EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Coden USA: EJBPBO
Volume: 12
Issue: 12
Year: 2025

ANEMIA CONTROL AMONG ADOLESCENT GIRLS THROUGH AYURVEDIC INTERVENTION: A CRITICAL REVIEW

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DOI: https://doi.org/10.5281/zenodo.17745563

How to cite this Article: Deepak Kumar*. (2025). Anemia Control Among Adolescent Girls Through Ayurvedic Intervention: A Critical Review. European Journal of Biomedical and Pharmaceutical Sciences, 12(12), 01–06.

Article Received on 22/10/2025 **Article Revised on 12/11/2025** **Article Published on 01/12/2025**

ABSTRACT

Anaemia continues to be a significant public health concern among adolescent girls in India, adversely impacting their physical growth, cognitive development, and future maternal health outcomes. Despite decades of large-scale iron and folic acid supplementation programmes under initiatives such as Anemia Mukt Bharat and Weekly Iron Folic Acid Supplementation (WIFS), the prevalence of anaemia remains alarmingly high. This situation underscores the need for integrative and culturally rooted approaches to prevention and management. Ayurveda, through its holistic understanding of *Pandu Roga*—a condition analogous to anaemia—offers a multidimensional therapeutic model that encompasses dietary regulation (*Ahara*), lifestyle modification (*Vihara*), and herbal-mineral formulations (*Aushadha*). Classical Ayurvedic preparations such as Krimimudgar Rasa, Punarnava Mandura, Drakshavaleha have been documented for their haematinic, hepatoprotective, and metabolic corrective properties. Recent clinical trials and systematic reviews indicate that these formulations can effectively improve haemoglobin levels, enhance digestion and nutrient assimilation, and reduce the side-effects often associated with conventional iron salts. Moreover, their safety, affordability, and cultural acceptability make them viable for large-scale community implementation. This critical review explores the Ayurvedic concept of *Pandu Roga*, evaluates evidence from contemporary research, and analyses the potential role of Ayurvedic interventions within adolescent anaemia control programmes. The findings suggest that integrating Ayurveda with existing public-health strategies can provide a sustainable, holistic solution addressing both the nutritional and metabolic dimensions of anaemia, thereby supporting the national goal of "Anaemia-Free India."

KEYWORDS: Anaemia, Adolescent girls, *Pandu Roga*, Ayurveda, Iron deficiency, Nutritional anaemia, public health.

INTRODUCTION

Anaemia is a pathological condition characterized by a reduction in the number of red blood cells (RBCs) or haemoglobin concentration below the normal range, leading to a diminished oxygen-carrying capacity of the blood. The World Health Organization (WHO) defines anaemia in adolescent girls as haemoglobin levels below 12 g/dl. According to the *National Family Health Survey-5 (NFHS-5)*, the prevalence of anaemia among adolescent girls in India exceeds 57%, making it one of the most pressing nutritional and public health challenges of the nation.[1] Among various forms, Iron Deficiency Anaemia (IDA) remains the most common, primarily resulting from inadequate dietary iron intake, increased physiological demand during rapid growth, menstrual blood loss, malabsorption, and frequent infections.

Adolescence represents a vital developmental stage between childhood and adulthood, marked by accelerated physical growth, hormonal changes, and cognitive maturation. In adolescent girls, the onset of menarche substantially increases iron requirements due to cyclic menstrual blood loss. Coupled with poor dietary diversity and limited intake of haem iron sources, this physiological demand often leads to iron depletion. Prolonged anaemia during adolescence can adversely affect learning capacity, concentration, and memory, besides impairing immunity and work performance.[2]

The consequences also extend into adulthood, as anaemic adolescent girls are more likely to enter pregnancy with depleted iron stores, predisposing them to obstetric complications, low birth weight, and poor perinatal outcomes. Hence, addressing anaemia in this age group is critical not only for individual health but also for intergenerational well-being and national productivity.

To address this burden, several national initiatives have been implemented, such as the Weekly Iron and Folic Acid Supplementation (WIFS) programme, Anemia Mukt Bharat (AMB) strategy, and school health initiatives under Rashtriya Bal Swasthya Karyakram (RBSK). These programmes provide weekly IFA tablets, periodic deworming, and nutrition education to school-going adolescents. However, despite these efforts, anaemia prevalence has not declined significantly over the past decade. One of the key challenges lies in poor compliance due to the gastrointestinal side-effects of synthetic iron preparations—such as nausea, constipation, metallic taste, and abdominal discomfort—which often discourage regular consumption.[3] In addition, low bioavailability of inorganic iron salts, improper dietary habits, and lack of awareness about iron absorption enhancers (like vitamin C-rich foods) further hinder success.

In this context, Ayurveda offers a time-tested and culturally consonant alternative for prevention and management of anaemia. Classical Ayurvedic literature describes a disease entity known as *Pandu Roga*, whose clinical presentation—pallor (*Panduta*), fatigue (*Daurbalya*), dizziness, and dryness of skin—closely resembles that of nutritional anaemia. Ayurveda attributes its pathogenesis to impaired digestive and metabolic function (*Agni Dushti*), leading to the defective formation of nutritive fluids (*Rasa Dhatu*) and blood tissue (*Rakta Dhatu*). This understanding expands the aetiological framework beyond mere iron deficiency, encompassing factors like poor digestion, inadequate nutrient assimilation, and disturbed metabolic balance.[4]

Ayurvedic management of *Pandu Roga* follows a comprehensive approach involving digestive stimulation (*Deepana–Pachana*), blood enrichment (*Rakta Dhatu Pushti*), and rejuvenation (*Rasayana Chikitsa*). Classical formulations such as *Lauha Bhasma*, *Vajravatak Mandura*, and *Punarnava Mandura* are described as effective haematinic and hepatoprotective agents, improving both digestion and iron bioavailability. Additionally, Ayurveda emphasizes *Ahara* (diet) and *Vihara* (lifestyle) as integral components of therapy, encouraging consumption of iron-rich, easily digestible foods and adherence to healthy daily routines.

Thus, the Ayurvedic perspective not only addresses the symptomatology of anaemia but also its root causes through a holistic correction of digestion, metabolism, and tissue nourishment. When integrated with modern public health interventions, Ayurvedic strategies hold potential for sustainable anaemia control among adolescent girls in India.

CONCEPTUAL CORRELATION OF ANAEMIA WITH PANDU ROGA IN AYURVEDA

Definition and Nomenclature

In Ayurveda, *Pandu Roga* is characterised by pallor (*Panduta*), weakness (*Daurbalya*), dizziness, shortness of breath, and dryness. The term *Pandu* itself denotes paleness—an external reflection of internal deficiency.[5]

Nidana (Etiological Factors)

According to *Charaka Samhita* (Chikitsa Sthana 16/8-9), excessive intake of sour (*Amla*), salty (*Lavana*), alkaline, and heavy (*Guru*) foods; suppression of natural urges; indulgence in fear, grief, or excessive exertion disturb *Pitta Dosha* and impair *Rasa–Rakta Dhatu Poshana*, resulting in *Pandu Roga*.[6]

Samprapti (Pathogenesis)

Disturbed *Agni* (digestive/metabolic fire) leads to *Ama* formation and impaired *Rasa Dhatu* synthesis. When *Pitta* contaminates *Rakta*, tissue nourishment declines, manifesting as pallor and fatigue.[7]

This is analogous to:

- Reduced iron absorption/metabolism → Mandagni
- Defective erythropoiesis → Dhatu Kshaya
- Pallor and weakness → Panduta & Daurbalya

Thus, the Ayurvedic and modern pathophysiologies share conceptual parallels.

Modern Perspective on Adolescent Anaemia

Globally, anaemia affects approximately 29% of women aged 15–49.[8] In India, adolescent girls are particularly vulnerable due to nutritional inadequacy and menstrual blood loss.

Major causes include:

- Insufficient iron intake (poor dietary diversity)
- Hookworm infestation
- Menstrual losses
- Early pregnancy
- Malabsorption disorders

Clinical manifestations include fatigue, headache, dizziness, pale skin, spoon-shaped nails (*koilonychia*), and pica. Severe anaemia can lead to cardiac strain and developmental delays.

Public-health programmes such as WIFS and Anemia Mukt Bharat (AMB) provide weekly IFA tablets and deworming, yet compliance often remains below 60%.[9] Hence, safe and acceptable alternatives from Ayurveda may complement existing measures.

Ayurvedic Therapeutic Principles for Anaemia Control

Treatment Objectives

- Correct *Agni Dushti* (impaired digestion)
- Nourish *Rasa and Rakta Dhatu*
- Restore tissue metabolism (*Dhatu Poshana*)
- Strengthen immunity and vitality (*Ojas*)

Classical Treatment Protocol

Ayurvedic management of *Pandu Roga* follows a systematic approach[10]:

1. **Deepana–Pachana** (Digestive correction): using *Trikatu*, *Chitraka*, *Hingu* etc.
2. **Mridu Virechana** (Mild purgation): with *Trivrut Leha* or *Haritaki Churna* to eliminate vitiated *Pitta*.
3. **Rasayana Chikitsa** (Rejuvenation): with *Lauha Bhasma*-based preparations.
4. **Pathya Ahara**: inclusion of jaggery, dates, pomegranate, green leafy vegetables, sesame, and *Amalaki*.
5. **Lifestyle regulation** (*Dinacharya*): adequate rest, avoidance of stress, and balanced routines.

IMPORTANT AYURVEDIC FORMULATIONS IN ANAEMIA

S. No.	Name of the Medicine	Dose	Frequency	Duration	Anupana (Adjuvant)	Remarks / Indication
1	*Krimimudgar Rasa*	1 tablet	Twice daily (BD)	7 days	With lukewarm water	For *Krimi* (parasitic infestation), to correct *Agni* and enhance absorption before main therapy
2	*Punarnava Mandura*	1 tablet	Twice daily (BD)	3 months	With lukewarm water or *Triphala Kashaya*	Classical *Rakta Vardhaka* and *Pandu Roga Nashaka* formulation; improves Hb and liver function
3	*Drakshavaleha*	10 g	Twice daily (BD)	3 months	With milk or lukewarm water	*Brimhana* and *Rasayana* effect; improves strength and digestion

Clinical Mechanisms

Ayurvedic formulations act via:

- Restoring digestion (*Deepana–Pachana*)
- Enhancing absorption (via organic acids & bioactive phytochemicals)
- Detoxifying hepatic metabolism (*Yakrut Shuddhi*)
- Providing bioavailable iron through nano-metallic *Bhasma* forms.[14]

Review of Clinical Studies

Krimimudgar Rasa

Krimimudgar Rasa is a herbo-mineral formulation indicated in *Krimi Roga* (parasitic infections), which often contribute to chronic anaemia in adolescents. It contains ingredients like *Vidanga*, *Palasha*, *Pippali*, and *Lauha Bhasma* that destroy intestinal parasites and restore *Agni* (digestive fire). A study by Tiwari et al. (2021) demonstrated that a 7-day course of *Krimimudgar Rasa* significantly reduced helminthic load and improved haemoglobin levels in school-going children by enhancing nutrient absorption.[15] Its use before *Rakta Vardhaka* therapy is recommended to cleanse the gut and improve the bioavailability of iron-containing drugs.

Punarnava Mandura

Punarnava Mandura is one of the most extensively researched Ayurvedic formulations for *Pandu Roga*. It contains *Punarnava (Boerhavia diffusa)*, *Triphala*, *Trikatu*, *Mandura Bhasma*, and *Gomutra Bhavita* ingredients, which exert *Deepana*, *Pachana*, *Rakta Vardhaka*, and *Yakrit Uttejaka* actions.

A randomized clinical study conducted on 60 adolescent girls with iron deficiency anaemia showed that *Punarnava Mandura* (250 mg BD for 3 months) produced a mean haemoglobin rise of 1.8 g/dL, comparable to ferrous sulphate therapy, but with better gastrointestinal tolerance and overall well-being.[16]

Another trial by Sharma et al. (2019) observed significant improvement not only in haemoglobin but also in appetite, complexion, and energy levels, indicating a holistic restoration of *Dhatu Pushti* (tissue nourishment).[17]

Drakshavaleha

Drakshavaleha is a polyherbal preparation containing *Draksha* (Vitis vinifera), *Pippali*, *Dhatri*, *Musta*, and *Lauha Bhasma*, traditionally indicated in *Pandutva*, *Kshaya*, and *Balya Roga*. It acts as a *Brimhana* and *Rasayana*, promoting haemopoiesis, tissue strength, and improved digestion.

A clinical study conducted by Singh et al. (2020) on adolescent girls with mild anaemia reported that *Drakshavaleha* (10 g twice daily for 12 weeks) significantly improved haemoglobin levels (mean increase 1.6 g/dL) and enhanced subjective parameters like fatigue, appetite, and pallor.[18] The presence of *Draksha* and *Amalaki* provides natural antioxidants and vitamin C, aiding in iron absorption.

Systematic Review Evidence

A 2025 systematic review (11 RCTs, 2015-2024) concluded that Ayurvedic therapies improved Hb and ferritin with fewer gastrointestinal side-effects than conventional iron salts.[19]

Dietary and Lifestyle Measures
Ayurveda emphasises *Ahara* (diet) and *Vihara* (lifestyle) equally with *Aushadha* (medicine).

Key recommendations include[20]:

- **Pathya (Wholesome):** black raisins, pomegranate, beetroot, green leafy vegetables (*Palak*, *Methi*), jaggery, sesame seeds, cow's ghee, *Amalaki*, milk.
- **Apathya (To avoid):** sour, fermented foods, excessive tea/coffee, junk foods, and day sleep.
- **Lifestyle:** early meals, adequate sleep, regular mild exercise, stress reduction.

In adolescent girls, awareness about menstrual hygiene, adequate rest during menstruation, and avoidance of excessive dieting are essential supportive measures.

INTEGRATION WITH PUBLIC-HEALTH PROGRAMMES

Complementarity with WIFS/Anemia Mukt Bharat
Ayurvedic formulations can complement ongoing IFA programs by:

- Reducing side-effects (nausea, constipation).
- Providing better compliance through palatable syrups/asavas.
- Improving overall metabolism and digestion.

Feasibility at School/Community Level
AYUSH practitioners can:

- Conduct anaemia screening camps.
- Distribute standardised Ayurvedic formulations (e.g., *Punarnava Mandura*) under supervision.
- Provide dietary counselling and health education.
- Integrate *Yoga* and *Pranayama* to enhance metabolism and stress management.

Evidence from Implementation Projects
Pilot projects in several Indian states (e.g., Gujarat, Madhya Pradesh) have shown feasibility of integrating Ayurveda with public health schemes.[21]

DISCUSSION

Strengths of the Ayurvedic Approach
Ayurveda presents a comprehensive, multi-dimensional framework for the prevention and management of anaemia that extends beyond mere supplementation of iron. Its fundamental strength lies in its holistic correction of the digestive, metabolic, and tissue-nourishment processes (*Agni*, *Dhatu Poshana*), which directly influence blood formation (*Rakta Dhatu Nirmana*). This integrative concept ensures that the underlying metabolic dysfunction—often responsible for poor absorption and utilisation of nutrients—is addressed, leading to sustainable improvement rather than symptomatic relief.

Another major advantage is its cultural acceptability. Ayurvedic formulations and dietary prescriptions are rooted in indigenous knowledge systems familiar to Indian communities. This cultural resonance enhances compliance, particularly among adolescent girls who may resist conventional iron tablets due to their unpleasant taste or side effects. Ayurvedic approaches integrate seamlessly with traditional food habits and social beliefs, making them easier to implement at the community level.

The safety profile of Ayurvedic interventions is another important strength. Studies have reported minimal gastrointestinal disturbances compared to synthetic iron preparations, which are often associated with nausea, constipation, and abdominal discomfort. This improved tolerability encourages adherence and long-term use, which are essential for achieving measurable haematological improvement.

Furthermore, many Ayurvedic formulations exhibit multinutrient and antioxidant activity. Herbs such as *Punarnava* (*Boerhavia diffusa*), *Triphala*, *Amalaki* (*Emblica officinalis*), and *Yashtimadhu* (*Glycyrrhiza glabra*) not only provide bioavailable iron but also contain trace minerals like zinc and copper, along with phytonutrients that enhance iron absorption and protect against oxidative stress. This synergistic action promotes overall metabolic restoration, improved immunity, and vitality—outcomes especially beneficial for adolescents in their formative years.

Limitations
Despite promising evidence, there are certain limitations in the existing body of research on Ayurvedic management of anaemia. The foremost limitation is the lack of large, multicentric randomized controlled trials (RCTs). Most available studies are small-scale, single-centre trials with limited sample sizes and short durations, restricting their generalisability. Larger, well-designed RCTs are required to validate the efficacy and safety of Ayurvedic formulations on a national scale.

Another limitation is the need for pharmaceutically standardised preparations. Variability in raw material quality, manufacturing methods, and dosage across formulations can lead to inconsistent outcomes. Standardisation in terms of particle size, iron content, and safety testing is crucial for ensuring reproducibility and regulatory acceptance. Longitudinal follow-up data and cost-effectiveness analyses are also lacking. Most trials assess outcomes over 8–12 weeks, whereas adolescent anaemia requires sustained therapy and long-term monitoring to assess relapse prevention and nutritional sustainability. Economic evaluations comparing Ayurvedic formulations with conventional iron–folic acid (IFA) supplementation are essential for policy-level integration. Additionally, there is variability in dosage, duration, and combination of therapies used across studies. Some trials employ Krimimudgar Rasa, Punarnava Mandura, Drakshavaleha-based preparations, with differences in adjuvants, vehicle (e.g., *Amalaki Swarasa* or *Ghrita*), and dietary advice. This heterogeneity complicates meta-analysis and evidence

synthesis. Therefore, protocol standardisation is necessary for comparative evaluation and formulation of national guidelines.

Future Research Directions

Future research should focus on comparative clinical trials evaluating IFA, Ayurvedic formulations, and combination regimens. Such trials should adopt standardised outcome measures—haemoglobin, serum ferritin, mean corpuscular volume, and clinical symptomatology—to generate robust comparative data. Pharmacokinetic and toxicological studies of Krimimudgar Rasa, Punarnava Mandura, Drakshavaleha in adolescent populations are warranted to establish safety and bioavailability profiles using modern analytical methods such as ICP-MS and XRD. This will help in validating traditional claims through modern science.

At the programme level, cost–utility and implementation analyses should assess feasibility, affordability, and scalability of integrating Ayurvedic interventions into national adolescent health programmes like WIFS and Anemia Mukt Bharat. Such evidence could strengthen policy advocacy for AYUSH inclusion.

Further, mechanistic studies are needed to explore the biochemical correlates of Ayurvedic parameters—such as *Agni* (digestive capacity), *Dhatu Kshaya* (tissue depletion), and *Rakta Dhatu Dushti* (blood tissue pathology)—with measurable modern biomarkers like serum ferritin, total iron-binding capacity, and inflammatory indices. This integrative approach can help bridge classical Ayurvedic concepts with evidence-based biomedicine. Lastly, interdisciplinary research involving Ayurveda, nutrition, public health, and behavioural sciences should be encouraged to develop comprehensive, adolescent-friendly anaemia control models that combine dietary education, menstrual health management, and culturally appropriate herbal supplementation.

CONCLUSION

Anaemia among adolescent girls continues to pose a significant challenge to India's public health and human-capital development. Despite decades of nationwide interventions such as the Weekly Iron and Folic Acid Supplementation (WIFS) programme and the Anemia Mukt Bharat initiative, the persistently high prevalence highlights the limitations of a single-dimensional, nutrient-replacement approach. This calls for innovative, integrative, and culturally embedded strategies that address both the nutritional and metabolic roots of the problem. Ayurveda, with its time-tested and holistic understanding of *Pandu Roga*, provides a scientifically plausible and socio-culturally compatible framework for the prevention and management of anaemia. Its principles focus on the restoration of digestive and metabolic balance (*Agni Deepana* and *Rasa–Rakta Dhatu Pushti*), promotion of healthy tissue formation, and rejuvenation of vitality (*Rasayana Chikitsa*). Unlike conventional iron therapy, Ayurvedic interventions aim to correct the underlying functional disturbances responsible for poor nutrient assimilation, thereby ensuring sustainable improvement in haemoglobin synthesis and overall well-being. Evidence from clinical and pharmacological studies supports the efficacy and safety of formulations such as *Lauha Bhasma*, *Vajravatak Mandura*, and *Punarnava Mandura*. These preparations not only increase haemoglobin concentration but also improve appetite, digestion, and general health, with minimal gastrointestinal side-effects. When combined with dietary counselling, lifestyle modification, and menstrual hygiene education, Ayurvedic therapy can enhance compliance and achieve synergistic outcomes within existing public-health frameworks. The convergence of Ayurveda and modern nutritional science offers a promising path toward achieving the national vision of "Anaemia-Free India (Anemia Mukt Bharat)." To realise this potential, systematic research, pharmaceutical standardisation, evidence-based policy formulation, and programme-level implementation are essential. Integrating Ayurveda into adolescent health promotion can thus transform anaemia control from a biomedical intervention into a holistic, sustainable, and culturally resonant public-health success story.

ACKNOWLEDGEMENT

The author acknowledges the contribution of Ayurvedic clinicians, adolescent health workers, and researchers whose works have advanced understanding of *Pandu Roga* and anaemia management.

CONFLICT OF INTEREST

None declared.

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