

## Assessing the factors influencing the severity of anemia in tribal women of Malkangiri, Odisha, India

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### Abstract

**Background:** Anemia is a serious public health concern with a high prevalence in tribal communities' women in India. Despite several implementations to strengthen the maternal health and nutrition program, anemia persists. **Objectives:** The objectives of this study were to estimate anemia prevalence and to examine the predictors of anemia among Koya and Matia tribal women in a district of Odisha, Malkangiri. **Materials and Methods:** For this study, a cross-sectional survey was conducted among 519 tribal (Koya- 326) and (Matia- 193) women aged 15-49 years. A pre-tested schedule was used to collect data on different demographic variables, and a Hemoglobin (Hb) meter was used to estimate Hb level. Prevalence of anemia among tribal women was estimated and Chi-Square and Multinomial logistics regression were used to find the association. **Results:** The mean hemoglobin value in the overall sample (n=519) was 7.86±1.77. The results showed that 34.35% of Koya and 33.67% of Matia were severely anemic, while 56.13% of Koya and 55.43% of Matia were moderately anemic, and mild anemia was reported to be 3.68 in Koya and 4.14 in Matia's women. Early marriage, women's age at first childbirth, parity, were major factors influencing the severity of anemia. **Conclusion:** The high prevalence of anemia among both communities' tribal women necessitates immediate action through targeted interventions to enhance and ensure widespread coverage of anemia control programs, especially in tribal areas.

**Keywords:** Anemia, Koya, Matia, tribal women, reproductive age, Malkangiri

### Introduction

Anemia, a clinical nutritional deficiency disease that is more prevalent among women of low- and middle-income nations like India and is affecting approximately half a billion women globally, poses a significant public health challenge worldwide with both immediate and long-term consequences<sup>(1)</sup>. Although anemia affects individuals of all ages, it is particularly prevalent in children, adolescent girls, Women of Reproductive Age (WRA), and pregnant and breastfeeding women<sup>(2)</sup>. During pregnancy, anemia can result in premature birth and Low-Birth-Weight child (LBW), as well as poor physiological and cognitive development in infancy and early childhood<sup>(3)</sup>. The World Health Organization (WHO) defines anemia as a medical condition in which hemoglobin concentration in blood is less than 12.0g/dl for non-pregnant women of reproductive age and below 11.0g/dl during pregnancy<sup>(1)</sup>. It is a condition in which the hematocrit value and the size and count of Red Blood Cells (RBCs) drop to a defined threshold. Anemia is primarily caused by nutritional deficiency, infectious diseases, and genetic hemoglobin abnormalities<sup>(2)</sup>. However, in impoverished countries like India, the lack of proper nutrition, especially iron deficiency, plays a significant role in the high prevalence of anemia<sup>(4-6)</sup>.

Several studies indicate that Indigenous communities across the globe face a higher burden of anemia compared to the general population, highlighting their vulnerability to this condition<sup>(7)</sup>. As per the census report 2011, India has 8.6% tribal population, with tribal women comprising 47% of the total tribal population<sup>(8)</sup>. Odisha is a home of 14 Particularly Vulnerable Tribal Groups (PVTG) and 64 notified tribal communities, making it the third most tribal-populated state<sup>(8)</sup>. These tribal communities are the most marginalized social groups, especially in terms of geography, with few or no basic civic amenities, poor socio-economic and political conditions, and low literacy rates. The women of these communities are living in remote rural areas with challenging terrain and very far from infrastructural development with limited access to resources and with cultural and economic barriers, inadequate dietary intake, and high birth rates, which lead to poor maternal and child health status among them. The National Family Health Survey (NFHS-5)<sup>(9)</sup> (2019-20) reveals a concerning anemia burden on the nation, as 52.2% of pregnant women and 57% of WRA are reported to be anemic. In Odisha, there are considerable spikes of anemia cases, from 51% to 64.3%, in women of reproductive age, according to the latest NHFS-5 report<sup>(10)</sup>.

As the prevalence of anemia among women of tribal communities is unacceptably high, it is becoming a hindrance

in achieving Sustainable Development Goals (SDGs), particularly SDG-2 (Zero Hunger) and SDG-3 (Good Health and well-being), which call for urgent addressal. To address this issue, the central and state government launched the Anemia Mukht Bharat (AMB) project in 2018, which focussed on eradicating and reducing the prevalence of anemia among vulnerable age and gender groups<sup>(11)</sup>. The Odisha Government launched Anemia Mukta Laqshya Abhiyan (AMLAN), which includes T3 approach- testing, treating, and talking, as well as raising awareness about dietary diversity and social behavior towards the nutritional programs. The United Nations Development Programme (UNDP) in India has recommended the Aspirational District Programme (ADP)<sup>(12)</sup> for improving five key sectors such as health and nutrition, education, agriculture, basic infrastructure, and financial inclusion to develop local areas where the persistence of regional disparities in development is considerably seen, due to remote location, neglect and highly affected area of 'Left Wing Extremism'. Malkangiri is one of the Odisha districts selected by ADP. Despite this project of ADP, the tribal-dominated Malkangiri area has a high prevalence of anemia, as reported by NFHS-4 (71.3%) and NFHS-5 (71.9%), indicating minimal to no progress in reducing anemia rates in the tribal population. By examining the prevalence of anemia in two ethnic groups, Koya and Matia of Malkangiri district, this study aims to offer valuable insights that can be utilized to implement targeted interventions, reduce anemia rates, and improve the overall well-being of WRA residing in this particular area. The objectives of this study were to estimate prevalence of anemia and to investigate the socio-demographical and reproductive predictors of anemia among Koya and Matia tribal women of an aspirational district of Odisha, Malkangiri.

### Materials and Methods

A cross-sectional survey was conducted in hamlets dominated by Koya and Matia tribal women of five administrative blocks, Podia, Maithili, Malkangiri NAC, Khairput, and Kalimela of Malkangiri district, from October 2021 to November 2022. A total of 519 tribal women (Koya=326 and Matia =193) aged 15-49 years were selected randomly for this study.

### Inclusion criteria

Tribal women belonging to Koya and Matia tribe, aged between 15-49 years, who were willing to provide blood sample for Hemoglobin (Hb) testing were included.

### Exclusion criteria

The study excluded women who were pregnant or recently had their delivery (post-natal).

### Procedure

The study employed a descriptive survey design and a quantitative survey methodology. The data collection tools were a pre-tested schedule and hemoglobin strip apparatus. The primary data was collected using a pre-tested questionnaire with domains such as socio-demographical details, diet history, menstrual history, marital and reproductive profile, and anthropological and physiological measurements. Hemoglobin estimation was done using a battery-operated portable Quick-check Plus Hb hemoglobin meter, which works on the principle of optical reflectance photometry. A blood drop was diffused over a hydrophilic mesh of a thin plastic strip loaded with reagents that estimated Hb and had 86% sensitivity and 83% specificity. To assess the anemia levels, a drop of blood from a finger prick was collected in a capillary tube, which was then aligned with the sample application area on the test strip. The Hb results were displayed within 15 seconds with the Hematocrit (HCT) value at the bottom of the screen. Anemia was further subclassified as severe (<7.0 g/dl), moderate (7.1-9.9g/dl), mild (10 -11.9g/dl), and non-anemic (>12g/dl) among women of reproductive age.

### Statistical Analysis

Descriptive statistics and percentage distribution were used to describe socio-demographic and reproductive factors and anemia levels among both (Koya and Matia) ethnic group women. This study also examined the combined and separate data of 519 tribal women from both communities residing in the Malkangiri district. Different socio-economic and demographical factors such as age groups, marital status, education, household income, family size, employment status; reproductive factors [women's age at marriage, women's age at menarche, women's age at first childbirth, bearing children and parity, Body Mass Index (BMI)] and dietary patterns and lifestyle behavior such as alcohol consumption and tobacco chewing were all used as independent variable. The dependent variable was the Hb category (Mild, Moderate, Severe).

The association between variables and anemia was determined using the chi-square test. A Multinomial logistic regression model was used to assess the influence of demographical and reproductive factors on anemic status. The data analysis was carried out using IBM Statistical Package for Social Sciences (SPSS) software version 2020.

### Results

Table 1 displays the various background characteristics and anemia categories among Koya and Matia tribal women in their reproductive age groups. The Mean hemoglobin level in the overall sample's blood (n=519) was 7.86± 1.77. Similarly, the mean hemoglobin value in Koya was 7.90 ±1.79 while in

Matia, it was  $7.08 \pm 1.73$ . These values depict that the majority of women of both tribal communities had moderate anemia. According to data analysis, 34.35% of Koya and 33.67% of Matia were found to be severely anemic, while 56.13% of Koya and 55.43% of Matia were moderately anemic, and mild anemia was reported to be 3.68% in Koya and 4.14% in Matia women. Only 5.82% of Koya and 3.11% of Matia women had normal hemoglobin levels in their blood.

The age group of 20-29 years had the highest percentage of anemia (38.92%) in the overall sample size; however, it was appreciably high for Koya women (36.49%) in comparison to Matia women (34.72%). Similarly, in both Koya and Matia tribal women, a high percentage of anemia cases (both severe and moderate) were found among married women. The rate of occurrence of anemia was highest (57.61%) in tribal women with no education while it was lowest (5.01%) among tribal women with secondary education. In comparison to both tribes, Matia women who had no education (69.95%) had more cases of severe (26.42%) and moderate (39.90%) anemia than Koya women.

In households with poor economic conditions, anemia was more prevalent for both Koya (78.51%) and Matia (83.94%) tribal women in comparison with households having income

ranging from 10,000-25,000 INR per month. The result also depicted that employed women (42.93%) in Koya and (40.41%) in Matia were anemic. The larger was the family size, the greater was the risk of developing anemia. The result suggested that tribal women from joint families had a significant frequency of anemia (59.15%). On the other hand, mild anemia cases were more common in Matia tribal women from nuclear families (4.15%) than in joint families (0.52%). In terms of maternal characteristics, women who married before the legal age of marriage were more likely to have anemia if they conceived a child before 18 years of age. Tribal women with zero parity had the highest prevalence of moderate anemia in both Koya (15.64%) and Matia (22.28%). In Koya and Matia, women with two parities had a high prevalence of anemia, 43.85% and 36.79%, respectively. Similarly, in terms of Body Mass Index status, undernourished women 42.39% and tribal women with normal BMI (48.75%) showed a higher incidence of severe and moderate anemia in both tribal groups than overweight women.

The chi-square value showed age groups, marital status, marriage age, age at first conceiving, parity, diet, BMI status had significant association ( $p < 0.01$ ) with anemia among WRA.

**Table 1: Percentage distribution of anemia status among Koya and Matia tribe women of reproductive age group and association of demographical category with anemia**

Variable Category	Sample size (n= 519) (%)	Koya (n=326)					Matia (n= 193)					$\chi^2$	p-value
		Severe	Moderate	Mild	Non - Anemic	(%)	Severe	Moderate	Mild	Non - Anemic	(%)		
<b>Age groups (in years)</b>													
15 - 19	24.47	9.5	8.28	2.45	2.76	23	9.33	13.47	2.07	1.55	26.94	29.69	<0.001
20 - 29	38.92	11.96	24.23	0.3	2.45	39.26	12.44	21.24	1.04	0.52	38.34		
30 - 39	19.65	7.97	9.2	0.61	0.3	18.09	7.77	13.47	0.52	0.52	22.28		
40 - 49	16.96	4.9	14.41	0.3	0.3	19.63	4.15	7.25	0.52	0.52	12.44		
<b>Marital status</b>													
Married	70.13	25.76	43.25	0.92	0.92	70.85	24.35	43.01	1.55	0.52	68.91	52.13	<0.001
Unmarried	29.87	8.58	12.88	2.76	4.9	29.14	9.33	16.06	2.59	2.59	31.09		
<b>Education</b>													
Illiterate	57.61	18.71	24.23	0.3	4.29	50.3	26.42	39.9	2.07	1.04	69.95	15.7	0.07
Primary	17.53	3.68	13.19	2.45	0.23	17.48	3.63	11.4	1.04	1.04	17.62		
Secondary	5.01	3.68	1.53	0.61	0.32	5.21	2.07	2.07	0.52	0.52	4.66		
Higher	19.65	8.28	17.17	0.3	0.92	26.68	1.55	0.52	0.52	0.52	7.77		
<b>Family size</b>													
Joint	59.15	20.85	30.98	2.14	4.29	58.28	18.65	40.41	0.52	1.55	60.62	4.78	0.19
Nuclear	40.85	13.49	25.15	1.53	1.53	41.71	15.03	18.65	4.15	0.52	39.38		

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Variable Category	Sample size (n= 519) (%)	Koya (n=326)					Matia (n= 193)					$\chi^2$	p-value
		Severe	Mode-rate	Mild	Non - Anemic	(%)	Severe	Mode rate	Mild	Non - Anemic	(%)		
<b>Employed</b>													
Yes	44.12	17.17	23.31	2.45	1.53	46.01	12.44	26.42	1.55	0.52	40.93	4.04	0.26
No	55.88	17.17	32.82	1.22	4.29	53.98	21.24	32.64	2.59	2.59	59.07		
<b>Household income (in INR)</b>													
<10,000	84.78	28.83	47.23	2.45	5.52	84.35	30.57	50.78	2.59	2.07	85.49	6.90	0.08
10,000 – 25,000	15.22	5.52	8.89	1.22	0.12	15.64	3.11	8.81	1.55	1.04	14.51		
<b>Age at menarche (in years)</b>													
12-13	57.42	15.95	32.51	2.14	3.06	0.56	18.65	39.38	1.55	2.59	63.21	8.54	0.20
14 -15	34.68	14.11	18.71	1.22	2.45	36.5	12.95	16.58	2.07	0.52	31.61		
>15	7.9	4.29	4.9	0.307	0.12	9.5	2.07	3.11	0.52	0.52	5.18		
<b>Age at marriage (in years)</b>													
Not Married	28.32	6.74	11.96	3.06	4.6	26.68	9.33	16.06	2.59	2.59	31.09	66.44	<0.001
Before 18	50.67	17.79	30.06	0.3	0.61	48.76	20.21	33.68	0.52	0.52	53.89		
After 18	21	9.81	14.11	0.3	0.61	24.54	4.15	9.33	1.04	0.52	15.03		
<b>Bearing child</b>													
Yes	44.51	23	15.64	3.37	4.6	34.66	21.76	37.82	1.55	0.52	61.14	42.68	<0.001
No	55.49	11.35	40.49	0.3	1.22	65.33	11.92	21.24	2.59	2.59	38.86		
<b>Age at first conceiving (in years)</b>													
Not having child	34.68	8.28	15.95	3.06	4.6	32.2	11.4	22.28	2.59	2.07	38.86	53.86	<0.001
Before 18	38.73	11.04	25.46	0.3	0.92	37.73	14.51	25.39	0.52	0	40.41		
After 18	26.59	15.03	14.72	0.35	0.25	0.25	7.77	11.4	1.04	0.52	20.73		
<b>Parity</b>													
No child	34.49	8.28	15.64	2.43	4.6	31.9	11.4	22.28	2.07	1.55	38.86	25.72	<0.001
1-2	41.81	19.32	24.23	0.3	0.61	44.47	14.51	21.24	1.04	0.52	37.31		
3-4	19.27	6.13	12.57	0.61	0.3	19.32	6.74	12.44	0.52	0.52	19.17		
≥5	4.43	0.61	3.68	0.3	0.3	4.29	1.04	3.11	0.52	0.52	4.66		
<b>Diet</b>													
Veg	2.12	0.3	1.84	0.3	0.3	1.84	1.04	1.55	0.52	0.52	2.59	22.26	<0.001
Non- Veg	97.88	34.04	54.29	3.37	5.52	98.16	32.64	57.51	3.63	2.07	97.41		
<b>Meal per day</b>													
1	3.08	0.92	2.14	0.3	3.06	3.06	1.04	1.04	0.52	0.52	3.11	5.16	0.52
2	62.81	21.16	34.96	2.45	4.29	63.19	23.83	33.68	3.11	1.55	62.18		
≥3	34.1	12.27	19.01	0.92	1.53	33.74	8.81	24.35	0.52	1.04	34.72		

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**Table 1: Percentage distribution of anemia status among Koya and Matia tribe women of reproductive age group and association of demographical category with anemia**

Variable Category	Sample size (n= 519) (%)	Koya (n=326)					Matia (n= 193)					$\chi^2$	p-value
		Severe	Moderate	Mild	Non - Anemic	(%)	Severe	Moderate	Mild	Non - Anemic	(%)		
<b>Alcohol consumption</b>													
No	29.29	7.36	17.17	0.92	2.14	27.91	9.84	37.82	0.52	0.52	31.61	4.46	0.26
Yes	70.71	26.99	38.95	2.76	3.68	72.08	23.83	21.24	40.41	2.59	68.39		
<b>Tobacco consumption</b>													
No	52.02	18.09	28.22	1.84	4.29	53.06	17.1	31.61	1.04	0.52	50.26	3.43	0.33
Yes	47.98	16.25	27.91	1.84	0.92	46.33	16.58	27.46	3.11	2.59	49.74		
<b>BMI status</b>													
Undernutrition	42.39	16.25	18.71	1.53	3.37	39.87	24.87	23.83	2.59	2.07	46.63	19.59	<0.001
Normal	48.75	15.33	31.59	1.22	1.53	49.69	8.29	32.64	1.04	0.52	47.15		
Overweight	7.9	2.76	5.21	0.92	0.92	9.81	0.52	2.59	0.52	0.52	4.66		

Abbreviation : BMI: Body Mass Index

In Table 2, Multinomial logistic regression was used to examine how socio-demographical and maternal factors influence hemoglobin levels in blood among tribal women of reproductive age. The results depicted that women of 30-39, and 40-49 years were 10.80, and 9.00 times more likely to be severely anemic, respectively. A similar pattern was observed in moderate and mild anemic cases, indicating that women aged 30-39 years had a higher risk of having anemia than younger age groups. Women who were married before 18

years were 26.92, 23.10 times more likely to be with severe, and moderate anemia than unmarried women. If they gave birth to a child before 18 years of age, they had 8.71 times more chances of having severe anemia than women with no child.

On the other hand, women with one to two-child parity were found to be 6.04 times more likely to be severely anemic and 4.15 times more likely to be moderately anemic than women with no child. The result showed that a vegetarian diet was a protective factor for severe and moderate anemia.

**Table 2: Multinomial logistic regression showing the association between socio-demographic variables and hemoglobin level in blood (anemia) among tribal women of Malkangiri**

Variable	Severe	Moderate	Mild
<b>Tribe</b>			
Koya®	1	1	1
Matia	1.83(0.70-4.83)	1.99(0.77-5.13)	1.84(0.50-6.83)
<b>Age Groups</b>			
15-19®	1	1	1
20-29	2.13 (0.80-5.67)	1.66 (0.65-4.18)	0.36 (0.08-1.70)
30-39	10.80 (2.26-51.50)**	8.42 (1.82-38.96)**	1.64 (0.23-11.70)
40-49	9.00 (1.88-43.11) **	6.87 (1.48-31.90)	1.09 (0.13 - 9.12)
<b>Marital Status</b>			
Married®	1	1	1
Unmarried	0.07 (0.02-0.20)***	0.06 (0.02 - 0.19)***	0.53 (0.12 - 2.34)



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**Table 2: Multinomial logistic regression showing the association between socio-demographic variables and hemoglobin level in blood (anemia) among tribal women of Malkangiri**

Variable	Severe	Moderate	Mild
<b>Education</b>			
Illiterate®	1	1	1
Primary	1.11 (0.27 - 3.79)	2.47 (0.70 - 8.67)	2.18 (0.41 - 11.64)
Secondary	1.13 (0.13- 9.69)	1.94 (0.24 - 15.42)	3.27 (0.27 - 40.47)
Higher	2.09 (0.58 - 7.48)	2.20 (0.63 - 7.76)	1.09 (0.16 - 7.59)
<b>Family size</b>			
Nuclear®	1	1	1
Joint	1.49 (0.61 - 3.64)	1.41 (0.59 - 3.38)	3.64 (1.04- 12.78)
<b>Employed</b>			
Yes®	1	1	1
No	1.82 (0.78 - 4.27)	1.99 (0.87 - 4.58)	3.25 (0.93 - 11.41)
<b>Household income</b>			
<10k®	1	1	1
10k-25k	1.80 (0.40 - 8.15)	2.10 (0.48 - 9.21)	6.71 (1.20 - 37.44)**
<b>Age at menarche</b>			
12-13®	1	1	1
14-15	1.41(0.56 - 3.55)	0.89(0.36 - 2.20)	1.75 (0.47 - 6.48)
>15	0.96 (0.25 -3.67)	0.56 (0.15-2.11)	1.75 (0.28 - 10.81)
<b>Age at marriage</b>			
Not Married®	1	1	1
Before 18	26.92 (6.01 - 120.57)	23.10 (5.26 -10.15)	0.63 (0.05 - 7.53)
After 18	5.64 (1.54 - 20.68)	5.92 (1.68 - 20.86)	0.83 (0.12 - 5.61)
<b>Bearing child</b>			
No®	1	1	1
Yes	8.00 (2.86 - 22.38)	8.82 (3.21-24.21)	0.75 (0.16 - 3.62)
<b>Age at first conceiving</b>			
No child®	1	1	1
Before 18	8.71 (2.45 - 30.98)***	9.26 (2.68 - 32.07)***	0.82(0.12 - 5.61)
After 18	13.06 (2.91 - 58.56)	7.47 (1.69 - 33.02)***	0.63 (0.05 - 7.53)
<b>Parity</b>			
No child®	1	1	1
1-2	6.04 (1.87 - 19.51)***	4.15 (1.31 - 13.14)***	1.44 (0.28-7.34)
3-4	1.75 (0.57 - 5.38)	1.80 (3.61 - 5.29)	0.87 (0.18 -4.58)
≥5	0.35 (0.07- 1.78)	0.88 ( 0.23 - 34)	1.44 (0.24 -8.84)
<b>Diet</b>			
Non-Veg®	1	1	1
Veg	0.05(0.01 - 0.25)***	0.13 (0.04-0.41)***	1.07(0.24 - 4.66)

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**Table 2: Multinomial logistic regression showing the association between socio-demographic variables and hemoglobin level in blood (anemia) among tribal women of Malkangiri**

Variable	Severe	Moderate	Mild
<b>Meals per day</b>			
1®	1	1	1
2	1.35 (0.15-12.29)	1.17 (0.14 -9.80)	0.88 (0.05 -15.37)
>3	1.63 (0.17-16.02)	1.75 (0.19 -15.80)	0.43 (0.02 -9.36)
<b>Alcohol consumption</b>			
No®	1	1	1
Yes	0.68(0.28-1.96)	1.03(0.43-2.46)	0.57(0.14-2.27)
<b>Tobacco consumption</b>			
No®	1	1	1
Yes	0.51(0.21-1.24)	0.50(0.21-1.19)	0.34(0.10-1.18)
<b>BMI status</b>			
Underweight®	1	1	1
Normal	2.16(0.80-5.85)	3.83(1.44-10.19)**	1.50 (0.38 -6.00)
Overweight	0.46(0.13-1.65)	0.81(0.25-2.65)	1.13 (0.21- 6.14)

## Discussion

The study attempted to understand the community-level factors associated with anemia among tribal women (aged 15 to 49 years) of Koya and Matia residing in the Aspirational district of Odisha, Malkangiri. This study found that the prevalence rate of anemia is above 90% among both ethnic groups, which is quite higher than the report of NFHS-5 (71.6%). The findings of this study reveal a significant occurrence of severe and moderate anemia in both studied tribal groups. A similar study conducted in the Manipur tribe of Chothe, Vaiphei, and Kom also showed the prevalence of moderate and mild anemia in all three tribes (17.58%, 38.95%, 32.29% respectively)<sup>(13)</sup>.

A few studies have indicated that poor socio-economic group has a higher prevalence of anemia<sup>(1,2)</sup>. The present study also showed that tribal women who have low household incomes exhibit a higher likelihood of developing anemia. In both communities, people are living below the poverty line, and several factors contribute to the prevalence of anemia, like lack of education and awareness of dietary intake and not having various diet patterns, early marriage and early onset of childbearing, lack of awareness of health care during pregnancy and a high percentage of undernutrition.

This study found a higher prevalence of anemia in the age group 20-29 years, which contradicts studies conducted among seven Southeast Asian countries. The studies reported higher proportion of anemia among the older women (over 35

years) in Cambodia (47.1%), Bangladesh (42.9%), Myanmar (48.1%), Maldives (64.3%)<sup>(14)</sup>. Present study findings suggest that married women of both ethnicities and women embracing motherhood before 18 years of age had a high prevalence of severe and moderate anemia. The odds of severe anemia were higher among women who became mothers before 18 years of age by eight times. Our study findings were also well aligned with the study conducted to examine the determinants of anemia at the global and regional levels, which stated the prevalence of anemia is associated with low dietary intake, iron deficiency, lacking sufficient meals, and absence of variation in diet<sup>(15-18)</sup>. The higher prevalence of anemia in both communities may also be due to malaria, poor iron absorption<sup>(19)</sup>, and iron loss during intestinal worm infection<sup>(20)</sup>, as the hilly district is covered with dense forest area, which is rich in flora and fauna, experiences high rainfall, humid temperature, and stagnated water, that enable mosquitoes to breed.

The major strength of this study is that it is probably the first study in tribal groups to provide data from district Malkangiri. The study focused on specific tribal community women of reproductive age, which will be useful for implementing public health intervention strategies and monitoring their progress over time to mitigate anemia.

## Limitations

One of the key limitations of this research is the exclusion of pregnant women and several key variables such as dietary pattern, iron-folate, vitamin B12, vitamin A intake, and

community's socio-cultural norms variable, which could play a role in anemia prevalences in both communities. Therefore, future research should incorporate more variables to provide a comprehensive study on the prevalence of anemia among tribal women of this district of Odisha.

### Conclusions

Anemia was found to be a severe public health issue in the present study area for both women of the Koya and Matia tribes. The factors that showed significant impact on the high prevalence of anemia among women of these tribes were early marriage, and early age during first childbirth, making it a public health problem. The high prevalence of anemia among tribal women necessitates immediate action through targeted interventions to enhance and ensure widespread coverage of anemia control programs, especially in tribal districts.

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**Conflict of Interest:** Nil

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### Ethical Consideration

The study was carried out as per the ethical guidelines issued by Institution. This study was approved by 10<sup>th</sup> Institute Ethical Committee of Amity University, Uttar Pradesh. Written informed consent was obtained from the participants and confidentiality and anonymity of the participants was ensured.

### Author's Contribution

KK: Data collection, analysis and manuscript writing, RD: Manuscript review and guidance

### Data Availability Statement

Data will be available with corresponding author on request.

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