

INTEGRATIVE MANAGEMENT OF IRON DEFICIENCY ANAEMIA IN WOMEN OF REPRODUCTIVE AGE GROUP THROUGH AYURVEDA AND DIETARY MODIFICATION: A CRITICAL REVIEW

Archana Yadav¹, Shivani Chauhan^{2*}, Deepti Raj³, Rajendra Prasad⁴, Ajai Kumar Pandey⁵, Ranjana Sharma⁶, Anurag Pandey⁷

¹Research Scholar, Department of Kayachikitsa, Faculty of Ayurveda, Institute of Medical Sciences, Banaras Hindu University, Varanasi, India.

²Research Scholar, Department of Kayachikitsa, Faculty of Ayurveda, Institute of Medical Sciences, Banaras Hindu University, Varanasi, India.

³Research Scholar, Department of Kayachikitsa, Faculty of Ayurveda, Institute of Medical Sciences, Banaras Hindu University, Varanasi, India.

⁴Professor, Department of Kayachikitsa, Faculty of Ayurveda, Institute of Medical Sciences, Banaras Hindu University, Varanasi, India.

⁵Professor, Department of Kayachikitsa, Faculty of Ayurveda, Institute of Medical Sciences, Banaras Hindu University, Varanasi, India.

⁶Research Scholar, Department of Paediatrics, Faculty of Medicine, Institute of Medical Sciences, Banaras Hindu University, Varanasi, India.

⁷Assistant Professor, Department of Vikriti Vigyaan, Faculty of Ayurveda, Institute of Medical Sciences, Banaras Hindu University, Varanasi, India

*Corresponding Author – Shivani Chauhan, Email Id : shivanichauhan@bhu.ac.in

ABSTRACT

Globally, Anaemia is a major public health concern especially in low and middle-income countries. Acharya Charaka and Vagbhata consider this disease in the context Pandu roga & it is a disease of *Rasavaha Srotas*. While, Acharya Sushruta accepted it as disease of *Raktavaha Srotas*. Stress, mensuration, pregnancy, worm infection, diet deficiency are key factors that leads to anaemia. Women are prone to anaemia in their reproductive age group that marked as 30.7% prevalence in age between 15-49 years. Ayurveda is traditional health system that help through various measures in the clinical condition of anaemia. Rasayana drugs of Ayurveda such as *Amlaki*, *shatavari*, *punarnava mandura*, *lauha bhasma* etc have potential to manage the cases of anaemia. By adopting *dincharya*, *ratricharya*, *ritucharya*, *sadvritta* and Yoga as a part of daily routine help to calm mind, release stress and give sense of right food choices which help to cope up from the condition of anaemia.

KEYWORDS- Ayurveda, Anaemia, Diet, Rasayana, Pandu Roga

INTRODUCTION

Globally, Anaemia is a major public health concern especially in low and middle-income countries.¹ According to World Health Organization (WHO), women age between 15-49 years are consider under reproductive age that start from menarche to menopause.² Further WHO (2025) also marked that 30.7% women between the age of 15-49 years suffered from anaemia in 2023. The data also showed that it is much higher in pregnant women that is 35.5% and in children (aged 6-59 months) is 39.8%. Only 10% countries showed progress to achieve the goal of 50% reduction in anaemia by 2030.³ The most common cause in the development of anaemia is deficiency of iron, folate, vitamin B12, vitamin A, vitamin C and other nutrients.⁴ In 50% cases of anaemia iron deficiency is the major key factor.⁵

Anaemia in Ayurveda

In Charaka Samhita, *Pandu* is described after the concept of *Agni*, *Ajirna*, *Aama* etc, which is a *Rasapradoshaja* condition. Acharya Charaka and Vagbhata consider this as disease of *Rasavaha Srotas*, while Acharya Sushruta also accepted it as disease of *Raktavaha Srotas*.⁶ According to Ayurveda *Pandu Roga* is basically an imbalance between *Rasa* and *Rakt Dhatu* which is highly influenced by *Agni* imbalance. This *Pitta Pradhan Vyadhi* in which due to *Pitta Pradhan Hetusevana*, *Pitta* dominant *Tri Dosha Prakopa* occurs that causes *Dhatu Shaithilyam* and *Dhatu Gauravam*, further it leads to *Sneha*, *Bala*, *Varna* and *Ojokshaya* and due to this *Rakta* and *Meda Dhatu* decreases and *Vaivarnata* occurs.⁷ This vitiated *Pitta* then circulates in the whole body by the channels of circulation or *Srotasa* getting lodged in the *Rasa Dhatu* and results in the manifestation of *Pandu Roga*. Initially, only the *Rasavaha Srotasa* are involved, but later, all the tissues of the body and their channels might also get involved.⁸

This imbalance leads to poor digestion, pallor or yellowish skin body, heaviness of the body, poor nutrition absorption, lethargic feeling, decreased immune system, headache, palpitations, impaired memory, decreased motor abilities, hair fall, anger, disturbed sleep, restlessness, body weakness, muscle cramps etc.,⁹ similar to the corresponding haematological anaemia.^{10, 11}

पाण्डुत्वं नाम वै वर्णः शुक्लपीतावभासकः ।
तत् पाण्डुरोग इत्युक्तं तन्मूलं पित्तमेव च ॥¹²

Which means *Pandu Roga* is a condition in which there is a deterioration of normal body complexion. The presence of generalized pallor is its defining clinical feature.

Causes of Anaemia

Stress:

When the body undergoes chronic stress, the hypothalamic-pituitary-adrenocortical (HPA) axis gets activated, which elevates the release of pro-inflammatory cytokines that further stimulates the synthesis of hepcidin peptide hormone. Hepcidin reduces the iron absorption in the intestines and traps the body's iron in within the reticuloendothelial system. This ultimately limits the availability of red blood cells (RBCs) production.¹³ Additionally stress can also inhibit the RBC synthesis in bone marrow, the abundance of cytokines like tumour necrosis factor- α (TNF- α) and interferon- γ (INF- γ) suppress the growth of erythroid cells and shortens the lifespan of RBCs. Stress driven inflammation also increases erythrophagocytosis.¹⁴ These mechanisms together are linked to lower serum iron, reduced haemoglobin levels and an increased risk of iron deficiency anaemia. Studies show that children chronically subjected to high-level family stress during infancy have lower levels of iron and are more susceptible to have iron deficiency anaemia.¹⁵ Further, just a week of high level of psychological stress prominently inhibited the iron levels in Navy SEAL trainees.¹⁶

Menstruation

Menstruation is primary leading cause iron deficiency in non-pregnant women of reproductive age.^{17, 18} Heavy Menstrual Bleeding (HMB) lowers the body's iron reserves and due to this continuous loss, HMB is the most predominant cause of iron deficiency anaemia (IDA) and around 63% of women with HMB have iron deficiency (ID).^{19, 20} When the body loses iron, it favours erythropoiesis to sustain survival by reallocating iron from the necessary cellular and enzymatic processes (like mitochondrial ATP production and synthesis of neurotransmitters).²¹ For most of the females' average daily iron absorption through diet is nearly about 1-2 mg and a single HMB can account for several days of iron intake, limit the body's ability to maintain iron balance via diet alone.^{21, 22, 23} When HMB is episodic, it results in the development of negative iron balance, slowing lowering ferritin levels substantially before haemoglobin levels drops to a critical level to be in the range of diagnostic anaemia. This phenomenon is called "ferritin gap". This is a vulnerable state where any other stressor like pregnancy, infection or blood loss can cause IDA.^{21, 24}

Pregnancy:

Anaemia during pregnancy is mostly caused due to iron deficiency. Maternal blood plasma volume increases by 40% - 50%, while Red Blood Cell (RBC) mass only increases by 15%-25%. This uneven expansion creates a haemodilution effect known as "physiological anaemia", which results in declination in haemoglobin concentrations (often 10.5-11.0 g/dL) but the total oxygen carrying capacity stays adequate.^{25, 26} During pregnancy approx. 1000mg to 1240 mg of total iron is needed to support the increasing RBC mass, placental and foetal development and also for the expected blood loss during delivery.^{17, 27} A significant number of women generally enter gestation with iron deficient state and often typical diets do not meet the increasing demand and leads to IDA.^{17, 28} The requirement for folate and Vitamin B12 increases during pregnancy to aid DNA synthesis and cell division, its deficiency leads to megaloblastic anaemia and enhances the risk of birth defects of brain and spinal cord, predominantly in the women malabsorption, vegan/vegetarian diets or lack of proper pregnancy supplements. Chronic blood loss like a history of excessive menstrual blood loss before conception or bleeding during pregnancy may increase the severity of anaemia.^{26, 28} Untreated anaemia during pregnancy can cause increased risk of preterm delivery, low birth weight, birth asphyxia and postpartum haemorrhage.^{26, 29, 30, 31} The studies indicate that even low level of iron deficiency in the first trimester can adversely affect the hippocampus and associated cognitive developments.³²

Dietary Deficiency

Globally more than 1 billion population are impacted from anaemia due to chronic blood loss, insufficient dietary iron quality, limited availability of fortified foods and poor absorption. In nutritional deficiency, the bone marrow is unable to generate normal RBCs.³³ Iron functions as a rate limiting factor in the haemoglobin production as it is forms the core element of the heme molecule within haemoglobin. When iron losses are more than the absorption, the tissues slowly deplete. Ferritin declines first, this state is called "iron-deficient erythropoiesis". Further to cope with this stressor, erythroblasts in the marrow undergo additional cell divisions to compensate for limited iron availability. This leads to the production of RBCs that are smaller and paler than the normal as they have less haemoglobin. Overtime, this pattern appears in blood smear, indicating IDA.^{17, 33, 34} In the one-carbon metabolism, vitamin B12 and folate act as coenzymes, which is needed for DNA synthesis and its deficiency slows down the nuclear development but the haemoglobin forms normally, leading to nuclear-cytoplasmic asynchrony, which further causes large immature cells in bone marrow, abnormal neutrophils and other megaloblastic symptoms of anaemia.^{17, 34, 35} Deficiency of vitamins like; Vitamin A deficiency impairs normal iron metabolism, Vitamin B₂ deficiency decreases body's ability to absorb and mobilize iron. Vitamin C & E shield RBCs from oxidative damage, Vitamin C also facilitates iron absorption from digestive tract and hence their deficiency causes oxidative damage and poor iron absorption. Trace elements like copper and zinc also serve as a necessary co factor for enzymes regulating iron.³⁶

Worm Infection

Hookworm infection another important cause of iron deficiency anaemia mostly in endemic tropical and subtropical regions with poor sanitation and barefoot exposure. Worms like *Ancylostoma duodenale* and *Necator americanus* act as "vampire parasites", which feeds on host's blood for months to years, resulting in clinical manifestation of the disease

especially among children, adolescents and women of reproductive age.^{17, 36, 37} The parasites gets attached to small intestine mucosa by incising capillaries and releasing anticoagulants to ensure continuous blood flow. In case of severe infection (nearly 500 adult worms) body loses substantial amount of blood i.e., loss of about 100mL blood/day which is around 50mg of elemental iron. With time this persistent blood loss limit the daily iron absorption further causing iron depletion, low ferritin and with progression leading to hypochromic anaemia. This further creates a self-perpetuating cycle of ongoing blood loss which depletes iron and at the same time inflammation in the intestine also weakens the gut's ability to support iron absorption for replenishment, aggravating the severity and duration of anaemia.^{36, 37}

Management of Anaemia

Ayurvedic Rasayana in Anaemia

Rasayana chikitsa is a special branch of Ayurveda which exclusively are made for nutrition, immunology, rejuvenation and geriatrics. Vegetarian people are more prone to anaemia because vegetarian food are deficient in some key nutrient like Vitamin B₁₂ and iron and vegetarian food also contain non-heme iron which has less bioavailability up to 1-10%.³⁸ In iron deficiency anaemia rasayana (rejuvenation) therapy is significantly effective as it directly acts on the disease mechanism. It works on the qualitative and quantitative improvement of depleted *dhatus* by *dhatu poshana* (*Poshaka Rasa*), enhancing haemoglobin and restoring *Ojas*.^{39, 40} In ayurveda there are some rasayana drug that help in absorption of iron which comes under in *Naimittika Rasayana*.

Herbs used in the management of the disease are:

- **Amlaki (Phyllanthus Emblica):** *Amlaki* rasayana is best rasayana in the condition of anaemia. It has *Tridoshaghna* property especially pacifying *pitta*, increase the bioavailability to absorb iron and purify blood in the body. It has *dipana* and *rochana* property that increase digestive material in gut and promote better absorbtion in intestine.⁴¹ Shaizi et al study shows significance importance of *amlaki* rasayana in anaemia and also suggest that ayurvedic drug or rasayana are required more time to disrupt the ongoing pathogenesis of anaemia to cure *ama* and *agnimandya* at *dhautus* level.⁴² Research also show that *amlaki* churna show progressively higher positive result comparatively better to *haritaki* churna because it is good source of vitamin C, D-glucose, D-fructose, bioflavonoids, flavones, polyphenols, carotenoids and also have antioxidant and immunomodulator property.⁴³

- **Punarnava Mandur (Boerhavia Diffusa):** *Punarnava mandur* has *Pitta-Kapha Shamaka* property. Research show it has best rasayana *deepana-pachana* (digestive), *Raktavardhaka*, and laxative properties and it enhance digestion and metabolism, increase iron absorption, and promoting healthy blood formation in *garbhini pandu*.⁴⁴ It also promote immunity, increase digestive fire and work as immunomodulator.⁴⁵ Pandya study show that it work on every aged people of anaemia. In 90 days of this study it improve quality of life and show significant improvement in *Kshaya* of *Dhatu* and *Agni Bala*, *Deha Bala* and *Sattwa Bala* in geriatric people.⁴⁶ *Punarnava* has hepatoprotective and antioxidant property whereas *mandura bhasma* has hematinic and cytoprotective and hepatoprotective activity. *Mandur Bhasma* provide sufficient amount of iron by ferric and ferrous fraction which is important for normal erythropoiesis.⁴⁷

- **Shatavari (Asparagus Racemosus):** *Shatavari* is a versatile herb used widely in Ayurveda which contains bioactive compounds such as saponins, asparagamine, racemosol, polysaccharides, mucilage, folic acid, sarsasapogenin, flavonoids, and polyphenol.^{48, 49} Women body are more prone to anxiety and depression in the reproductive age of life due to increased sensitivity of adrenal cortex and influence of steroid hormone such as estradiol as well as progesterone.⁵⁰ It has phytoadaptogen and antioxidant property to maintain oocyte quality in female as well as protect from stress and anxiety.⁵¹ Stress Use of *Shatavari* enhance cognitive function, protect against stress, increase immunity, promote strength, and in female it is best in menopausal symptoms and enhancing lactation.^{60, 52}

- **Lauha Bhasma:** *Lauha churna* is anciently described in *Garuda Purana* for management of *Pandu Roga* with buttermilk. *Lauha Bhasma* contains both Fe⁺⁺ and Fe⁺⁺⁺ oxidation states and improve iron storage in ferritin protein in the body. It maintains adequate availability of the Fe(II) state in the blood stream for better oxygen absorption in the lungs. It is also best rasayana for anti-aging, memory rejuvenation.⁵³ A study shows that 60 mg capsule of *lauha bhasma* twice a day with water empty stomach improve anaemia symptoms like fatigue, weakness, irritability, leg cramps, low haemoglobin, pallor of skin, giddiness, anorexia etc. They also found in this study female are 70% which is high number to show that female are prone to anaemia.⁵⁴

Pathya and Apathya

According to Ayurveda *Pathya* are recommended diet and lifestyle practices that should be include in the condition of anaemia and *Apathya* are things that should be avoided in any disease.

<i>Pathya</i>	<i>Apathya</i>
Food- Wholesome food, <i>shali chawal</i> (type of rice), jawar, wheat, moong dal, masoor dal (lentils), vegetable soups, Flashy & meat soup, amla, ghee, buttermilk, sugarcane juice, <i>Kooshmand</i> (ash gourd), pomegranate, <i>Panchagavya Ghrit</i> etc and some	Food - Urad dal, beans (Shimbi), green leafy vegetables, excessive water consumption, sour food, sesame oil, betel leaves, tila tail, rajma, excessive use of peas mustard leaves, etc should be avoided. ⁶⁷

combination like gooseberry juice with honey are recommended. ⁵⁵	
Lifestyle- By Inculcate dincharya, ratricharya, ritucharya, sadvritta and yoga as a part of daily routine. ^{66,56}	Lifestyle- Fear, desire, worry, anger, grief, excessive exercise, day time sleep, alcohol consumption, holding natural urges, sexual activity, smoking should be avoided. ⁵⁷

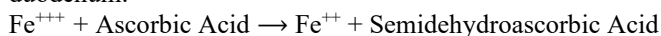
Dietary recommendation in Anaemia

Food is one of the necessary things of human life. Any medicine can't cure any disease without wholesome diet. In Ayurveda food is Supreme or *Brahma*. Iron is present in two forms i.e. heme iron and non-heme iron. Heme iron is basically found in animal food and non-heme iron is present in both, plant and animal sources. Diet rich with iron, proteins, b-complex vitamins, ascorbic acid, copper, and zinc help in iron absorption and improve the capacity to store iron.

- Tea, coffee, cocoa are prohibited because they contain tannis and polyphenols that hinder the absorption of iron.⁵⁸
- For non-vegetarian people, red meat, poultry products, fish, seafoods are good source of Heme iron.⁶⁹
- For vegetarian, increase intake of food and fruits that contain vitamin C (ascorbic acid) like amla, orange, mango, guava, lemon, pineapple because it enhances absorption of non-heme iron in intestine by acting as a ligand and forming a soluble complex (chelate) with iron in stomach. It converts Fe^{+++} to Fe^{++} to enhance iron absorption.⁵⁹
- Indian spices and herb contain some amount of iron in which jeera (cumin seed) contain maximum iron (66.36 mg/100g), haldi powder (turmeric) (55 mg/100g), methi seeds (fenugreek) (33.53 mg/100g) etc and these spices have the quality to boost digestion and help in the absorption of iron.⁶⁰
- Halim seed or garden cress seed is richest source of iron which is easily absorb in small intestine. Study reveals that 25gm of halim powder in girls show significant increment in haemoglobin level. It also contains folic acid, calcium, iron, omega-3 fatty acids, vitamin A, E, C, B₁₂, and also has antidiabetic and antioxidant property.⁶¹
- Soaking, sprouting or germination, fermentation, cooking of grain, pulses, cereals and nuts enhance bioavailability of iron in intestinal flora, increase phytase activity and degrade phytates thus further improve iron absorption and release minerals.⁶²
- Using iron pots in cooking also help in the condition of anaemia.
- Milk and milk products are good source of fortification. They are fortified with Vitamin A, B, D and folic acid and minerals like calcium, iron, zinc. It enhances iron absorption in intestine and boost immunity and several study show that it help in the condition of anaemia in all age group people.⁶³

Role of Vitamin C in iron absorption

Vitamin C (ascorbic acid) plays an important role in iron absorption especially non-heme iron derived from plant based foods. Iron from plants predominantly exists in ferric form (Fe^{+++}), which is difficult for the gut to absorb. Ascorbic acid acts as a strong electron donor, reducing ferric iron (Fe^{+++}) into ferrous iron (Fe^{++}) in acidic conditions of stomach and duodenum.^{64, 65, 66}



This reduction is necessary as ferrous iron is the functional form that can be optimally transported in the intestinal cells by Divalent Metal Transporter-1 (DMT-1).⁶⁴ It improves absorption via chelation. In the acidic environment of the stomach ascorbic acid with ferric iron forms a soluble complex. As this compound reaches duodenum, the environment becomes alkaline and without vitamin C, iron would be removed as insoluble compound. The vitamin C-iron chelate remains soluble in the alkaline conditions of the small intestine.^{64, 67} At the cellular level, duodenal cytochrome b (integral membrane protein) depends on ascorbic acid to function. For iron uptake by DMT-1 this is a key enzymatic process. Thus it, efficiently mitigates iron absorption inhibitors such as phylates, polyphenols, tea and calcium-rich dairy products, making the absorption of iron easier for the body even when consumed together.⁶⁸

Importance of Nutrition

Proper nutrition is essential for both physical and mental well-being. Adequate intake of carbohydrates, proteins and fats helps to maintain energy levels and physical functioning. Proteins aid in muscle repair and growth, whereas complex carbohydrates provides consistent energy throughout the day. Fruits, vegetables and nuts provide essential nutrients like, Vitamin C, E, zinc and selenium which enhances immune function and antioxidant activity. The nutrient rich foods help the body fight infections more effectively, it also lowers the risk of heart disease, diabetes, cancer, obesity and hypertension. Omega-3 fatty acids, antioxidants and vitamins (mostly B vitamins) support brain function, memory, cognitive health, reduce neuroinflammation and foster mental well-being. Furthermore, healthy dietary intake rich in unsaturated fats, legumes and plant based foods contribute to healthy aging by maintaining microbiome balance and decreasing risk of chronic diseases.^{69, 70, 71, 72}

DISCUSSION

Human body naturally loses small amounts of iron every day through urine, stool, sweat, shedding of skin cells, and in women, especially through menstrual bleeding. During mensuration women loss estimate 40 ml of menstrual blood in average of 1.6mg of iron.⁷³ Anaemia doubles the risk of death during pregnancy and leads to poor motor and mental growth in children Studies show that vitamin C can significantly mitigate the inhibitory impacts of phylates and tannins.

A meal with ample amounts of phylates can reduce iron absorption by 50% compared to the meals without these inhibitors, whereas by adding about 50mg of Vitamin C is seen to have positive impact on iron absorption. In iron deficient individuals it was found that ingestion of vitamin C along with an iron rich meal can enhance the absorption of non heme iron by 2-4 times, depending on the inhibitor content of the diet.^{64, 67, 74} Holistic approaches like Yoga and Ayurveda mitigate stress, anxiety, physical discomfort and rasayana like *amlaki*, *shatavari*, *ashwagandha*, *guduchi* etc enhance immunity and prevent from nutritional deficiency pregnancy.⁷⁵ Buttermilk and ghee also help in the condition of anaemia because buttermilk is *tridosahar* and excellent source of vitamin B₁₂ which help to improve iron absorption and ghee is best antioxidant because it contain beta-carotene and vitamin E.⁶³ Rasayana helps in improving the body's absorption of macro- and micro-nutrients to enhance the quality of body tissues (*dhatu*), while *dincharya*, *ratricharya*, and *ritucharya* optimize *Agni* (digestion) for better nourishment. Yoga and Sadvritta promote functional balance between organ and promote healthy eating habits like green leafy vegetables, seeds to maintain strength and better nutrient absorption.⁷⁶ Dairy product like milk, ghee, seeds like halim and pumpkin, fermented and fortified food help to met the criteria of daily iron need.

CONCLUSION

In reproductive age, women go through from all of the phases from menstruation to pregnancy, lactation, repeated childbearing etc and each phase required adequate amount of nutrients & vitamin to compensate the losses. Ayurvedic code of conduct, dietary management, rasayana therapy impart significant benefits to anaemia patient. By adding vitamin C in the diet, it enhances the bioavailability of iron. In this way we can say that Ayurvedic rasayana along with diet and lifestyle play a key role to deal with any kind of disease including anaemia.

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