. The single most sensitive indicator of early iron insufficiency is serum ferritin.[25] When iron stores are depleted, abnormal serum ferritin levels can be diagnosed before the serum iron level is altered. Serum iron concentrations fall below the normal range only when the amount of iron in the body decreases owing to the depletion of iron reserves.[25] Following the administration of *Dhatri Lauha* in this study, iron metabolism parameters such as serum ferritin and serum iron showed statistically significant improvement. Further, none of the study participants had reported a decline in hemoglobin concentration during the study duration.

**Table 4: Effect of *Dhatri Lauha* on hemoglobin levels, RBC and iron metabolism parameters**

| Laboratory parameters | Baseline | Day 45 | $P^{\$}$ |
|---|---|---|---|
| Hb % (g/dl) | | | |
| 6.0 – 10.0 | 8.46±1.144 | 9.18±1.614 | <0.001* |
| 6.0 – 7.9 | 6.98±0.603 | 7.64±1.323 | <0.001* |
| 8.0 – 10.0 | 9.11±0.596 | 9.85±1.231 | <0.001* |
| PCV (%) | 28.46 3.963 | 30.50±5.283 | <0.001* |
| MCV (fl) | 71.97±8.46 | 76.39±10.79 | <0.001* |
| MCHC (g/dl) | 29.48±2.928 | 30.63±3.192 | <0.001* |
| Serum ferritin (ng/dl) | 11.470±8.35 | 17.76±18.51 | <0.001* |
| Serum iron (µg/dl) | 31.08±11.286 | 46.58±29.66 | <0.001* |
| ESR (mm/hour) | 25.38±18.596 | 23.50±19.328 | 0.037* |

Values have been represented as Mean±SD; $^{\$}$Within group *P* value, compared using paired sample t-test; **P*<0.05 considered as statistically significant; Hb: Hemoglobin; PCV: Packed Cell Volume; MCV: Mean corpuscular volume; MCHC: Mean corpuscular hemoglobin concentration; ESR: Erythrocyte sedimentation rate; SD: Standard deviation

The trial drug was also well-tolerated and safe as no SAE was observed or reported during the study period. Only a few incidences of adverse events such as burning sensation in the abdomen, nausea, skin rashes, and diarrhea were observed, which were self-limiting, and required no treatment. None of the participants were withdrawn from the study or required discontinuation of the trial interventions owing to the onset of adverse events. Further, the safety parameters (liver and kidney function tests) were also within the normal limits after the study period. It was also evident from a published preclinical study in which *Lauha Bhasma*, one of the major constituents of *Dhatri Lauha* exhibited no serious toxic effect even after administration of five times the therapeutic effective dose for 60 days.[26]

The constituents of *Dhatri Lauha* possess *Deepana* (improves digestion and metabolism), *Srotoshodhaka* (correcting obstructive pathology occurring in body channels), *Rasayana* (medicines used to improve health and longevity), *Shonitasthapana* (restore the normal properties of blood), hepatoprotective and bio-enhancer properties.[27-31] Further, *Dhatri Lauha* contains *Amalaki* (*Emblica officinalis* Gaertn.), one of the richest sources of ascorbic acid which helps in the absorption of iron.[32,33] Apart from animal tissue, ascorbic acid is the only dietary component that has been shown to aid in the absorption of non-heme iron in humans.[34] Further, *Lauha Bhasma* possesses hematinic and hemoglobin regeneration properties.[17] Thus, the combined effect of all the constituents of *Dhatri Lauha* leads to correction of metabolism, improved iron absorption, and blood formation and significant clinical improvement was observed in study participants.

## Limitations of the study

As the study was conducted from 2007 to 2009, when CTRI registration was not mandatory, it was not registered with the Clinical trial registry of India. Further, the CTRI registration cannot be done now, as retrospective registration of the clinical study is not available on the CTRI website. Since the study was conducted as a single-arm open-label trial, the efficacy of the trial intervention could not be demonstrated precisely. In addition, the duration for relapse if any, or the proportion of participants with relapse was not included as study outcomes. Further, confounding factors such as geographical location, diet etc., may also influence the final study outcomes. The efficacy of *Dhatri Lauha* in IDA may be further validated by double-blind randomized controlled trials with suitable

**Table 5: Effect of *Dhatri Lauha* on chief complaints of the study participants**

| Chief complaints | Baseline | Day 15 | Day 30 | Day 45 | $P^{\#}$ |
|---|---|---|---|---|---|
| Weakness | 397 (99.25) | 368 (92.00) | 323 (80.75) | 255 (63.75) | <0.001 |
| Fatigue | 392 (98) | 354 (88.50) | 291 (72.75) | 206 (51.50) | <0.001 |
| Palpitation | 240 (60.00) | 191 (47.75) | 125 (31.25) | 77 (19.25) | <0.001 |
| Effort Intolerance | 227 (56.75) | 185 (46.25) | 109 (27.25) | 55 (13.75) | <0.001 |
| Shortness of breath | 201 (50.25) | 138 (34.50) | 83 (20.75) | 42 (10.50) | <0.001 |
| Oedema of feet | 49 (12.25) | 25 (6.25) | 15 (3.75) | 8 (2.00) | <0.001 |

Values have been represented as *n* (%); $^{\#}$Compared using Cochrane Q-test

**Table 6: Effect of *Dhatri Lauha* on Safety Parameters**

| Laboratory parameters | Baseline | Day 45 | $P^{\$}$ |
|---|---|---|---|
| Total Bilirubin (mg/dl) | 0.62±0.299 | 0.60±0.221 | 0.148 |
| Bilirubin (direct) (mg/dl) | 0.2±0.143 | 0.20±0.146 | 0.371 |
| SGPT (IU/L) | 19.65±11.534 | 19.36±9.505 | 0.608 |
| SGOT (IU/L) | 21.39±8.586 | 20.83±7.377 | 0.172 |
| Alkaline phosphatase (U/L) | 112.56±67.607 | 110.43±67.288 | 0.254 |
| Serum protein (g/dl) | 7.07±3.515 | 7.11±3.197 | 0.854 |
| Serum albumin (g/dl) | 4.07±1.297 | 4.08±0.528 | 0.830 |
| Serum globulin (g/dl) | 2.96±1.328 | 2.87±0.625 | 0.209 |
| Blood urea (mg/dl) | 22.91±7.169 | 22.44±22.44 | 0.164 |
| Serum creatinine (mg/dl) | 0.87±0.180 | 0.89±0.210 | 0.181 |

Values have been represented as Mean±SD; $^{\$}$Within group *P* value, compared using paired sample *t*-test; SGPT - Serum glutamic pyruvic transaminase; SGOT- Serum glutamic oxaloacetic transaminase

follow-up periods to obtain more accurate and reliable results. Being a single-arm exploratory trial, the inability to avoid selection bias or to distinguish between the effect of the treatment and the placebo effect is inherent in the study design. No methods were used specifically to increase the precision of the estimates as the study was a pilot trial conducted in a limited resource setting.

## Conclusions

The findings of this multi-center trial demonstrate that *Dhatri Lauha* use is associated with improvement in the hemoglobin level, RBC, and iron metabolism parameters in patients with IDA. Further, it was well tolerated and clinically safe. Based on the outcomes of this exploratory single-arm trial, future RCTs with a large sample size and extended follow-up period may be planned to obtain more reliable results. The outcomes of these RCTs will enable the inclusion of Ayurveda interventions in the Government of India programs to reduce the prevalence of anemia such as the Anemia Mukt Bharat program.

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### Conflict of interest

There are no conflicts of interest.

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