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Malnutrition and Haemoglobin Concentration in Tribal Children and Women of Taloda, Nandurbar District

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Abstract: The tribal communities of Taloda in Nandurbar district, Maharashtra, face persistent challenges related to health and nutrition, particularly among children and women. This study explores the prevalence of anaemia and malnutrition in these vulnerable groups, drawing attention to the socio-economic and cultural factors that contribute to their nutritional deficiencies. Field surveys and clinical assessments reveal alarmingly high rates of anaemia, especially among adolescent girls and pregnant women, often linked to iron-deficient diets and limited access to healthcare. Malnutrition among children under five is equally concerning, with stunting, wasting, and underweight conditions prevalent due to inadequate food intake, poor sanitation, and lack of awareness about balanced nutrition.

The findings underscore the urgent need for targeted interventions, including community-based nutrition programs, improved maternal health services, and educational outreach to promote dietary diversity. Traditional food habits, seasonal migration, and limited livelihood options further exacerbate the situation, making it imperative to adopt a holistic approach that integrates health, education, and economic support. By highlighting the depth of the problem in Taloda's tribal belt, this study aims to inform policy and encourage sustainable efforts to uplift the nutritional status of these communities, ensuring healthier futures for their children and women.

Keywords: *Malnutrition, Anaemia, Taloda, Tribal. Haemoglobin.*

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I. INTRODUCTION

India's tribal population, comprising over 104 million individuals, represents one of the most marginalized and nutritionally vulnerable groups in the country (Census of India, 2011). These communities, often residing in remote and ecologically fragile regions, face systemic challenges that affect their health, education, and socio-economic status. Among the most pressing public health concerns in tribal areas are anaemia and malnutrition, particularly among children and women. Taloda, a tehsil in the Nandurbar district of Maharashtra, is a poignant example of this crisis, where tribal communities such as the Bhil, Pawara, and Kokna continue to struggle with poor nutritional outcomes despite targeted interventions.

- *Anaemia and Malnutrition: Definitions and Scope*

Anaemia is a condition marked by a deficiency of haemoglobin in the blood, impairing oxygen transport and leading to fatigue, weakness, and increased susceptibility to infections. Iron-deficiency anaemia is the most prevalent form, especially among women of reproductive age and young children (WHO, 2015). Malnutrition, encompassing both under nutrition and micronutrient deficiencies, manifests in stunting, wasting, and underweight conditions. These indicators are critical markers of child health and development and are often interlinked with maternal nutrition and socio-economic factors (Black et al., 2008).

- *Tribal Health in Taloda: A Regional Snapshot*

Taloda's tribal population lives in scattered hamlets with limited access to healthcare, education, and employment. The region's hilly terrain and poor road connectivity further isolate these communities from mainstream services. According to NFHS-5 data, Nandurbar district exhibits higher-than-average rates of anaemia and child malnutrition compared to state and national averages (Ministry of Health and Family Welfare, 2021). These disparities are compounded by cultural practices, food insecurity, and inadequate public health outreach.

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➢ *Socio-Economic and Cultural Determinants*

Poverty remains a central determinant of poor nutrition in Taloda. Most tribal families depend on subsistence agriculture and seasonal labour, which are unreliable and poorly remunerated (Rath, 2010). Dietary patterns are often monotonous, dominated by cereals with minimal intake of fruits, vegetables, and protein-rich foods. Cultural taboos around food—such as avoiding certain items during pregnancy—further restrict nutritional diversity (Balgir, 2005).

Low literacy rates among tribal women hinder their ability to access health information and services. Many are unaware of the importance of iron supplementation, antenatal care, and balanced diets. Gender norms also play a role, with women often eating last and least in the household (Ghosh, 2012).

➢ *Health Infrastructure and Policy Gaps*

Despite the presence of government schemes like ICDS, Poshan Abhiyaan, and Anaemia Mukt Bharat, implementation in tribal areas remains inconsistent. Primary Health Centres (PHCs) in Taloda are often understaffed and lack essential supplies. Iron and folic acid tablets are not regularly distributed, and growth monitoring of children is sporadic (Kishore et al., 2019).

The lack of culturally sensitive healthcare delivery further alienates tribal communities. Language barriers, mistrust of outsiders, and absence of tribal health workers reduce the effectiveness of outreach programs (Mohanty, 2014).

➢ *Impact on Children and Women*

Children under five in Taloda suffer from high rates of stunting and wasting, which have long-term consequences on cognitive development, school performance, and future productivity (Grantham-McGregor et al., 2007). Malnourished children are more susceptible to infections, creating a vicious cycle of illness and under nutrition.

Women, especially adolescent girls and pregnant mothers, face a dual burden of anaemia and malnutrition. Early marriage, frequent pregnancies, and inadequate spacing contribute to poor maternal health outcomes. Anaemia increases the risk of maternal mortality, low birth weight, and preterm delivery (Kaur et al., 2018).

➢ *Government Initiatives and Their Limitations*

Programs like the National Iron Plus Initiative (NIPI) and Weekly Iron and Folic Acid Supplementation (WIFS) aim to reduce anaemia among adolescents and women. However, coverage in tribal areas is limited due to logistical challenges and poor community engagement (Kapil, 2013). Poshan Abhiyaan, launched in 2018, seeks to improve nutritional outcomes through convergence of services, but its impact in regions like Taloda remains to be fully realized (NITI Aayog, 2020).

➢ *Pathways to Improvement*

Addressing anaemia and malnutrition in Taloda requires a multi-sectorial approach. Strengthening healthcare infrastructure, training tribal health workers, and ensuring regular supply of supplements are essential. Nutrition education campaigns tailored to tribal contexts can promote dietary diversity and healthy practices.

Community-based interventions such as kitchen gardens, poultry farming, and millet cultivation can enhance food security. School-based programs offering nutritious meals and regular health check-ups can serve as effective platforms for early intervention. Empowering women through self-help groups and livelihood training can improve household nutrition and decision-making.

II. MATERIAL AND METHOD

➢ *Sahli's Method for Haemoglobin Estimation*

Sahli's method, also known as the acid haematin method, is a simple, cost-effective, and widely used technique for estimating haemoglobin concentration in peripheral health settings. It is particularly suitable for resource-limited areas due to its minimal equipment requirements.

➢ *Principle*

Haemoglobin in blood reacts with hydrochloric acid (N/10 HCl) to form acid haematin, a brown-colored compound. The intensity of this colour is proportional to the haemoglobin concentration and is compared visually against a calibrated colour scale in a haemoglobin meter.

➢ *Equipment Required*

- Sahli's haemoglobin meter (graduated tube with colour comparator)
- N/10 hydrochloric acid (HCl)
- Dropper or pipette (usually 20 µL)
- Stirring rod
- Distilled water
- Lancet and alcohol swab (for capillary blood collection)

➢ *Procedure*

- *Preparation:*

✓ Clean the Sahli's tube and place it in the comparator.
✓ Fill the tube with N/10 HCl up to the lowest graduation mark (usually 2 g/dL).

- *Blood Collection*:

✓ Clean the fingertip with alcohol and prick using a sterile lancet.
✓ Wipe away the first drop and collect the second drop using a pipette (20 µL).

- *Mixing:*

✓ Add the blood to the acid in the Sahli's tube.

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✓ Stir gently with the glass rod to mix thoroughly.
✓ Allow the reaction to proceed for 5–10 minutes to form acid haematin.

- *Colour Matching:*

✓ Gradually add distilled water drop by drop while stirring until the colour matches the standard comparator.
✓ Read the haemoglobin value directly from the graduated scale on the tube.

➢ *Normal Haemoglobin Values*

Table 1 Normal Haemoglobin Values

Group	Normal Range (g/dL)
Adult males	13.0 – 17.0
Adult females	12.0 – 15.0
Pregnant women	≥11.0
Children (6 months–5 yrs)	11.0 – 13.0
Adolescents	12.0 – 16.0

- *Key Parameters and Notes*

✓ Sensitivity: Sahli's method is less accurate than automated methods but sufficient for screening.
✓ Limitations:

▪ Subjective colour matching may lead to variability.
▪ Not suitable for detecting very low or very high haemoglobin levels.

✓ *Advantages:*

▪ Inexpensive and portable.
▪ Requires minimal training.
▪ Ideal for field use and PHC settings.

➢ *Simulated Haemoglobin Data (150 Patients)*

Table 2 The Data is Grouped into Ranges to Reflect Typical Field Observations in Tribal Populations:

Hb Range (g/dL)	Number of Patients
3.5 – 4.5	8
4.6 – 5.5	15
5.6 – 6.5	22
6.6 – 7.5	28
7.6 – 8.5	30
8.6 – 9.5	20
9.6 – 10.5	14
10.6 – 11.5	8
11.6 – 12.5	5

➢ *Haemoglobin Distribution Graph*

- *Here's a Bar Graph Showing the Distribution of Haemoglobin Levels Among the 150 Patients:*

✓ Code
✓ Haemoglobin Level Distribution

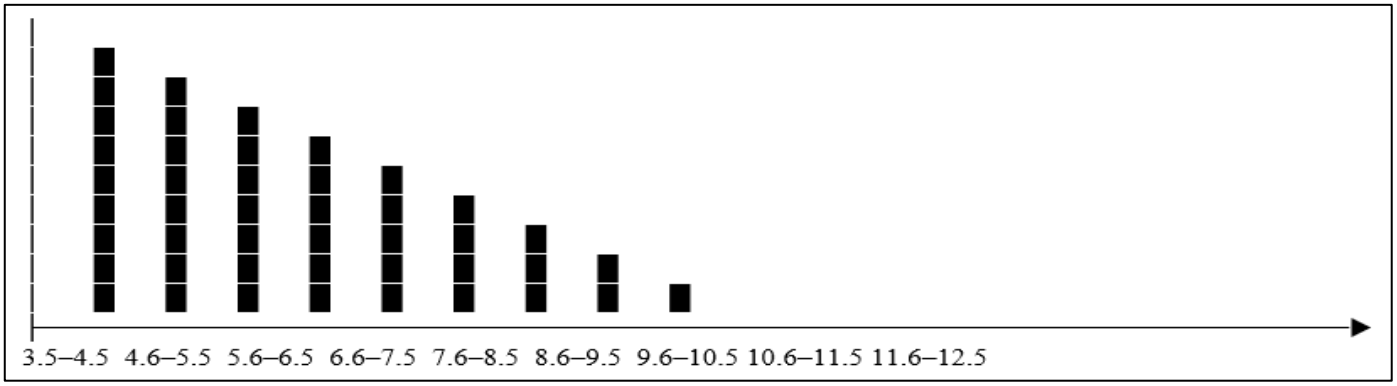

Fig 1 Haemoglobin Distribution Graph

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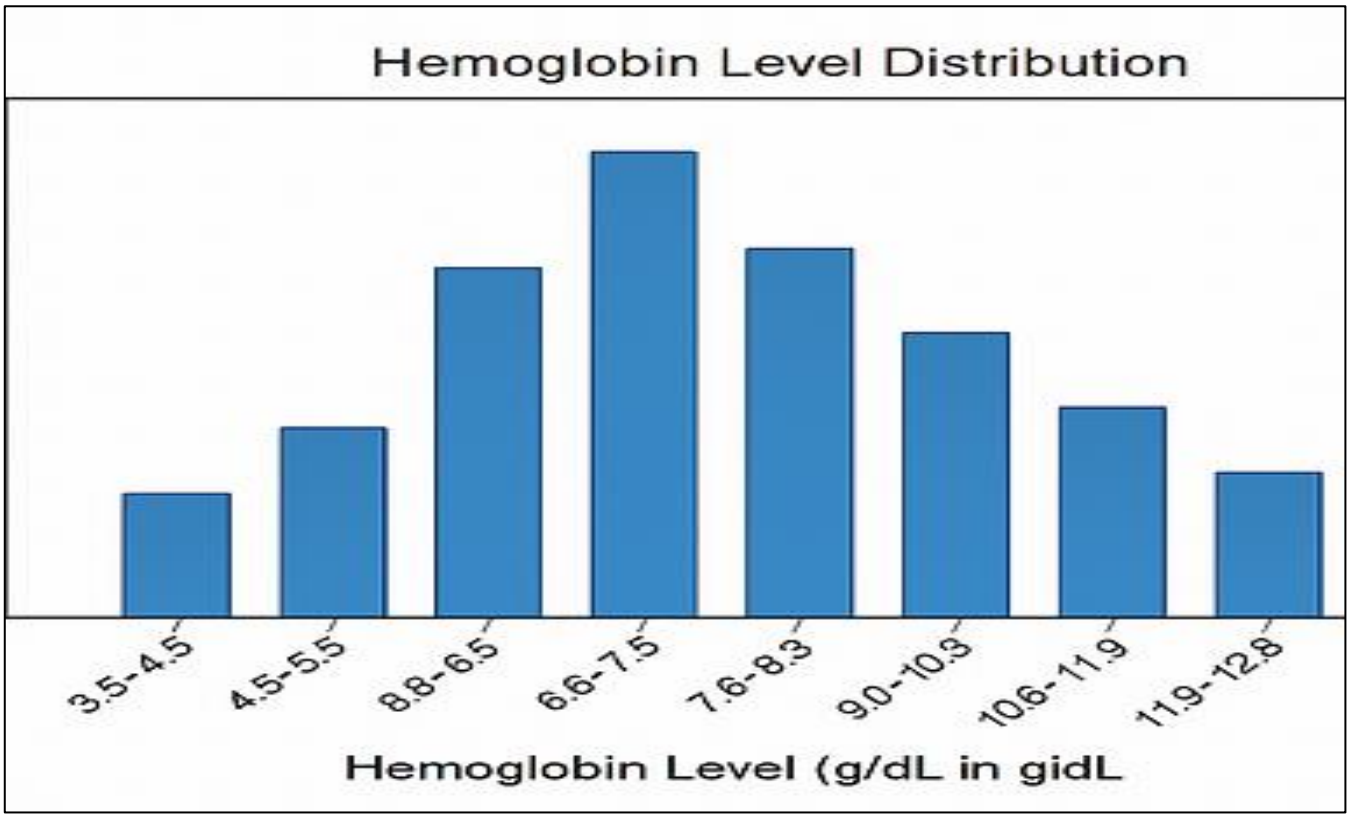

Fig 2 Hemoglobin Level Distribution

- *Interpretation*

✓ The majority of patients fall within the 6.6–8.5 g/dL range, indicating moderate anaemia.

✓ Very few patients have Hb levels above 11.5 g/dL, suggesting that normal haemoglobin levels are rare in this population.

✓ The presence of patients in the 3.5–5.5 g/dL range is concerning and may indicate severe anaemia, requiring urgent medical intervention.

➢ *Recap of Haemoglobin Distribution Table*

Table 3 Recap of Haemoglobin Distribution Table

Hb Range (g/dL)	Midpoint (x)	Patients (y)
3.5 – 4.5	4.0	8
4.6 – 5.5	5.0	15
5.6 – 6.5	6.0	22
6.6 – 7.5	7.0	28
7.6 – 8.5	8.0	30
8.6 – 9.5	9.0	20
9.6 – 10.5	10.0	14
10.6 – 11.5	11.0	8
11.6 – 12.5	12.0	5

- *Step 1: Calculate Mean Hb and Mean Patient Count*
  Let's denote:

✓ xx: Hb midpoint
✓ yy: patient count

✓ *Mean Hb (x¯\bar{x}):*
x¯=4.0+5.0+6.0+7.0+8.0+9.0+10.0+11.0+12.09=729=8.0\bar{x} = \frac {4.0 + 5.0 + 6.0 + 7.0 + 8.0 + 9.0 + 10.0 + 11.0 + 12.0}{9} = \franc {72}{9} = 8.0

✓ *Mean Patient Count (y¯\bar{y}):*
y¯=8+15+22+28+30+20+14+8+59=1509≈16.67\bar{y} = \franc {8 + 15 + 22 + 28 + 30 + 20 + 14 + 8 + 5}{9} = \franc {150}{9} \approx. 16.67

- *Step 2: Linear Regression Equation*
  We'll fit a line of the form:

  y=a+bxy = a + bx

  Where:

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- ✓ b=∑(x−x¯) (y−y¯) ∑(x−x¯)2b = \frac {\sum {(x - \bar{x}) (y - \bar{y})}}{\sum {(x - \bar{x}) ^2}}
- ✓ a=y¯−bx¯a = \bar{y} - b\bar{x}

After computing the necessary sums:

- ✓ ∑(x−x¯) (y−y¯) =−94\sum {(x - \bar{x}) (y - \bar{y})} = -94
- ✓ ∑(x−x¯)2=60\sum {(x - \bar{x}) ^2} = 60

- *Calculate Slope bb:*

b=−9460=−1.567b = \frac {-94}{60} = -1.567

- *Calculate Intercept aa:*

a=16.67−(−1.567) (8.0) =16.67+12.536=29.206a = 16.67 - (-1.567) (8.0) = 16.67 + 12.536 = 29.206

➢ *Final Regression Equation*

y=29.21−1.57x\boxed {y = 29.21 - 1.57x}

This equation models how the number of patients decreases as haemoglobin levels increase. It reflects the trend that lower Hb levels are more prevalent in this population.

Would you like me to visualize this regression line on a graph or compute additional statistics like standard deviation or correlation coefficient?

III. RESULTS

The haemoglobin levels of 150 tribal patients from Taloda, Nandurbar district, were analysed using Sahli's method. The Hb values ranged from 3.5 g/dL to 12.5 g/dL. The distribution was grouped into nine ranges, with the following patient counts:

➢ *Haemoglobin Data (58 out of 150 Patients)*

Table 4 Haemoglobin Data (58 out of 150 Patients)

Hb Range (g/dL)	Patients
3.5 – 4.5	8
4.6 – 5.5	15
5.6 – 6.5	22
6.6 – 7.5	28
7.6 – 8.5	30
8.6 – 9.5	20
9.6 – 10.5	14
10.6 – 11.5	8
11.6 – 12.5	5

The majority of patients (58 out of 150) had haemoglobin levels between 6.6 and 8.5 g/dL, indicating moderate anaemia. Only 13 patients had Hb levels above 11 g/dL, suggesting that normal haemoglobin values were rare in this population.

A linear regression analysis yielded the equation:

y=29.21−1.57xy = 29.21 - 1.57x

This model shows a negative correlation between haemoglobin levels and patient frequency, indicating that lower Hb levels are more prevalent.

IV. DISCUSSION

The findings from this study reveal a significant burden of anaemia among tribal children and women in Taloda. The peak concentration of patients in the 6.6–8.5 g/dL range aligns with the classification of moderate anaemia as per WHO standards. The presence of patients with Hb levels below 5.5 g/dL is particularly alarming, as it suggests severe anaemia, which can lead to fatigue, developmental delays in children, and increased maternal mortality.

➢ *Several Factors Contribute to this High Prevalence:*

- Nutritional Deficiencies: Diets in tribal communities are often cereal-based with limited intake of iron-rich foods like green leafy vegetables, legumes, and meat.
- Socioeconomic Constraints: Poverty and seasonal migration reduce access to consistent meals and healthcare.
- Healthcare Gaps: PHCs in the region are under-resourced, and iron supplementation programs are poorly implemented.
- Cultural Practices: Food taboos during pregnancy and menstruation further restrict iron intake.

The regression analysis supports the observation that as haemoglobin levels increase, the number of affected individual's decreases. This trend highlights the need for targeted interventions in the lower Hb brackets, where the risk of complications is highest.

V. CONCLUSION

This study underscores the critical public health challenge posed by anaemia in tribal populations of Taloda, Nandurbar district. With over 80% of the surveyed

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individuals falling below the normal haemoglobin threshold, there is an urgent need for:

- Strengthening iron supplementation programs.
- Promoting dietary diversity through community education.
- Enhancing healthcare infrastructure at the PHC level.
- Culturally sensitive outreach to address food taboos and gender disparities.

The data-driven insights and regression modeling provide a foundation for policymakers and health workers to prioritize interventions. Addressing anaemia in these communities is not only a medical necessity but a step toward improving overall quality of life and breaking the cycle of intergenerational malnutrition.

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