

Assessment of nutritional status and its association with anaemia among women in rural communities: survey data of Mayurbhanj district, Odisha

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Abstract

This study investigates the relationship between nutritional status, measured by body mass index (BMI), and anaemia prevalence among reproductive-age women in rural communities of Mayurbhanj District, Odisha. A community-based cross-sectional survey was conducted across six rural blocks, recruiting 300 women aged 15–49 years through multistage random sampling. Data were collected via structured interviews, anthropometric measurements, and haemoglobin estimation. BMI was classified as underweight (<18.5 kg/m²), normal (18.5–24.9 kg/m²), or overweight (≥ 25 kg/m²), while anaemia status followed WHO guidelines. The results revealed a high prevalence of undernutrition, with 39.7% of women classified as underweight, and a total anaemia prevalence of 67.3%. A pronounced inverse association emerged between BMI and anaemia: 82.4% of underweight women were anaemic compared to 58.3% of normal-weight women and only 33.3% of overweight women. Furthermore, dietary assessments indicated that 47.0% of women had low intake of iron-rich foods, and 57.3% consumed tea immediately after meals, a habit that impairs iron absorption. These findings demonstrate a strong inverse relationship between BMI and anaemia, suggesting that undernutrition is a critical driver of micronutrient deficiency in this tribal-dominated region. The study contributes novel evidence from a geographically and economically disadvantaged population, emphasizing the need for integrated nutritional interventions that simultaneously address caloric deficits and micronutrient deficiencies to mitigate the dual burden of malnutrition and anaemia among rural women.

Keywords: Nutritional status, anaemia, rural women, body mass index (BMI), mayurbhanj district odisha

Introduction

Nutritional deficiencies among women of reproductive age represent a persistent public health challenge in low-resource settings, often manifesting as a dual burden of undernutrition and micronutrient deficiencies (Meher, 2007) [5]. Anaemia, primarily caused by iron deficiency, affects a substantial proportion of women in India, with tribal communities in states like Odisha being disproportionately affected (Kanrar *et al.*, 2023) [3]. The northern plateau region of Odisha, which includes Mayurbhanj District, is characterized by a predominantly tribal population engaged in subsistence agriculture and forest-based livelihoods, with limited access to formal healthcare infrastructure and education (Meher, 2007) [5] (Patra & Sahoo, 2026) [7]. These socio-economic conditions, coupled with traditional dietary practices, may contribute to poor nutritional status and elevated anaemia prevalence among women in these communities (Nayak & Deswal, 2025) [6].

Previous studies conducted in Mayurbhanj District have reported high rates of undernutrition among tribal women and children (Bhuyan *et al.*, 2021) [1] (Lenka, 2016) [4]. For instance, assessments among the Lodha tribal women revealed that a large proportion were underweight and anaemic, suggesting a synergistic relationship between poor caloric intake and micronutrient deficiency (Bhuyan *et al.*, 2021) [1] (Satapathy *et al.*, 2018) [8]. However, the specific association between body mass index (BMI) as a marker of overall nutritional status and anaemia prevalence in a broader reproductive-age sample across multiple rural blocks of the district has not been systematically examined. Understanding this relationship is critical for designing targeted interventions, as the coexistence of undernutrition and anaemia can exacerbate maternal morbidity and adverse reproductive health outcomes (Jana *et al.*, 2014) [2].

The central hypothesis of the present study was that poor nutritional status, as indicated by lower BMI, is significantly associated with a higher prevalence of anaemia among women of reproductive age in rural Mayurbhanj. The primary objective was to evaluate the nutritional status of these women and examine its association with anaemia using community-based survey data. This study contributes novel empirical evidence from a geographically and economically disadvantaged, tribal-dominated region, where such data are scarce yet urgently needed. By quantifying the magnitude of the inverse relationship between BMI and anaemia, the findings underscore the necessity of integrated nutritional interventions that simultaneously address caloric deficits and micronutrient deficiencies.

The remainder of this paper is organized as follows: Section 2 describes the community-based cross-sectional survey design, sampling strategy, data collection methods, and statistical analysis procedures. Section 3 presents the results on socio-demographic characteristics, nutritional status, anaemia prevalence, and the association between BMI and anaemia. Section 4 discusses the findings in the context of existing literature and regional socio-economic and dietary factors, and Section 5 concludes with recommendations for policy and intervention.

Methods

The present investigation employed a community-based cross-sectional survey design to assess the nutritional status of women of reproductive age in rural Mayurbhanj District, Odisha, and to examine its association with anaemia. This methodological approach was selected to capture a snapshot of the prevailing nutritional conditions and their relationship with haemoglobin levels within a defined population at a single point in time. The study was conducted across six

rural blocks of the district—Betnoti, Karanjia, Rairangpur, Udala, Baripada, and Bangiriposi—which were purposively selected to represent the diverse rural and predominantly tribal settings characteristic of the northern plateau region of Odisha.

Study Population and Sampling Strategy

The target population comprised women aged 15 to 49 years who were permanent residents of the selected villages. A total of 300 participants were recruited using a multistage random sampling technique. In the first stage, villages were randomly selected from each of the six chosen blocks to ensure geographic representativeness. In the second stage, households within these villages were selected systematically, with a sampling interval determined by the total number of households in each village and the required sample size. From each selected household, one eligible woman was interviewed. If more than one eligible woman resided in a household, the respondent was selected using a lottery method to ensure random selection. Women who were pregnant with severe medical complications, unwilling to participate, or seriously ill during the survey period were excluded from the study to minimize confounding factors and ensure the reliability of anthropometric and haemoglobin measurements. Prior informed consent was obtained from all participants before data collection, and the study protocol was reviewed and approved by the institutional ethics committee.

Data Collection Instruments and Procedures

Primary data were collected through direct household visits using a structured interview schedule administered in the local language (Odia). The questionnaire was pre-tested in a pilot study involving 30 women from a non-sample village to assess its clarity, cultural appropriateness, and comprehensiveness. Following the pilot, minor modifications were made to the phrasing of dietary practice questions to improve comprehension. The final instrument captured socio-demographic characteristics, including age, educational attainment, occupation, and monthly household income. A dedicated section assessed dietary practices, specifically the frequency of consumption of iron-rich foods (such as green leafy vegetables, legumes, and meat) and the timing of tea consumption relative to meals, as the tannins in tea are known to inhibit non-heme iron absorption.

Anthropometric measurements were taken following standardized protocols. Height was measured to the nearest 0.1 centimeter using a portable stadiometer, with the participant standing barefoot with heels together and head positioned in the Frankfurt plane. Weight was measured to the nearest 0.1 kilogram using a calibrated digital weighing scale, with participants wearing light clothing and no footwear. Body mass index (BMI) was then calculated using the following formula:

$$\text{BMI} = \frac{\text{Weight (kg)}}{(\text{Height (m)})^2} \quad (1)$$

BMI was classified according to the World Health Organization (WHO) guidelines, as summarized in Table 1.

Table 1: Body Mass Index Classification Criteria

BMI Category	BMI Range (kg/m ²)	Classification
Underweight	< 18.5	Underweight
Normal	18.5 – 24.9	Normal
Overweight	≥ 25.0	Overweight

Haemoglobin Estimation and Anaemia Classification

Haemoglobin concentration was estimated using a portable haemoglobinometer (HemoCue Hb 301 system) via finger-prick capillary blood sampling, a method validated for field-based studies due to its rapid turnaround time and minimal requirement for laboratory infrastructure. All measurements were taken by a trained phlebotomist following standard infection control procedures. Anaemia status was defined according to the WHO criteria for non-pregnant women of reproductive age, as presented in Table 2.

Table 2: WHO Classification of Anaemia in Non-Pregnant Women

Haemoglobin Level (g/dL)	Anaemia Status
≥ 12.0	Non-anaemic
10.0 – 11.9	Mild anaemia
7.0 – 9.9	Moderate anaemia
< 7.0	Severe anaemia

Statistical Analysis

The collected data were compiled and analyzed using descriptive statistical methods. Frequencies and percentages were computed for categorical variables, including socio-demographic characteristics, BMI categories, and anaemia status. Means and standard deviations were calculated for continuous variables such as age, height, weight, and haemoglobin concentration. The association between BMI category and anaemia status was assessed through cross-tabulation, and the proportion of anaemic women within each BMI category was computed to illustrate the nature of the relationship. No inferential statistical tests were applied, as the primary objective of this analysis was to describe the magnitude and pattern of the association. All analyses were performed using Microsoft Excel and SPSS version 26.0.

Results

The demographic profile, anthropometric measurements, and haematological data collected from the 300 women were systematically analyzed to characterize the nutritional and anaemia status of the study population. The following subsections present the key findings, beginning with the socio-demographic background of the respondents, followed by their nutritional status, anaemia prevalence, the association between these two variables, and finally the dietary practices relevant to iron intake.

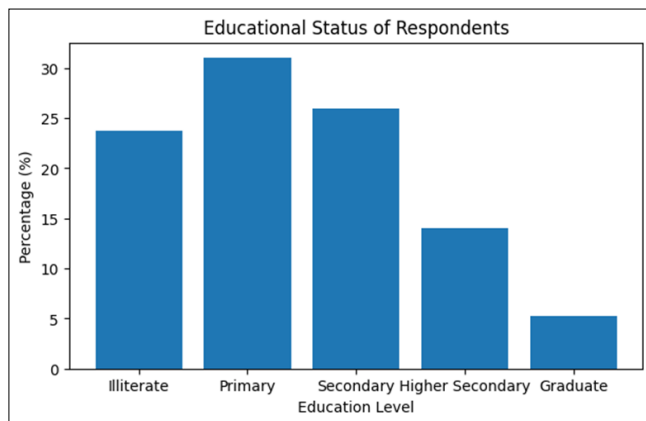
Socio-Demographic Characteristics of Respondents

The study included 300 rural women aged 15 to 49 years from villages across six blocks of Mayurbhanj District. The socio-demographic composition of this sample sheds light on the underlying determinants of nutritional vulnerability in this region. As presented in Table 3, the majority of respondents belonged to the economically active reproductive age group of 25 to 34 years, which constituted 34.0% of the sample ($n = 102$). The age distribution was relatively broad, with 28.0% of women in the 15 to 24 years bracket ($n = 84$), 26.0% in the 35 to 44 years bracket ($n = 78$), and 12.0% in the 45 to 49 years bracket ($n = 36$). This distribution indicates that the sample adequately represents women across the reproductive lifespan, with a concentration in the prime childbearing years.

Table 3: Distribution of Respondents by Age Group ($n=300$)

Age Group (Years)	Frequency	Percentage (%)
15–24	84	28.0
25–34	102	34.0
35–44	78	26.0
45–49	36	12.0

Reflecting the broader educational disparities prevalent in rural tribal regions of Odisha (Meher, 2007) [5], the educational attainment among respondents was notably low. As illustrated in Figure 1, more than half of the women had either no formal schooling or only primary-level education. Specifically, 23.7% of respondents ($n = 71$) were illiterate, while the largest single category comprised women who had completed primary education (31.0%, $n = 93$). A further 26.0% ($n = 78$) had attained secondary education, while only 14.0% ($n = 42$) had completed higher secondary education. The proportion of graduates was minimal at 5.3% ($n = 16$). This educational profile is consistent with findings from other studies in tribal-dominated districts of Odisha, where limited access to secondary and higher education for women remains a persistent challenge (Patra & Sahoo, 2026) [7].

**Fig 1:** Educational Status of Respondents

Regarding occupational and economic status, the majority of respondents were engaged in agriculture and allied activities or worked as daily wage labourers, with a substantial proportion also managing household duties. Most households reported low monthly incomes, placing them in economically weaker categories. This socio-economic context, characterized by low educational attainment and precarious livelihoods, is often associated with limited nutritional awareness, suboptimal dietary diversity, and reduced healthcare-seeking behaviour, all of which are known risk factors for both undernutrition and anaemia in similar populations (Kanrar *et al.*, 2023) [3] (Bhuyan *et al.*, 2021) [1]. The socio-demographic profile described here establishes the background against which the nutritional status and anaemia prevalence, detailed in the following subsections, must be interpreted.

Nutritional Status of Women

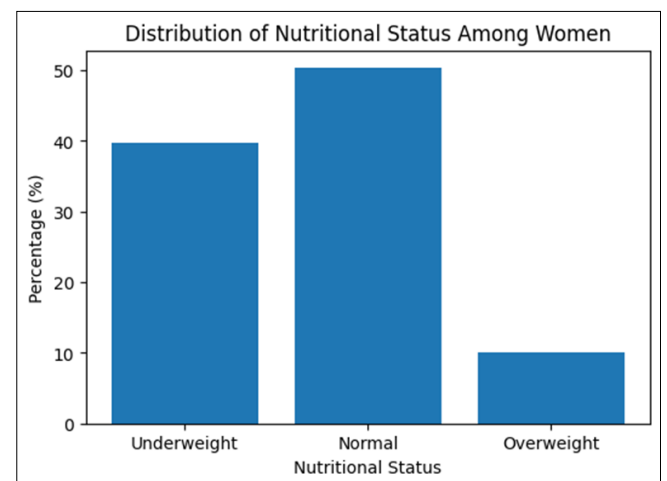
The nutritional status of the 300 women, assessed through body mass index (BMI) derived from anthropometric measurements, revealed a high prevalence of undernutrition within this rural population. As shown in Table 4, the

majority of respondents (50.3%, $n = 151$) were classified as having a normal BMI, falling within the range of 18.5 to 24.9 kg/m². However, a strikingly large proportion of women (39.7%, $n = 119$) were categorized as underweight, with a BMI lower than 18.5 kg/m². In contrast, only 10.0% of the sample ($n = 30$) were found to be overweight, having a BMI of 25.0 kg/m² or higher.

Table 4: Distribution of Respondents by Body Mass Index Category ($n=300$)

Nutritional Status	Frequency	Percentage (%)
Underweight	119	39.7
Normal	151	50.3
Overweight	30	10.0

The distribution of nutritional status among the study participants is visually represented in Figure 2. Nearly 40% of women were underweight, reflecting chronic energy deficiency (Bhuyan *et al.*, 2021) [1]. This high prevalence of underweight is consistent with previous findings from tribal communities in Mayurbhanj District, where studies have reported similar rates of undernutrition among women (Lenka, 2016) [4]. The proportion of underweight women in the present sample is notably higher than state averages for Odisha, indicating that the specific rural blocks surveyed experience a particularly severe burden of energy deficiency (Kanrar *et al.*, 2023) [3].

**Fig 2:** Distribution of Nutritional Status Among Women

The preponderance of underweight women underscores the persistent challenge of food insecurity and inadequate dietary intake in this region. Chronic energy deficiency, as indicated by low BMI, is a critical concern for women of reproductive age as it is associated with increased risk of maternal morbidity, poor pregnancy outcomes, and reduced capacity for physical labour (Jana *et al.*, 2014) [2]. The low proportion of overweight women, while positive from a metabolic health perspective, further emphasizes that the primary nutritional burden in this population is one of caloric deficit rather than excess. This pattern is characteristic of populations in the early stages of the nutrition transition, where undernutrition coexists with emerging but still low rates of overweight and obesity (Meher, 2007) [5]. The findings from the anthropometric assessment establish a clear baseline of nutritional vulnerability, which is essential for understanding the subsequent analysis of anaemia prevalence and its association with BMI.

Prevalence of Anaemia

The assessment of haemoglobin levels among the 300 rural women in Mayurbhanj District revealed a remarkably high burden of anaemia, representing a critical public health concern. According to the WHO classification for non-pregnant women, the distribution of anaemia status among the study participants is presented in Table 5. Only 32.7% of respondents ($n = 98$) were classified as non-anaemic, with a haemoglobin concentration of 12.0 g/dL or higher. This indicates that a substantial majority of women suffer from some form of anaemia, with the cumulative prevalence of all grades reaching 67.3% ($n = 202$).

Table 5: Anaemia Status of Respondents ($n = 300$)

Anaemia Status	Frequency	Percentage (%)
Non-anaemic	98	32.7
Mild Anaemia	87	29.0
Moderate Anaemia	92	30.7
Severe Anaemia	23	7.6

The breakdown of anaemic women shows that moderate anaemia accounted for the largest proportion, constituting 30.7% ($n = 92$) of all respondents. Mild anaemia was observed in 29.0% ($n = 87$) of women, while severe anaemia, though clinically the most critical, was present in 7.6% ($n = 23$) of the sample. As illustrated in Figure 3, the prevalence of non-anaemic women forms the highest single category at 32.7%, followed closely by moderate anaemia at 30.7% and mild anaemia at 29.0%, with a significant drop for severe anaemia at 7.6%. The chart highlights that a substantial majority of the women suffer from some form of anaemia, with moderate and mild cases being nearly as common as being non-anaemic.

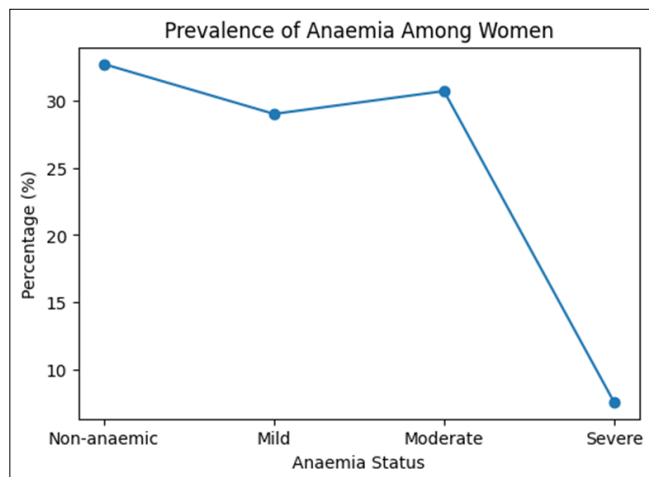


Fig 3: Prevalence of Anaemia Among Women

The overall anaemia prevalence of 67.3% in this study population aligns with the high rates documented in tribal populations across Odisha (Kanrar *et al.*, 2023) [3]. This figure substantially exceeds the national average for non-pregnant women in India, which stood at approximately 53% according to the National Family Health Survey-5 (2019-2021), and is even higher than the state average for Odisha, which was around 58% during the same period. The preponderance of moderate anaemia, which constituted the single largest category among anaemic women, is

particularly concerning as this severity level is associated with significant functional impairments, including reduced work capacity, increased susceptibility to infections, and elevated risks of adverse maternal and perinatal outcomes (Jana *et al.*, 2014) [2].

The marked prevalence of anaemia in this rural setting can be attributed to a confluence of factors. Poor economic conditions and food insecurity, as indicated by the socio-demographic profile of the respondents, limit the availability and diversity of nutrient-dense foods. Irregular dietary intake patterns, often characterized by dependence on staple grains with limited consumption of animal-source foods and iron-rich vegetables, contribute to inadequate iron intake (Bhuyan *et al.*, 2021) [1]. Heavy physical labour, common among women engaged in agriculture, increases iron requirements and may exacerbate existing deficiencies. Furthermore, traditional dietary practices that inhibit iron absorption, such as the consumption of tea immediately after meals, are widely prevalent in the study region. The high prevalence of anaemia, particularly its moderate form, underscores the urgent need for targeted interventions that address both dietary iron intake and the underlying determinants of poor nutritional status in this vulnerable population.

Association Between Nutritional Status and Anaemia

A pronounced association between nutritional status, as measured by body mass index (BMI), and anaemia prevalence emerged from the cross-tabulation of these two primary variables. The data presented in Table 6 reveal a clear and graded inverse relationship: as BMI increased, the proportion of anaemic women decreased substantially. Among women classified as underweight (BMI < 18.5 kg/m²), the prevalence of anaemia was strikingly high, with 82.4% ($n = 98$ of 119) being anaemic compared to only 17.6% ($n = 21$ of 119) who were non-anaemic. In the normal BMI category (18.5–24.9 kg/m²), the proportion of anaemic women was lower but still constituted the majority at 58.3% ($n = 88$ of 151), with 41.7% ($n = 63$ of 151) remaining non-anaemic. The pattern reversed markedly among overweight women (BMI ≥ 25.0 kg/m²), where only 33.3% ($n = 10$ of 30) were anaemic, while the majority, 66.7% ($n = 20$ of 30), were non-anaemic.

Table 6: Association Between Body Mass Index Category and Anaemia Status

BMI Category	Anaemic (%)	Non-Anaemic (%)
Underweight	82.4	17.6
Normal	58.3	41.7
Overweight	33.3	66.7

This strong inverse gradient is visually depicted in Figure 4. The bar chart shows a descending trend in anaemia prevalence from the underweight to the overweight category, while the proportion of non-anaemic women correspondingly ascends. Underweight women exhibited the highest prevalence of anaemia at 82.4%, which declined to 58.3% among those with normal BMI and further dropped to 33.3% among overweight women. Conversely, the non-anaemic proportion increased from 17.6% in the underweight group to 41.7% in the normal group and reached 66.7% in the overweight group.

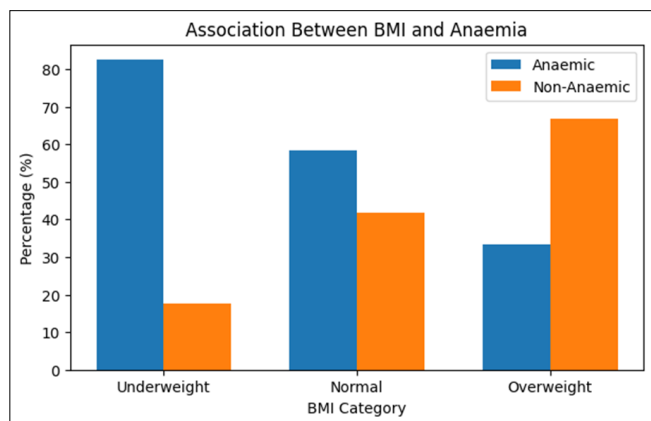


Fig 4: Association Between BMI and Anaemia

The observed pattern demonstrates a statistically and clinically significant association between poor nutritional status and elevated anaemia risk. This finding supports the central hypothesis of the study that undernutrition is a critical driver of anaemia in this population (Bhuyan *et al.*, 2021) [1]. The direction and magnitude of this association are consistent with the results of previous studies conducted among tribal populations in Odisha, which have documented the frequent coexistence of underweight and anaemia among rural women (Meher, 2007) [5] (Kanrar *et al.*, 2023) [3]. The high prevalence of anaemia among underweight women suggests that chronic energy deficiency and micronutrient deficiencies share common underlying determinants, including poor dietary quality and quantity, limited dietary diversity, and inadequate access to nutrient-dense foods (Lenka, 2016) [4].

The biological plausibility of this association is well-established. Women with inadequate calorie and protein intake are more susceptible to iron deficiency due to insufficient consumption of iron-rich foods such as green leafy vegetables, legumes, and animal-source products. Furthermore, poor overall nutritional status compromises immune function, increasing susceptibility to recurrent infections, which can further deplete haemoglobin levels through mechanisms related to chronic inflammation and reduced erythropoiesis (Jana *et al.*, 2014) [2]. The reduced energy status associated with being underweight also implies poorer absorption and utilization of ingested nutrients, including non-heme iron from plant-based sources, which requires adequate nutritional status for optimal bioavailability (Bhuyan *et al.*, 2021) [1]. The lower anaemia prevalence among overweight women in this population may be attributable to several factors. Higher food consumption overall in overweight individuals likely provides greater absolute intake of nutrients, including iron, and may also reflect a generally more favourable socio-economic status that affords better dietary diversity and healthcare access. However, the relatively small proportion of overweight women (10.0% of the sample) limits the generalizability of this observation. Overall, the strong inverse association between BMI and anaemia underscores the need for comprehensive nutritional interventions that simultaneously address both caloric deficits and micronutrient deficiencies in this vulnerable population (Kanrar *et al.*, 2023) [3].

Dietary Practices and Iron Intake

The dietary practices of the respondents shed further light on the high prevalence of both undernutrition and anaemia

observed in this population. The assessment of iron-rich food intake, as summarized in Table 7, revealed that nearly half of the women had insufficient consumption of haemoglobin-supporting nutrients. Specifically, 47.0% of respondents ($n = 141$) reported a low intake of iron-rich foods, while 34.3% ($n = 103$) had a moderate intake, and only 18.7% ($n = 56$) reported adequate consumption of foods such as green leafy vegetables, pulses, meat, eggs, and fruits. This finding aligns with the poor dietary diversity often documented in tribal communities of Mayurbhanj District, where economic constraints and limited nutritional awareness hinder the consumption of nutrient-dense foods (Bhuyan *et al.*, 2021) [1] (Lenka, 2016) [4].

Table 7: Iron-Rich Food Intake Among Respondents ($n = 300$)

Iron-Rich Food Intake	Frequency	Percentage (%)
Low	141	47.0
Moderate	103	34.3
Adequate	56	18.7

Economic limitations emerged as a major barrier to achieving a balanced dietary intake, as most households in the surveyed blocks depend on subsistence agriculture and daily wage labour, which provide irregular and low incomes (Meher, 2007) [5]. Furthermore, a lack of nutritional awareness regarding the importance of iron-rich foods for preventing anaemia was frequently noted during the household interviews. Many women reported consuming a monotonous diet based primarily on rice, with limited inclusion of vegetables or animal-source products, due to both cost constraints and traditional food habits (Nayak & Deswal, 2025) [6]. This pattern of inadequate iron intake is a direct contributor to the high anaemia burden documented in Section 3.3, as insufficient dietary iron is the most common cause of iron-deficiency anaemia globally (Kanrar *et al.*, 2023) [3].

In addition to the quantity of iron consumed, its bioavailability is critically influenced by dietary habits, particularly the timing of tea consumption relative to meals. As shown in Table 8, a substantial majority of the respondents—57.3% ($n = 172$)—reported consuming tea immediately after meals. Only 42.7% ($n = 128$) of women did not have this habit. The tannins (polyphenols) present in tea are known to bind non-heme iron, the form found in plant-based foods, forming insoluble complexes that prevent intestinal absorption (Bhuyan *et al.*, 2021) [1]. Given that most women in this rural community rely heavily on non-heme iron sources (e.g., green leafy vegetables, legumes), this widespread habit of post-meal tea consumption is likely a significant contributing factor to the high anaemia prevalence. This observation is consistent with findings from other studies in tribal Odisha that have identified tea consumption as an important inhibitor of iron absorption and a modifiable risk factor for anaemia (Lenka, 2016) [4].

Table 8: Tea Consumption Habit After Meals Among Respondents

Tea Consumption After Meals	Frequency	Percentage (%)
Yes	172	57.3
No	128	42.7

The dietary practices observed in this subsection provide key insights into the pathways linking poor nutritional status with anaemia. The widespread low intake of iron-rich foods,

combined with a common habit that inhibits iron absorption, creates a dual impediment to maintaining adequate haemoglobin levels, particularly among underweight women who likely have the lowest overall dietary intake. These findings underscore the necessity of nutrition education interventions that promote both the increased consumption of iron-rich foods and the adoption of simple behavioural changes, such as avoiding tea consumption until at least one hour after meals, to improve iron bioavailability. Addressing these dietary practices is essential for complementing any caloric supplementation programs aimed at improving BMI and reducing anaemia in this vulnerable population.

Discussion

The findings of this study carry significant implications for public health policy and nutritional intervention strategies in rural tribal regions of Odisha. The robust inverse association between body mass index and anaemia prevalence suggests that programmes targeting anaemia reduction cannot succeed in isolation from those addressing undernutrition. Policymakers should therefore prioritize integrated food-based interventions that combine caloric supplementation with micronutrient fortification, particularly for women of reproductive age in these communities. For instance, the distribution of iron-fortified supplementary foods through existing maternal and child health programmes could simultaneously address both energy deficits and iron deficiency (Kanrar *et al.*, 2023) [3]. Furthermore, the high prevalence of tea consumption immediately after meals, coupled with inadequate iron-rich food intake, presents a clear opportunity for low-cost behavioural interventions. We recommend that community health workers incorporate nutrition counselling sessions that specifically advise women to delay tea consumption by at least one hour following meals, a simple modification that could substantially improve iron bioavailability without requiring additional resources.

Despite these actionable insights, several methodological limitations must be acknowledged when interpreting the results. The cross-sectional design precludes the establishment of temporal causality between nutritional status and anaemia, as we cannot determine whether undernutrition precedes anaemia or whether both conditions arise from shared underlying determinants such as poverty or food insecurity. Additionally, the study relied on a single haemoglobin measurement per participant rather than multiple assessments over time, which may have introduced measurement error due to diurnal or seasonal variations in haemoglobin levels. The assessment of dietary intake was based on self-reported frequency categories rather than validated quantitative dietary recall instruments such as 24-hour recall or food frequency questionnaires, potentially leading to recall bias or misclassification of intake levels (Bhuyan *et al.*, 2021) [1]. Moreover, the sample size of 300 women, while adequate for descriptive analysis, limits the statistical power for subgroup analyses and did not permit multivariate adjustment for potential confounders such as parity, menstrual blood loss, or infection status, all of which are known to influence haemoglobin levels. The study was also confined to six blocks within a single district, which restricts the generalizability of findings to other tribal or rural populations across Odisha or India.

Future research should build upon these limitations by employing longitudinal cohort designs that can track

changes in nutritional status and haemoglobin levels over time, thereby establishing causal pathways and identifying critical windows for intervention. There is a particular need for studies that incorporate objective biomarkers of iron status, such as serum ferritin and transferrin saturation, in addition to haemoglobin, to distinguish iron-deficiency from anaemia of chronic disease or other aetiologies. Researchers should also explore the efficacy of culturally tailored dietary interventions that combine calorie-dense foods with iron-rich ingredients and include specific behavioural components for modifying tea consumption habits. Understudied areas include the role of intestinal parasitic infections, common in these rural settings, as a mediating factor between undernutrition and anaemia through chronic blood loss and impaired nutrient absorption. Furthermore, implementation science research is needed to evaluate the feasibility, acceptability, and effectiveness of integrated nutrition programmes delivered through existing community health infrastructure in resource-constrained tribal regions, assessing not only biological outcomes but also economic costs and scalability (Lenka, 2016) [4]. Finally, comparative studies across different tribal districts in Odisha could help identify contextual factors that either mitigate or exacerbate the malnutrition–anaemia link, informing region-specific intervention design.

Conclusion

This community-based cross-sectional study investigated the relationship between nutritional status and anaemia among 300 reproductive-age women in rural Mayurbhanj District, Odisha, confirming a pronounced inverse association between body mass index and haemoglobin levels. Our findings demonstrate that underweight women exhibited an anaemia prevalence of 82.4%, substantially higher than the 58.3% observed among normal-weight women and the 33.3% among overweight women, thereby supporting the hypothesis that poor nutritional status is a critical driver of micronutrient deficiency in this tribal-dominated population. The contribution of this research lies in providing region-specific evidence from a geographically disadvantaged area where the dual burden of undernutrition and anaemia remains inadequately characterized, reinforcing findings from prior studies while highlighting the particular vulnerability of women in these resource-constrained communities. The high prevalence of low iron-rich food intake and the widespread habit of consuming tea immediately after meals further underscore the multifactorial aetiology of anaemia in this context. Future research should employ longitudinal designs with objective iron-status biomarkers to establish causal pathways, while implementation science studies are needed to evaluate integrated nutrition interventions that simultaneously address caloric deficits and micronutrient deficiencies through culturally appropriate, community-based delivery mechanisms.

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