**Effect of Finger Millet (Ragi) Consumption on Haemoglobin Level among Adolescent Girls of Jalaun District, Uttar Pradesh, India**

**Abstract**

The adolescent years are a golden opportunity to tackle nutritional deficiencies, especially in rural Jalaun District, where anaemia is rampant among adolescent girls due to poverty and limited healthcare access. Finger millet, or ragi, a drought-resistant, iron-rich cereal, was studied to see its impact on haemoglobin levels and BMI in 60 girls aged 13–16 from Rura Mallu Gram and Kukargoan. Split into two groups, the experimental group ate 50 grams of ragi porridge twice daily for 90 days, while the control group didn’t. The results were striking: the ragi group’s haemoglobin jumped significantly from 10.5 g% to 11.5 g% (t-value 5.59, p<0.05), unlike the control group’s slight, non-significant rise from 9.5 g% to 9.9 g%. No BMI changes were noted in either group. Affordable and nutritious, ragi—whether as porridge, roti, or dumplings—proved a game-changer for fighting anaemia, calling for greater awareness to make it a dietary staple for healthier futures.

**Keywords:**  Adolescence, Body Mass Index, Haemoglobin, Nutrition, Ragi

### Introduction

### Introduction Adolescence, defined by the World Health Organization as the age range of 10 to 19 years, represents a critical transitional phase from childhood to adulthood, characterized by significant psychological, behavioural, and physical developments (World Health Organization, 1996). This period is marked by rapid growth spurts and heightened physical activity, necessitating increased nutritional requirements to support optimal development. Globally, adolescents number approximately 1.2 billion, constituting one-fifth of the world’s population, with over 21.4% of India’s population being adolescents, of which adolescent girls account for roughly 10% (Kishore, 2006). Anaemia, predominantly caused by iron deficiency, is a major global nutritional concern, with a disproportionately high prevalence among women of childbearing age, particularly adolescent girls in India, where rates exceed those of other developing nations (Kaur et al., 2006). The onset of menstruation during adolescence further elevates the risk of nutritional anaemia, especially in rural areas where early marriage and pregnancy increase the likelihood of anaemia and low birth weight infants (Shah & Gupta, 2002). In the Jalaun district of Uttar Pradesh, the prevalence of anaemia among adolescent girls is notably high due to low socioeconomic status and limited access to healthcare services (District Administration, 2016). Despite extensive research on anaemia in pregnant women and children, studies focusing on adolescent girls remain limited (Pipher, 1998). This study aims to evaluate the impact of finger millet (Eleusine coracana), commonly known as ragi or mandua, on haemoglobin levels and body mass index (BMI) among adolescent girls in rural Jalaun district. Improving anaemia and raising nutritional awareness among this demographic can significantly reduce maternal morbidity and mortality, particularly during pregnancy. Finger millet, a staple in East and Central Africa and India, is a major global millet, with India contributing nearly 60% of its production (Jenkins et al., 1982). Well-adapted to high-rainfall (600–1,200 mm) and acidic soils, it matures in 100–130 days and boasts the highest productivity among millets (Gopalan et al., 2002). Extensively cultivated in states like Karnataka, Tamil Nadu, Andhra Pradesh, and Uttarakhand, finger millet is consumed as dumplings, porridge, or roti and is gaining recognition for its rich dietary fibre, starch profile, and high calcium (220–450 mg%) and iron (3–20 mg%) content (Balakrishna Rao et al., 1973; Vijayakumari et al., 2003). Its low-glycemic-index properties make it a valuable dietary intervention for managing diabetes mellitus by reducing plasma glucose levels and glycemic surges (Lakshmi & Sumathi, 2002; Arora & Srivastava, 2002). Furthermore, finger millet’s superior nutritional profile, particularly its iron and calcium content, positions it as an effective tool for combating anaemia and supporting the health of adolescents, expectant mothers, and lactating women (Ojha et al., 2025a; Ojha et al., 2025b).

### Materials and Methods

In a meticulously designed experimental study, 60 adolescent girls aged 13 to 16 years from Rura Mallu Gram and Kukargoan in Jalaun district were randomly selected and evenly divided into two groups: T1 (control) and T2 (experimental). Comprehensive clinical examinations were conducted, with blood samples analysed via an auto-analyser to assess haemoglobin levels (mg/dl), and anthropometric measurements of height and weight were recorded to calculate BMI before and after the intervention. Data were rigorously evaluated using advanced statistical tools, including a t-test, to ascertain significant differences between the group means, with the threshold for statistical significance established at a p-value of < 0.05, ensuring robust and reliable findings.

**Results And Discussion**

In this groundbreaking study, a cohort of 60 adolescent girls, aged 13–16 years, from Rura Mallu Gram and Kukargoan in Jalaun district, was strategically selected due to their heightened vulnerability to anemia, a condition with alarmingly high prevalence across various Indian states. Recognizing the pivotal role of dietary quality in bolstering human physical well-being, sustaining health, and unlocking genetic potential, this research underscores the urgent need to combat deep-seated food insecurity and malnutrition through nutrient-rich diets (Singh & Raghuvanshi, 2012). To investigate the transformative potential of ragi, the study meticulously randomized participants into two groups—30 in the experimental group and 30 in the control group—aiming to rigorously evaluate its impact on elevating hemoglobin levels and optimizing body mass index among adolescent schoolgirls, thereby paving the way for targeted nutritional interventions.

**Table 1: Comparison of the mean scores and standard deviation and t-test for haemoglobin**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Group** | **Stage** | **Mean** | **SD** | **t-test** | **Df** | **p-value** |
|  T1- (Control group) n=30 | Pre | 9.5 | 1.345 | -1.59 | 29 | 0.10 |
|   | Post | 9.9 | 0.289 |
| T2- (Experiment group) n=30 | Pre | 10.5 | 0.195 | -5.59 | 29 | 0.0001\* |
|   | Post | 11.5 | 0.960 |
| T1+T2= Control group+ Experiment groupn=30+30 =60 | Pre | 9.9 | 1.283 |  2.15  | 58 | 0.975 |
|   | Post | 11.5 | 1.414 |

*\*Statistically significant*

*df-degree of freedom, pre- hemoglobin level on day1, post- hemoglobin level on day90, SD- standard deviation,*

 In a meticulously executed 90-day study, the impact of twice-daily 50-gram supplementation of ragi porridge on hemoglobin levels was thoroughly evaluated in the experimental group, with simultaneous tracking of body mass index (BMI) changes in both the experimental and control groups, as presented in Table 1. The findings demonstrated a statistically significant rise in hemoglobin levels in the experimental group, increasing from a mean of 10.5 g% to 11.5 g%, with a t-test value of 5.59, highlighting the intervention’s effectiveness. Conversely, the control group showed a slight, statistically insignificant increase in hemoglobin from 9.5 g% to 9.9 g%. Reinforcing the nutritional value of finger millet, Bhatt et al. (2003) noted its calcium content at a remarkable 344 mg%, while Babu et al. (1987) reported its iron content ranging from 3.3 to 14.8 mg%. Additionally, Singh and Srivastava (2006) examined 16 finger millet varieties, documenting iron content between 3.61 mg/100g and 5.42 mg/100g (mean: 4.40 mg/100g), zinc content from 0.92 to 2.55 mg% (mean: 1.34 mg%), and phosphorus content from 130 to 295 mg% (mean: 180.43 mg%). Vijayakumari et al. (2003) underscored finger millet’s exceptional richness in calcium and iron, establishing it as a critical dietary component to address calcium deficiency-related bone and dental issues and iron deficiency-induced anemia, thereby advocating its regular inclusion in daily diets for enhanced health outcomes.

**Table 2: Comparison of the mean scores and standard deviation and t-test for body mass index**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Group** | **Mean** | **SD** | **t-test** | **df** | **p-value** |
| T1 | Control group | 16.7 | 0.283 |  2.30 |  58 | 0.975 |
| T2 | Experiment group | 17.35 | 1.061 |

In an exceptionally thorough investigation, the impact of ragi supplementation on body mass index (BMI) was meticulously evaluated, revealing no notable difference between the control and experimental groups. The mean BMI in the experimental group rose modestly from 16.7 to 17.35, yielding an absolute t-test value of 2.30, which surpassed the critical value of 2.04 at a 97.5% confidence interval with 58 degrees of freedom. However, this analysis confirmed no statistically significant differences in mean BMI between the two groups, underscoring the need for further exploration of ragi’s broader nutritional influence.

**Conclusion**

Finger millet, a nutritional titan, surpasses rice with its remarkable abundance of protein, fat, and vital minerals, particularly calcium and iron, establishing it as a cornerstone of wholesome diets. Research underscores the profound health benefits of daily dietary incorporation of ragi in versatile forms such as porridge, dumplings, ragi balls, or roti, showcasing its cost-effectiveness and significant positive impact on elevating hemoglobin levels in adolescent girls. Products crafted from composite ragi flours demonstrate superior nutritional profiles compared to their control counterparts, making them ideal for supplementary feeding programs. To harness its full potential, concerted efforts must be undertaken to raise public awareness of finger millet’s exceptional nutritive value and myriad health benefits, as advocated by Singh et al. (2012). Thus, finger millet stands as an extraordinarily nutrient-dense cereal, pivotal for fostering optimal health and vitality.

**Recommendation**

Finger millet (Eleusine coracana), commonly known as ragi or mandua, stands as one of India’s most ancient and widely accessible food grains, revered for its exceptional nutritional profile. To fully harness its potential as a functional food, concerted efforts are essential to raise public awareness and promote its regular consumption. The consistent incorporation of finger millet and its derived products into diets plays a pivotal role in managing various physiological disorders by supporting blood glucose homeostasis. Moreover, whole meal-based finger millet products are particularly advantageous, owing to the protective and health-enhancing properties of the seed coat, which further amplifies their nutritional benefits.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1. Grammarly for checking grammatical errors

**REFERENCES**

1. Arora, S., & Srivastava, S. (2002). Suitability of millet-based food products for diabetics. Journal of Food Science and Technology, 39(4), 319–344.
2. Babu, B. V., Ramana, T., & Radhakrishna, T. M. (1987). Chemical composition and protein in hybrid varieties of finger millet. Indian Journal of Agricultural Sciences, 57(7), 520–522.
3. Balakrishna Rao, K., Mithyantha, M. S., Devi, L. S., & Perur, N. G. (1973). Nutrient composition of some new ragi varieties. Journal of Agricultural Science Chemistry, 7, 562–565.
4. Bhatt, A., Singh, V., Shrotria, P. K., & Baskheti, D. C. (2003). Coarse grains of Uttaranchal: Ensuring sustainable food and nutritional security. Indian Farmer’s Digest, 34–38.
5. District Administration. (2016). Jalaun district. https://jalaun.nic.in/
6. Gopalan, C., Ramashastri, B. V., & Balasubramanium, S. C. (2002). Nutritive value of Indian foods. National Institute of Nutrition, Indian Council of Medical Research.
7. Gull, A., Nayik, G. A., Prasad, K., & Kumar, P. (2014). Significance of finger millet in nutrition, health and value-added products: A review. Journal of Environmental Science, Computer Science and Engineering and Technology, 3(3), 1601–1608.
8. Jenkins, D. J. A., Ghafari, H., & Wolever, T. M. S. (1982). Relationship between the rate of digestion of foods and post-prandial glycaemia. Diabetologia, 22, 450–455.
9. Kaur, S., Deshmukh, P. R., & Garg, B. S. (2006). Epidemiological correlates of nutritional anaemia in adolescent girls of rural Wardha. Indian Journal of Community Medicine, 31, 255–258.
10. Kishore, J. (Ed.). (2006). National health programs of India (6th ed., pp. 82–84). Century Publications.
11. Lakshmi, P. K., & Sumathi, S. (2002). Effect of consumption of finger millet on hypoglycaemia in non-insulin dependent diabetes (NIDDM) subjects. Plant Foods for Human Nutrition, 57(3–4), 205–213.
12. Ojha, P. K., Kumar, A., & Ojha, P. (2025). Revitalizing millet-based food systems in Bundelkhand: A review of culinary heritage and local recipes. International Journal of Innovative Science and Research Technology, 10(6), 971–973. https://doi.org/10.38124/ijisrt/25jun134
13. Pipher, M. (1998). Reviving Ophelia: Saving the selves of adolescent girls. Journal of Leisure Research, 30(2), 291.
14. Shah, B. K., & Gupta, P. (2002). Weekly vs daily iron and folic acid supplementation in adolescent Nepalese girls. Archives of Pediatrics & Adolescent Medicine, 156, 131–135.
15. Singh, P., & Raghuvanshi, R. S. (2012). Finger millet for food and nutritional security. African Journal of Food Science, 6(4), 77–84.
16. Singh, P., & Srivastava, S. (2006). Nutritional composition of sixteen new varieties of finger millet. Journal of Community Mobilization and Sustainable Development, 1(2), 81–84.
17. Singh, P., & Srivastava, S. (2007). Development and quality evaluation of iron-rich biscuit mixes using finger millet. Journal of Community Mobilization and Sustainable Development, 2(1), 89–94.
18. Vijayakumari, J., Mushtari Begum, J., Begum, S., & Gokavi, S. (2003). Sensory attributes of ethnic foods from finger millet (Eleusine coracana). In Recent trends in millet processing and utilization (pp. 7–12). Proceedings of the National Seminar on Processing and Utilization of Millet for Nutrition Security, CCSHAU, Hisar.
19. World Health Organization. (1996). Programming for adolescent health and development (WHO Technical Report Series No. 886, p. 2).
20. Ojha, P. K., Saxena, P., Fatma, S., Rani, B., Kaur, P., Ojha, P., & Yadav, A. K. (2025). Millet adoption in Bundelkhand, U.P.: Traditional vs. emerging crop trends. Indian Journal of Extension Education, 61(3), 137–141. <https://doi.org/10.48165/IJEE.2025.613RN06>