Ayurveda's impact on Anemia in School Children of Rural Belagavi, Karnataka: An observational study

Sandeep S Sagare[1], B S Prasad[2*], Kavita Sutagatti[3], Zeba Mulla[4]

1 Department of Swasthavritta and Yoga KAHER's Shri BMK Ayurved Mahavidyalaya Shahpur, Belagavi, Karnataka 590005

2 National Commission for Indian System of Medicine, D" Block, 61-65, Janakpuri Institutional Area, Janakpuri, New Delhi, Delhi, 110058

3 Department of Panchakarma KAHER's Shri BMK Ayurved Mahavidyalaya, Shahpur, Belagavi, Karnataka 590005

4. Department of Dravyaguna KAHER's Shri BMK Ayurved Mahavidyalaya, Shahpur, Belagavi, Karnataka 590005

***Corresponding author**

Dr. B S Prasad MD(Ayu)PhD

President. National Commission for Indian System of Medicine, D" Block, 61-65, Janakpuri Institutional Area, Janakpuri, New Delhi, Delhi, 110058. India

Email: sandeepsagare@gmail.com

Phone: +91 9844586894

Abstract:

Anemia poses a significant public health challenge, particularly in developing nations. Indian government has initiated several programs aimed at reducing the prevalence of anemia, such as providing iron and folic acid supplements and Mid-day meals to school-aged children. This study aims to address the issue by employing Ayurveda's comprehensive approach and cooperative. A survey of baseline was conducted on 7101 children's from 41 schools and 85 Anganwadis by Hudali Primary Health Centre. A period of one academic year, 2022-23 out of 7101 Children's 301 instances were evaluated for anaemia. The data was analyzed using appropriate software and statistical methods. The height, weight, and Body mass index measurements during the first to third follow-up revealed that there was a statistically significant mean difference for the weight and BMI variables when comparing the initial screening to the follow-up assessments. Hb% observed differences are statistically significant between screening and follow-up measurements. The initial serum ferritin level before treatment was 75.7579 (SD: 57.04) for a sample size of 293.

After treatment, the serum ferritin level rose to 128.3211 (SD: 70.25) within the same sample size. Childhood anemia remains a significant public health issue within this age group. Our research highlights the substantial prevalence of anemia among school-age children. The effectiveness of intervention drugs in treating anemia was noted. We recommend the need for thorough, well-organized, and extensive investigations that use standardized methods to assess the occurrence and treat anemia

Keywords: Anemia, Ayurveda, Rural School, Illness, BMI

Introduction:

Anemia is a common blood disorder characterized by a deficiency of red blood cells or hemoglobin, resulting in reduced oxygen-carrying capacity. Its prevalence and incidence vary widely across different populations and regions. In general, anemia is more prevalent in developing countries, particularly among women of reproductive age and children, due to factors such as poor nutrition, infectious diseases, and limited access to healthcare. However, it also affects individuals in developed countries, often due to underlying medical conditions such as chronic diseases or genetic disorders. Effective prevention and treatment strategies, including iron supplementation, dietary changes, and addressing underlying health issues, are essential for reducing the burden of anemia worldwide. This ailment is particularly prevalent among women of childbearing age, children, and adolescents 9 (1). On a global scale, anemia impacts 1.62 billion individuals, making up approximately 24.8% of the world's population. The highest prevalence is observed among preschool-age children, affecting 47.4% of this demographic, and in India, 25.4% of school-age children are affected by anemia. Among young children, the prevalence of anemia surpasses 70% (2). A 2011 report from the World Health Organization (WHO) categorizes the public health significance of anemia in India as 'severe’ (3). Lower socioeconomic class and rural living significantly increase the risk. Despite gains in the public health system, the frequency increased from 1998-1999 to 2005-2006 (1).

Correcting anemia in school children is vital for their physical and cognitive development, as it can cause fatigue, weakness, and difficulty concentrating, affecting their academic performance and overall well-being. Iron deficiency anemia is commonly studied in school children due to its widespread prevalence and impact on health. Belagavi, a rural area with diverse socio-economic backgrounds, provides an ideal setting to study the health and educational outcomes of rural school children in Karnataka, with sufficient infrastructure and resources for research. Understanding the unique health challenges faced by rural areas like Belagavi can inform targeted interventions to improve educational outcomes. The study includes medicines like Krimikuthara rasa for its antiparasitic properties, Punarnavamandoora for rejuvenation and improved blood circulation, and Draksha avaleha for its high iron content, aiming to address anemia effectively.

The National Health Mission provides weekly iron and folic acid tablets to children aged 5-19, with biannual deworming in schools and Anganwadi centers. Anaemia can stem from various factors, including infections and genetic disorders. Maternal anaemia raises risks for both mother and child. In 2013, maternal and neonatal mortality accounted for 3 million deaths in developing regions. Iron deficiency alone contributed to 90,000 deaths globally. Monitoring iron deficiency involves regular assessment of individuals or communities. The WHO classifies anemia based on hemoglobin or hematocrit levels. (4-11).

Ayurveda, an ancient Indian system of medicine, views anemia as a result of imbalance in the body's doshas, particularly Pitta and Kapha. Treatment involves dietary modifications, herbal remedies, and lifestyle adjustments aimed at restoring balance and improving the body's ability to absorb nutrients, thereby alleviating anemia symptoms and promoting overall health.

The intervention involves implementing targeted strategies to address health and educational challenges faced by rural school children in Belagavi, Karnataka. Assessments are conducted to evaluate the effectiveness of these interventions, followed by regular follow-ups to monitor progress and make necessary adjustments for continuous improvement.

Materials and methods:

Information about medicine collection/preparation

Krimikutara rasa, Punarnava mandoora and Drakshavaleha are collected from GMP Certified, XXX Pharmacy, Teaching Pharmacy of XXXX. Krimikuthara Rasa is an Ayurvedic medicine typically available in tablet or powder form, containing 250mg of the herbal ingredients. Punarnavamandoora also comes in tablet form with a similar dosage of 250mg and is used for various health conditions according to Ayurvedic principles. Draksha Avaleha is a herbal jam-like preparation made from grapes (Draksha) and other ingredients, commonly used in Ayurveda for its rejuvenating properties. These medicines are typically prepared by practitioners, following traditional Ayurvedic recipes and methods.

Study design

The research design employed for this study is a observational study, which allows for the collection of data at a single point in time to examine associations between variables of interest.

Research Setting:

The study is planned to be conducted in the rural areas of Belagavi, Karnataka. Data collection will take place in these areas based on the research question's nature and the type of information required, providing insights into the health and educational outcomes of children.

Research Population:

The population under investigation consists of children under five years old residing in the rural areas of Belagavi. This population segment is chosen to focus on early childhood development and to understand the factors influencing health and educational outcomes in this age group.

1. **Sample calculation**

   Sample size was calculated using below formula at 95% confidence Interval 5% Tolerable Error and 10% Attrition (1.1). Prevalence of anemia was found to be 53%.

2. $$n = \frac{Z^2_{1-\alpha/2}\ p\ q * 1.1}{(5\%\ \text{of}\ p)^2}$$

   Where, $Z_{1-\alpha/2}$ = 1.96, p = Prevalence of Anemia, q = 100-p, p = 53%, q=100-53% = 47%
   Required minimum sample size was found to be 1499.

3. **Assessment parameters with follow-ups (Table form)**

   In the intervention, 301 students who were selected by systematic random sampling method (every 4th student was selected) received the specified medications for duration of 96 days. For children, the dosage was determined according to the guidelines outlined in the Yogaratnakar principle [Table 1].

4. **Hb% and other Tests details:**

Haemoglobin Test: The Quick Check Plus Hb Hemoglobin Testing system was used at schools and anganawadis. After sanitizing with an alcohol swab, a finger puncture was made with a lancing device. The initial blood drop was removed, and a sample collected using a glass-tipped capillary tube placed on a test strip. Results were displayed within 4 to 15 seconds. Students were educated on the process and hand hygiene. After disinfection and glove use, 3 ml of blood was drawn: 1 ml in an EDTA tube and 2 ml in a plain tube. Samples were transported to the lab in cold storage.

Serum Ferritin Test: Test was conducted at the XXXX. To perform the test, a blood sample was first centrifuged at 2500 rpm for 1 minute to separate the serum. Subsequently, 800 ml of Buffer and 200 ml of Latex reagent were added to a glass test tube. The mixture was then incubated at 37°C for 5 minutes. Following this, 50 ml of serum was added and thoroughly mixed, and the absorbance was recorded both after 5 seconds (A) and after 480 seconds (A2).

Peripheral smear test:

Select a slide with smooth edges for spreading. Place a small blood drop about 1 cm away from one end of the slide, positioned horizontally. Hold the spreading slide between thumb and index finger, positioning its narrow edge at a 45-degree angle in front of the blood drop. Slowly move it backward until it touches the blood, and then push it forward with consistent speed and pressure to spread the blood across two-thirds of the slide's width. Let the smear air-dry, then place it horizontally on a staining rack. Apply stain drop by drop, allowing it to sit for 1-2 minutes. Dilute the stain with double distilled water, gently mixing until a golden scum forms. Let it sit for 7-10 minutes until adequately stained. Rinse under tap water until clear and pink. Wipe the slide's back and position vertically to dry. Examine under low power, focusing on evenly distributed cells. Add cedar wood oil and view under oil immersion objective.

Ethical clearance no

The present study has been granted ethical clearance by the institutional ethical committee, as indicated by clearance number XXX/22/SSS/01 dated 13.06.22. This approval ensures that the research adheres to ethical guidelines and standards, safeguarding the rights and well-being of participants involved in the study.

5. **Inclusion Criteria:**

Children aged 4 to 16 years, regardless of their gender, religion, or economic status, will be eligible for participation. The study will include students with mild to moderate hemoglobin levels, specifically between 8 to 11.9 grams per deciliter (gm%) for girls and 8 to 12.9 gm% for boys. Participants will be drawn from 85 Anganwadis and 38 schools within the Hudali Primary Health Center (PHC) area.

6. **Exclusion Criteria:**

Children below 4 years of age and those above 16 years of age will not be considered for inclusion. Additionally, students with normal hemoglobin levels and those with severe anemia (i.e., less than 8 gm) will be were referred to a higher center for further medical management.

7. **Rescue medication and reporting ADR policies**

Rescue medication is given in clinical trials to ease symptoms or adverse effects experienced by participants, ensuring their safety while maintaining research integrity. Adverse drug reactions (ADRs) policies involve documenting and reporting unexpected or harmful effects of medications used, vital for participant safety and risk mitigation during the study.

Subjective parameters: Part-1

A baseline survey assessed iron deficiency anemia among 7,101 students across 41 schools and 85 Anganwadis in 26 villages within the Hudali PHC area. Hemoglobin levels were screened using the Quick Check plus Hb Hemoglobin testing system in both schools and Anganwadis. Previous data suggested an anticipated anemia incidence of 7.22%, around 490 students. Due to budget constraints, 301 children were randomly chosen for further follow-up studies.

Objective parameters Part-2

Anemia was classified into four levels: normal, mild, moderate, and severe based on Hb% levels. Students with severe anemia (Hb% below 8gm%) were referred to a specialized medical center. We selected 301 anemic students with Hb% between 8 to 11.9gm% for girls and 8 to 12.9gm% for boys. Blood samples were collected, and tests were conducted at XXXX. Following tests, students received Ayurvedic treatment for 96 days. Parents, teachers, and anganwadi teachers were informed and provided consent. Medication details were provided, and treatment began. Follow-up assessments were conducted on the 96th day, re-evaluating blood parameters and observational criteria. Statistical analysis was performed on collected data for the final report.

Statistical analysis:

The data collected was inputted into a Microsoft Excel 2013 spread sheet, and an analysis was conducted using a valid SPSS version license. The findings regarding descriptive statistics were presented as percentages, and Chi-square tests were employed to assess the association between the presence of anemia and different variables.

Results:

Out of 7,101 students screened for anemia, 1,321 (18.6%) were found anemic. 301 anemic children were included post-screening, making up 22.7% of the sample. On the 96th day of follow-up, 8 (2.6%) children were lost to follow-up.

Table 2 shows that before treatment, anemic students had an average Hb% of 10.28 ± 0.56. After treatment, this increased to 12.14 ± 0.86, indicating a significant rise (p=0.0001) with a mean difference of 1.85 in Hb%.

Table 3 shows an initial serum ferritin level of 75.75 ±57.04 for anemic students before treatment. After intervention, average Hb% rose to 128.32 ± 70.25, with a mean increase of 52.57, statistically significant (p=0.0001).

As indicated in Table 4 and 5, the height, weight and BMI upon 1st-3rd follow up was summarized, the mean difference was found significant level for weight and BMI variables upon screening and follow-up.

Discussion:

In Ayurveda, anemia treatment balances doshas and boosts vitality by addressing energy imbalances and weak digestion. Medications focus on root causes, improving digestion, nutrient absorption, detoxification, and rejuvenation. Personalized plans aim for overall well-being, but consulting qualified practitioners for tailored treatment is essential.

The combination of Krimikuthara rasa (250mg), Punarnavamandoora (250mg), and Draksha avaleha presents an interesting blend of ingredients with potential implications for addressing anemia. While the specific mode of action may vary based on the individual components, here's a general overview of how each ingredient may contribute to the management of anemia:

Krimikuthara rasa: This Ayurvedic preparation often contains herbs like Vidanga (Embelia ribes), Chitraka (Plumbago zeylanica), and Pippali (Piper longum), among others. These herbs are traditionally believed to have anti-parasitic properties and may help in addressing conditions associated with intestinal parasites, which can sometimes lead to anemia due to blood loss or nutrient malabsorption.

Punarnavamandoora: Punarnavamandoora is a classical Ayurvedic formulation commonly used in the management of various disorders, including anemia. It typically contains Punarnava (Boerhavia diffusa) as a key ingredient, which is known for its hematinic properties. Punarnava is believed to enhance hemoglobin levels and red blood cell production, thereby potentially aiding in the treatment of anemia.

Draksha avaleha: Draksha avaleha is an Ayurvedic herbal jam prepared from grapes (Draksha) and various medicinal herbs. Grapes are naturally rich in iron and other nutrients essential for red blood cell formation. Additionally, Draksha avaleha may contain herbs like Guduchi (Tinospora cordifolia) or Ashwagandha (Withania somnifera), which are traditionally used to boost immunity and improve overall health, potentially supporting the body's ability to overcome anemia.

Overall, the probable mode of action of this combination of medicines on anemia may involve a multifaceted approach, including addressing potential underlying causes such as parasitic infections, enhancing red blood cell production, and providing essential nutrients like iron to support hemoglobin synthesis. However, it's important to note that further research, including clinical trials, would be necessary to validate these potential benefits and elucidate the specific mechanisms of action involved.

Subjective parameters:

In our study of 7,101 students, 18.6% were anemic. After randomization, 301 anemic students participated. Only 1.96% was lost during the 96-day follow-up. Before treatment, average hemoglobin was 10.28 ± 0.56. After intervention, it increased significantly to 12.14 ± 0.86 (p=0.0001), showing a notable improvement in hemoglobin levels among anemic students.

The study found a considerable increase in hemoglobin levels among anemic students after intervention, with an average rise of 52.57 units. Initial serum ferritin levels showed widespread iron deficiency, averaging 75.75 ± 57.04. Post-intervention hemoglobin levels improved significantly to an average of 128.32 ± 70.25, indicating positive treatment response. Anthropometric measures revealed significant changes in weight and BMI. These results suggest the intervention not only improved hemoglobin but also impacted overall nutrition and body composition. Addressing iron deficiency anemia through targeted interventions is crucial for health improvements in this population. This study shows that intervention effectively boosts hemoglobin levels in anemic students, suggesting its potential for broader community health programs. It also highlights secondary benefits like improved weight and BMI, indicating better overall health. The findings support implementing similar interventions for iron deficiency anemia, especially where access to nutrition and healthcare is limited. However, more research is needed for long-term impact confirmation.

Likewise Shabadi et al., 2019(12) found a 27.6% anemia occurrence in Mysore and Chamarajanagara districts, contrasting with Jain et al., 2012 (13) 56.5% in the northern region. Shivaprakash et al., 2014 (14) reported 25.4% in Mandya, adjacent to Mysore. Muthayya et al., 2007 (15) Bangalore study revealed a 13.6% prevalence. Shabadi et al.(12) noted a higher anemia rate in females (36%) than males (19.2%). Basu et al., 2005(16)Chandigarh study showed 23.9% in females and 7.7% in males. Anand et al., 1999[17]in Delhi found higher prevalence in boys aged 12-14. Rural areas had higher prevalence (29.9%) than urban (22.7%), as found by Shabadi et al. (12)Gambar et al., 2003(18) noted 41.8% in urban slums. Our recent research showed a significant rise in hemoglobin levels post-intervention. Mishra et al., 2022(19) and Rani et al., 2017 (20) defined anemia similarly. Significant mean differences were observed in weight and BMI. Siva et al., 2016 (21) found higher anemia prevalence among obese individuals, while Pinhas-Hamiel et al., 2003 (22) observed low iron levels in obese children. Conversely, Kordas et al., 2013 (23) noted reduced anemia prevalence among overweight and obese Colombian women.

Shobha et al., 2003 (24) observed a notable prevalence of anemia among Indian teenage girls. Kapoor et al., 1992 (25) reported 50.8% of teenage girls in Delhi government and public schools having anemia. Verma et al., 1998 (26) and Malhotra et al., 1982 (27) found anemia rates ranging between 66.7% and 77% among children aged 5 to 14. Vasanthi et al., 1994 (28) noted higher anemia and iron insufficiency rates among rural adolescent girls compared to urban slum counterparts. Seshadri et al., 1998 (29) found 61% of rural Gujarat adolescent girls to be anemic. Toteja et al., 2006 (30) conducted a multicentric study across sixteen Indian regions, revealing widely varying anemia prevalence among pregnant women (ranging from 33% to 89%) and exceeding 60% among teenage girls.

Conclusion:

Childhood anemia persists as a major concern in India, demanding immediate attention. Our study focused on anemia prevalence, especially iron levels, in schoolchildren, revealing a significant issue. We urge comprehensive investigations using standardized methods to understand anemia and its causes across India's diverse regions and demographics.

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Conflicts of interest

Authors don’t have any conflict of interest.

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Table. 1 Study design and treatment schedule for participants

Medication	Dosage		Duration
	< 10 Yrs children	> 10 Yrs children	
Krimikuthara rasa (250mg)	1 Tab Twice a Day AF*	2 Tabs Twice a Day AF	6 Days
Punarnavamandoora (250mg)	l Tab Twice a Day AF	2 Tabs Twice a Day AF	90 Days
Draksha avaleha	6 gms Twice a Day AF	10 gms Twice a Day AF	
Total			96 Days

Note: After Food*

Table: 2 Haemoglobin concentration before and after treatment among the participants

Medication	Mean±SD	No	Mean Diff	SD Diff	p-value
Before	10.28±0.56	293	-1.85	0.3	**0.0001***
After	12.14±0.86				

Table: 3 Ferritin content before and after treatment among the participants

Medication	Mean±SD	No	Mean Diff	SD Diff	p-value
Before	75.75±57.04	293	-52.57	13.21	**0.0001***
After	128.32±70.25				

Table: 4 Pre treatment Height, Weight and BMI among the participants

	N	Mean	Std. Deviation	Median	Minimum	Maximum	F (3, 1162)	p-value
Height								
Screening	301	117.393	18.9842	115.5	80	183		
1st Follow up	292	118.553	18.89562	116	80	184		
2nd Follow up	284	118.721	18.40024	116.5	83	184		
3rd Follow up	290	120.855	18.6944	119	83	184	1.738	0.157
Weight								
Screening	301	20.5643	8.93999	17.7	9.8	60		
1st Follow up	292	21.5411	9.08564	19	10.3	61		
2nd Follow up	284	22.1518	9.03122	19.45	11	62.7		
3rd Follow	29	22.82	9.27108	20	11	63.2	3.295	0.020

up	0	48						
BMI								
Screening	301	14.2828	2.02987	13.93	10	27.68		
1st Follow up	292	14.7149	2.02356	14.405	10.25	27.86		
2nd Follow up	284	15.1299	1.95673	14.9	11.13	28.32		
3rd Follow up	290	15.0554	2.01796	14.745	10.52	27.56	10.919	0.000

Table: 5 Post treatment Height, Weight and BMI among the participants

Dependent Variable	**(I) Follow-up**	**(J) Follow-up**	**Mean Difference (I-J)**	**Std. Error**	**p-value**	**95% Confidence Interval**	
						Lower Bound	**Upper Bound**
Weight	Screening	1st Follow up	-0.97676	0.74659	0.191	-2.4416	0.4881
	Screening	2nd Follow up	-1.58743*	0.7519	0.035	-3.0627	-0.1122
	Screening	3rd Follow up	-2.26049*	0.74789	0.003	-3.7279	-0.7931
	1st Follow up	2nd Follow up	-0.61066	0.75689	0.42	-2.0957	0.8744
	1st Follow up	3rd Follow up	-1.28373	0.75291	0.088	-2.761	0.1935
	2nd Follow up	3rd Follow up	-1.28373	0.75291	0.088	-2.761	0.1935
BMI	Screening	1st Follow up	-.43210*	0.16505	0.009	-0.7559	-0.1083
	Screening	2nd Follow up	-.84706*	0.16622	0.000	-1.1732	-0.5209
	Screening	3rd Follow up	-.77255*	0.16534	0.000	-1.0969	-0.4482
	1st Follow up	2nd Follow up	-.41496*	0.16733	0.013	-0.7433	-0.0867
	1st Follow up	3rd Follow up	-.34045*	0.16645	0.041	-0.667	-0.0139
	2nd Follow up	3rd Follow up	0.07452	0.16761	0.657	-0.2543	0.4034

Note: * The mean difference is significant at the 0.05 level.