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Dietary Diversity and Nutritional Status of the *Oraon* Tribal Women: An Anthropometric Measurement Approach

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HIGHLIGHTS

- Despite having wide agrobiodiversity, Oraon tribal women are deprived of dietary diversity and district-wise significant differences in achieving minimum dietary diversity highlighted the variation in dietary intake over a 24-hour recall.
- The emergence of obesity and prevalence of undernutrition were observed, indicating that Oraon women face a double burden of malnutrition.
- A strong positive association was observed between BMI and MUAC, underscoring that MUAC can be employed instead of BMI.

ARTICLE INFO

Keywords: *Oraon* tribal women, Nutritional status, Dietary diversity, Anthropometry, Body mass index, Undernutrition, Malnutrition.

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ABSTRACT

The study was conducted among the *Oraon* tribal women of Chhota Nagpur Plateau, comprising Jharkhand and Chhattisgarh, during 2024-25. Using multi-stage random sampling, 400 respondents were selected. The data concerning dietary diversity was collected using a structured interview schedule. Anthropometric measurement tools, including BMI and MUAC, were employed to measure nutritional status. Only 22 per cent of the respondents met the minimum dietary diversity criteria, and 78 per cent of women had an inadequate nutritional intake, eating less than five defined food groups. A Welch's ANOVA test highlighted significant variation in dietary intake across selected districts. Only 37.75 per cent of the women had normal BMI, whereas 48.75 per cent were affected by chronic energy deficiency, and a transition towards obesity was evident. 73.50 per cent of women were in the undernutrition category, defined by a MUAC cut-off below 22.8 cm. A comparison of nutritional status across selected districts highlighted no significant difference. The Pearson correlation analysis indicated a significant positive relationship between BMI and MUAC. The findings highlighted the efforts to address malnutrition in *Oraon* tribal women and enhance women's nutritional outcomes through kitchen gardening, nutrition-sensitive agriculture, and effective implementation of government nutrition programs.

INTRODUCTION

India continues to be the biggest contributor to worldwide malnutrition rates, accounting for the vast majority of the world's undernourished population. On the other side, the country is seeing a progressive increase in overweight/obesity (Prithishkumar et al., 2024). In India, malnutrition is manifested in a vicious cycle, where childhood malnutrition continues into adulthood and is subsequently passed on to the next generation (Majumder, 2022). According to the NFHS-5 report, 24 per cent of adult women are overweight, 19 per cent of women are underweight, and about 57 per cent of women of reproductive age (WRA) are anaemic in India. The

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proportion of overweight or obese women increased from 21 per cent in 2015-16 to 24 per cent in 2019-21. Dietary diversity assures an appropriate consumption of essential nutrients required for better health. Higher dietary diversity leads to better anthropometric outcomes and overall nutritional well-being. The dietary diversity for women is measured by Minimum Dietary Diversity for Women (MDD-W), which is a global nutrition indicator used to assess whether a woman's diet is likely to meet her micronutrient needs (FAO, 2021).

As per the 2011 census, approximately 104 million tribal people (8.6%) of the country's total population reside in India. They continue to rely primarily on subsistence agriculture for their livelihood and rank among the most marginalised regarding socio-economic development, nutrition, and health. Women have contributed significantly to the socioeconomic advancement of the nation as a whole and the family in particular. Indigenous women play a crucial role in livelihood security by performing triple roles, including child rearing, household and agricultural work, and community development work. They contribute to the local economy through their involvement in subsistence activities. Yet, they are susceptible to numerous forms of malnutrition. Although malnutrition affects all segments of India's indigenous population, indigenous women and children are particularly vulnerable (Shamna et al., 2018; Kapoor et al., 2022).

Balanced food consumption and appropriate nutrient utilisation maintain a normal nutritional status. This indicates that an inadequate pattern of vitamin and mineral intake leads to malnutrition. WRA are particularly at risk for nutritional deficiencies because of the physiological demands of pregnancy and lactation (Kandel et al., 2024). In the tribal population, several factors contribute to the appallingly low nutritional intake. Traditional gender norms can increase women's susceptibility to malnutrition by limiting their access to food, education, and financial resources. Despite food availability, women may eat less or last than other family members due to cultural norms and intra-household food allocation procedures. The consequences of these vulnerabilities are severe (Ariyo et al., 2025). Consuming a varied diet is the greatest way to achieve dietary sufficiency because rich sources of several macro- and micronutrients can be found in different food groups. Indigenous women and children have poor nutritional status, despite considerable agrobiodiversity. Indigenous women achieved an average dietary diversity score of 4.22, which indicates poor intake. Among the women, only roughly one-third (37.3%) achieved a minimum dietary diversity of five or more food groups consumed in a day (Nongrum et al., 2022; Chakona & Shackleton, 2017).

METHODOLOGY

A large proportion of the total population comprises tribal people in Chhattisgarh (30.60%) and Jharkhand (26.20%), which are part of the Chhota Nagpur Plateau; therefore, these states were selected purposively. Additionally, these states have a high concentration of the Oraon tribal population, with 7,48,789 in Chhattisgarh and 17,16,618 in Jharkhand (Census, 2011). For district selection, five Oraon-dominant districts were identified in each state based on 2011 Census data. From these, two districts were randomly selected from each state for the study, namely Jashpur and Surguja in Chhattisgarh, and Ranchi and Gumla in Jharkhand. Two blocks were randomly selected from each of the four districts. Specifically, two blocks were selected from Ranchi district (out of 18 total blocks) and two from Gumla district (out of 12 total blocks) in Jharkhand state; similarly, two blocks were selected from Jashpur district (out of 8 total blocks) and two from Surguja district (out of 7 total blocks) in Chhattisgarh state, totalling eight blocks. Two villages from each block, totalling 16 villages, were selected randomly. From each village, 25 WRA were selected randomly to enhance sample representativeness, thus comprising 400 respondents. The MDD-W, a guideline given by FAO (2021), was used to measure the dietary diversity of women, using the 24-hour dietary recall method. It contains 10 defined food groups, which are 1. Grains, white roots and tubers, and plantains, 2. Pulses (beans, peas, and lentils), 3. Nuts and seeds, 4. Milk and milk products, 5. Meat, poultry, and fish, 6. Eggs, 7. Dark green leafy vegetables, 8. Other vitamin A-rich fruits and vegetables, 9. Other vegetables, 10. Other fruits. This was incorporated into a structured interview schedule to collect data from women on the foods and beverages they consumed the previous day. 'Yes' or 'No' answers were recorded when women from the specified food categories were asked to recollect every food item they had eaten a day earlier. A 'yes' response received a '1' score, while a 'no' response received a '0'. The dietary diversity score was calculated by summing these scores for each Oraon woman, then categorized as either adequate or inadequate dietary diversity. Women with a diversity score of fewer than 5 were considered to have inadequate dietary diversity. In contrast, those with scores from 5 to 10 were considered to have acceptable dietary diversity, following the FAO (2021) guideline.

The following formula was used to determine the proportion of WRA who consumed food or beverages from five or more food groups on the preceding day:

$$\text{Percentage of WRA meet MDD} = \frac{\text{Foods and beverages consumed by WRA from} \geq \text{five food groups during the previous day}}{\text{Total number of WRA surveyed}} \times 100$$

Nutritional status was measured using the most significant and reliable proxy indicators, namely Body Mass Index (BMI), Mid-Upper Arm Circumference (MUAC). The anthropometric measurement tools, including a measuring tape and a weighing scale, were used. BMI, an indicator of body fat based on height and weight, was computed by dividing each woman's weight (kg) by the square of her height (m). The classification of respondents based on BMI followed the criteria given by WHO (2000) for the Asian population. MUAC is a well-established measure of nutritional status. It is a sign of protein-energy deficiency and a reliable and simple tool for assessing nutritional status. MUAC was measured at the midpoint between the acromion of the scapula and the olecranon of the ulna. The respondents were categorized based on the criteria given by Tonder et al. (2019). A Welch's ANOVA test (unequal variance) was employed to analyse the differences in dietary diversity and nutritional status across the selected districts using the statistical software Jamovi (version 2.2.5). To check the association between BMI and MUAC, Pearson correlation analysis was employed using statistical software SPSS (version 26).

RESULTS

Distribution of *Oraon* tribal women based on MDD-W

The prevalence of MDD-W shows that less than half (22%) of WRA who achieved a minimum of five foods from the 10 defined groups indicated higher micronutrient adequacy. The majority (78%) of the respondents consumed fewer than five food groups, indicating poor dietary diversity and a reliance on monotonous diets with limited nutrient variety. This implies that only 22 per cent of women had higher micronutrient intake levels, whereas 78 per cent had insufficient consumption, which indicates micronutrient deficiency. About 19.75 per cent of the respondents reported consuming five to six food groups, reflecting a moderate level of dietary diversity and suggesting some improvement towards balanced food intake. 24-hour dietary recall indicated that the women's diets were dominated by staple foods such as rice, along with pulses including pigeon pea and black gram. Consumption of dark green leafy vegetables was common but limited due to their particular seasonal availability, with most varieties being locally available indigenous species. The diet also included indigenous aquatic foods, particularly snails and fish. Red-fleshed mammal's meat and poultry were occasionally consumed. Fruits consumed during the recall period were largely obtained from forest sources and formed part of the non-timber forest products (NTFPs) traditionally gathered by the community. In contrast, foods such as nuts and seeds, milk and milk products, eggs, processed meat, organ meats, and vitamin A–rich food items were consumed rarely and almost non-existent. Overall, the results highlight that the dietary diversity among the respondents was generally low, indicating micronutrient inadequacy, with a large proportion of the respondents being nutritionally vulnerable and micronutrient-deficient due to limited access to or consumption of diverse food items. Figure 1 illustrates the number of WRA who met the MDD-W across four districts. Ranchi had the largest number of women with MDD-W (31), followed by Jashpur (27). Gumla reported a moderate level (18), while Surguja had the fewest number of women with MDD-W (12).

Welch ANOVA result in Table 1 & Figure 2 indicated variations in both the average score and the distribution of scores across the districts. The study found a significant difference at the 1% level of significance in mean MDD-W scores across districts F_{welch} (3, 218.7) = 4.50, p = 4.36 × 10⁻³), indicating that dietary diversity among women varies notably across the study locations. The effect size (η^2 = 0.06) suggests a small-to-moderate practical significance. Ranchi exhibited the highest mean MDD-W score (4.02), suggesting the best average dietary diversity, while Gumla recorded the lowest mean score (3.65). The violin shapes indicate that scores range widely, from approximately 2 to 7, suggesting significant individual variability in dietary diversity within every district.

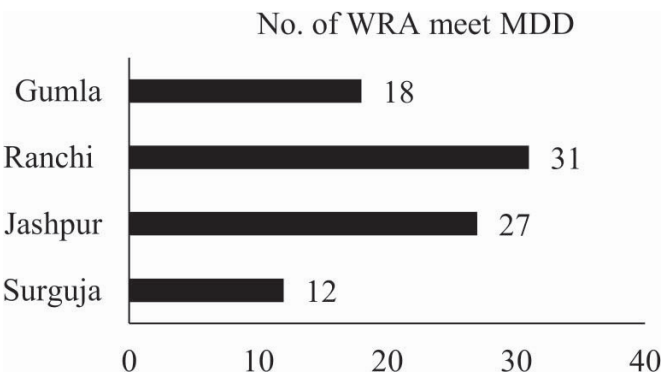

Figure 1. Bar graph representation of MDD-W among the respondents across the districts

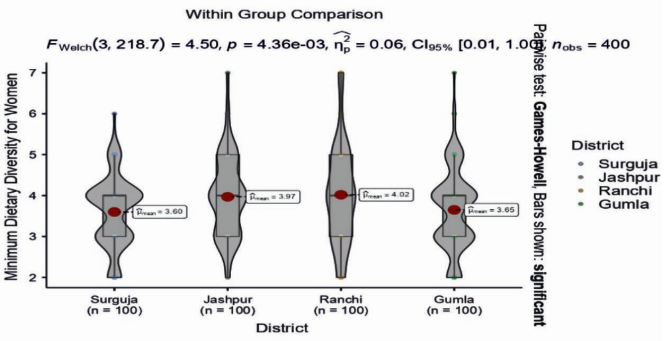

Figure 2. Violin plot depiction of MDD-W among women across selected districts

Table 1. Test Summary of MDD-W comparison across the selected districts

Component	Details of the test
Test Name	Welch's ANOVA
Test Statistics	F (3, 218.7) = 4.50
p-value	4.36×10^{-3} =0.00436 (significant at 1% level of significance)
Effect Size	Partial eta squared (η^2_p) = 0.06

Categorization and distribution of *Oraon* tribal women based on BMI & MUAC

The nutritional status results in Table 2 revealed that nearly half of the respondents (48.75%) were classified as underweight (BMI <18.5), indicating a high prevalence of chronic energy deficiency. Only 37.75 per cent of the women fell within the normal BMI range (18.5–22.9). In contrast, the proportion of women who were overweight or obese was relatively low. Only 8.25 per cent of the respondents were categorized as overweight (BMI 23.0–24.9), while 4.50 per cent were found to be in Obesity Class I (BMI 25.0–29.9). A very small proportion (0.75%) fell under Obesity Class II (BMI ≥30). The findings indicate that undernutrition remains a significant concern among Oraon tribal women, with half suffering from chronic energy deficiency (CED). The predominance of underweight women aligns with broader nutritional patterns observed among tribal communities in India, where socio-economic constraints, limited dietary diversity, and inadequate access to health and nutrition services contribute to persistent undernutrition. The statistical analysis, a Welch's ANOVA, revealed that the overall difference in mean BMI across the districts was not statistically significant (Figure 3).

The Oraon women's nutritional status based on MUAC, as shown in Table 3, revealed a highly skewed distribution toward undernutrition. The majority of respondents, comprising 73.50 per

Table 2. Categorization and Distribution of Respondents Based on the Nutritional Status Indicator Body Mass Index

Category	Asian BMI Classification	Percentage
Underweight	< 18.5	48.75
Normal weight	18.5 – 22.9	37.75
Overweight	23.0 – 24.9	8.25
Obesity class I	25.0 – 29.9	4.50
Obesity class II	≥30.0	0.75
Total		100

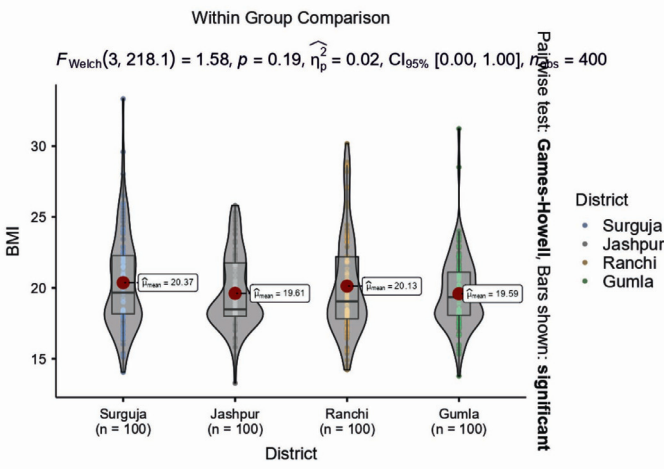

Figure 3. Violin plot depiction of BMI among the women across selected districts

Table 3. Categorization and Distribution of Respondents Based on Mid-Upper Arm Circumference

MUAC cut off* (cm)	MUAC Tertiles Categories	Percentage
Below (<) 22.8	Undernutrition	73.50
22.8-25.4	Normal	21.00
Above (>) 25.5	Obese	5.50
Total		100

cent, were in the undernutrition category, defined by an MUAC below 22.8 cm. In contrast, only 21.00 per cent are classified as normal with an MUAC between 22.8–25.4 cm. Only 5.50 per cent of the respondents were categorized as obese, defined as having an MUAC above 25.5 cm, indicating a transition from traditional diets to processed and calorie-dense foods, contributing to weight gain. It indicates a serious public health concern of widespread undernutrition in this tribe. From Figure 4, it is evident that MUAC values did not show any statistically significant differences across the four selected districts.

Association between BMI and MUAC

Pearson correlation analysis between BMI and MUAC in Oraon tribal women indicated a strong, positive, and statistically significant association (Table 4). This high correlation indicates that MUAC can serve as a reliable proxy for assessing women's nutritional status, although the cut-off values differ. The measure is particularly useful in field conditions where obtaining accurate height and weight data for BMI may not be feasible.

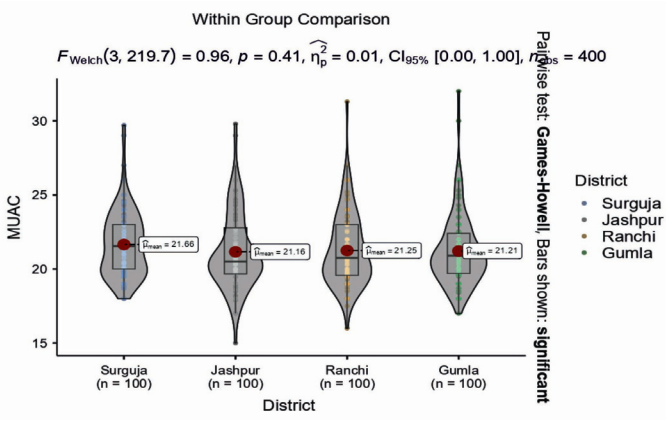

Figure 4. Violin plot depiction of MUAC among the women across selected districts

Table 4. Relationship between BMI and MUAC among Oraon women

Variables		BMI	MUAC
BMI	Pearson Correlation	1	.766**
	Sig. (2-tailed)		0.000
	N	400	400
MUAC	Pearson Correlation	.766**	1
	Sig. (2-tailed)	0.000	
	N	400	400

**Correlation is significant at the 0.01 level (2-tailed).

DISCUSSION

The prevalence of specific MDD-W food group consumption was evaluated in the study, and found that only 22 per cent of WRA were meeting nutritional adequacy, indicating that most WRA were unable to maintain diverse food intake. Dietary diversity significantly influences nutritional status, and failing to achieve minimum diversity can lead to malnutrition issues. This finding supports the findings of Ghosh-Jerath et al. (2018) that Oraon tribal women have a significant rate of undernutrition despite having extensive knowledge of the nutrient-dense native foods, and consumption of these foods was low. There was notable variation in dietary diversity among the selected districts. The Oraon tribe's diet was inadequate in all recommended food groups. Cereal consumption was the least deficient, whereas milk and fruit consumption were almost non-existent. The intake of green leafy vegetables was notably inadequate and was largely limited to a few lesser-known, locally available varieties. Among these, *dheki saag,* a type of edible fern cultivated alongside roots and tubers in household kitchen gardens, was commonly consumed. Substantial gaps were observed in the consumption of milk, a diverse range of vegetables (particularly green leafy varieties), and fruits (Mittal & Srivastava, 2006). Khadatkar et al. (2024) also indicated that poor micronutrient intake in relation to work activity leads to poor health. To tackle this issue, Kumbhare et al. (2023) suggested that healthy habits of nutritious food consumption should be promoted to achieve food security and improve nutritional security at the household level by promoting nutri-gardens and nutri-sensitive agricultural practices.

A significant proportion of Oraon tribal women are undernourished, indicating inadequate dietary diversity and a lack of nutritional awareness. This finding also reflects gendered nutritional inequality caused by factors such as intrahousehold food disparity, resource utilization gaps, and lack of agency, which lead to an intergenerational cycle of malnutrition. The findings support those of Ghosh-Jerath et al. (2018), who reported that women face various degrees of CED and underweight, indicating a high prevalence of CED. It has been noted that the Oraon tribe suffers high rates of CED and malnutrition. Monika et al. (2018) also highlighted that tribal women are more vulnerable to malnutrition, and they are a weaker part of society that has struggled in all aspects. Their BMI and nutritional intake are significantly lower than those of the reference women. More work must be done at the local level to uplift the tribal women's condition, whether it is awareness about nutrition, health, education, or male dominance in society. Majumder (2022) also pointed out that the primary reason for undernourishment among tribal women is household food insecurity and low caloric intake. Furthermore, he recommended addressing malnutrition with a lifecycle approach, ongoing behavior change communication, and effective enactment programs to increase food security and purchasing power. Kapoor et al. (2022) found that the prevalence of CED was significantly higher among tribal women than among rural women. Undernutrition was evident as a high proportion of Oraon tribal women with low MUAC 73.50 per cent, was observed in the study area. This supports Bhattacharya et al. (2019), who found a 64.90 per cent prevalence of undernutrition based on MUAC among Oraon tribal women. Women's nutritional status is crucial for identifying deficiencies and deploying effective nutritional interventions. To address the alarming rates of undernutrition, chronic energy malnutrition, and micronutrient deficiency among women, programs must be implemented with greater emphasis and commitment. Targeted interventions should focus on improving awareness of food choices and encouraging the cultivation of nutrient-dense crops, including leafy vegetables and pulses. Furthermore, the consumption of millets alongside staple cereals, as well as indigenous foods, should be encouraged among the tribal community, especially among women. Policies and nutrition programs to overcome the nutritional gap in tribal women by enhancing dietary diversity, orienting extension services toward women, are also essential (Priyanka et al., 2024; Mishra et al., 2025; Sekhri et al., 2025; Khadatkar et al., 2024).

It was found that BMI and MUAC had a strong, positive, and significant relationship. This finding is aligned with Rohini et al. (2025), who found a strong positive correlation between MUAC and BMI in both men and women across the three survey periods using NFHS data. Also, they highlighted that MUAC is commonly employed in nutritional surveillance, particularly in low-resource settings, but BMI remains the standard measure for measuring adult nutritional status. The MUAC is a reliable instrument for identifying malnutrition. Since MUAC and BMI are well correlated, MUAC can be used as a complement or substitute for the same in certain situations. MUAC has various benefits, such as measurement convenience, minimal logistical support, and accuracy. It may also test nutritional status in geographically isolated places (Benítez Brito et al., 2016; Negi et al., 2024; Das et al., 2020; Salih et al., 2023).

CONCLUSION

The study reveals chronic energy malnutrition, micronutrient deficiency, and the emerging trend of obesity among Oraon women. This implies that, due to being socio-economically disadvantaged and facing gendered nutritional inequality, women continue to suffer from an intergenerational cycle of malnutrition. The majority of women consuming less than 5 food groups indicate inadequate dietary diversity. Despite living in a region rich in agrobiodiversity, social norms and heavy workloads prevent these women from accessing and consuming local nutritious foods. The significant relationship between BMI and MUAC supports MUAC as a reliable substitute for measuring nutritional status in adults. Oraon tribal women's nutritional outcome can be considerably improved by enhancing their access to diverse foods through kitchen gardening, nutrition-sensitive agriculture, and effective implementation of government nutrition programs. Integrated interventions to address malnutrition, nutrition education, and empowerment programs should be prioritised to raise awareness and improve dietary practices.

DECLARATION

Ethics approval and informed consent: The respondents were made aware of the purpose, scope, and methodology of the research before the survey was conducted. Verbal informed consent was obtained from the respondents individually.

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Conflict of interest: The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The author declares that during the preparation of this article, the author utilised Grammarly to enhance grammar and improve the text's readability. After using this tool, the authors carefully reviewed, revised, and edited the content as necessary. The authors take full responsibility for the final content of this publication.

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