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Prevalence of anaemia and associated factors among Oraon females of North 24 Parganas, West Bengal, India

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ABSTRACT: Low haemoglobin level or anaemia is a health problem worldwide especially in developing countries like India. Anaemia is generally higher among indigenous groups compared to general population globally and females are specifically more prone to anaemia. However, studies are inadequate on indigenous groups of India. The aims of the study are to determine the prevalence of anaemia among the female Oraons of North 24 Parganas and to study the association between anaemia and concomitants like socio-demographic and food habit variables. Data have been collected on demographic, socio-economic and food habit variables using well-tested questionnaire from 309 Oraon females living in rural and urban areas of North 24 Parganas, West Bengal. Haemoglobin data were collected using standard instrument and technique. Descriptive statistics and binary logistic regression were used to analyze the data using SPSS version 16.0. Females of rural and urban areas were mostly married and non-literate, employed as labourers and had sedentary occupations. Majority of them consume fruits and vegetables but less animal protein and dairy product. Around 80% of the females were anaemic, irrespective of their habitat, socio-economic status and food habits. Anaemic status was associated with insufficient intake of animal protein, which is significantly associated with the anaemia status of the females in the present study.

KEY WORDS: low haemoglobin, rural-urban females, food habit, socio-economic traits

Introduction

Haemoglobin is a complex protein in blood containing a globular protein (globin) and a pigmented iron-containing complex (heme) which carries oxygen to fulfill the physiological need of the body (Waugh and Grant 2010). Normal haemoglobin level in human is 13–18 gm/100 dL in male and 11.5–16.5 gm/100 dL in female. Low haemoglobin level is termed as anaemia. In an anaemic condition, the amount of haemoglobin is not sufficient to carry enough oxygen from the lungs to fulfil the need of the tissues. Anaemia is a health problem worldwide (McLean et al. 2008), and especially in developing countries (Vijayaraghavan 2007). Anae-

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mia is mostly caused either by impaired erythrocyte production (which includes iron deficiency anaemia) or by increased erythrocyte loss. Haemoglobin level in blood is also determined by genetic factors (Evans et al. 1999). Generally, the haemoglobin level decreases in older age (Beghe et al. 2004) and Penninx et al. (2004) further reported that a low haemoglobin level (anaemia) was linked with disability and decreased physical performance in aged individuals. Murphy (2014) reported sex differences in the haemoglobin level. Haemoglobin level differs between occupational groups (Medhi et al. 2006; Kundu et al. 2013), socio-economic groups (Bharati et al. 2004) and residential groups (Balarajan et al. 2013). Several studies also reported the prevalence of anaemia among children (Ngesa and Mwambi 2014; Santos et al. 2011), adolescent girls (Balci et al. 2012), pregnant women (Adam et al. 2005; Antelman et al. 2000) and women (Pala and Dundar 2008), and found association with their food habits (Kabit et al. 2010; Shi et al. 2006).

In India, Bentlet and Griffiths (2003) reported a high prevalence of anaemia among women of reproductive age. Rammohan and colleagues (2012) reported a high prevalence of anaemia in Indian women, due to the deficit of nutrient intake. Several Indian studies also reported the prevalence of anaemia among children, adolescent girls, pregnant and non-pregnant women (Noronha et al. 2008; Das and Biswas 2005; Kanani and Poojara 2000; Chakma et al. 2000; Rajaratnam et al. 2000), but the association between the anaemic status and other concomitant variables was inadequate. Again, Khambalia and colleagues (2011) reported that the burden of anaemia is generally higher among indigenous groups compared to general population globally.However, studies among indigenous groups of India are scanty (NNMB 2006; Govt. of India 2010; Roy and Kundu Chowdhury 2013, Kamath et al. 2013) and the majority of them applied to rural areas. Studies are also scanty from urban areas, except the study on Munda (ST) and Pod (SC) females of Kolkata (Ghosh and Bharati 2003). In view of the above, objectives of the present study are to report the prevalence of anaemia among the Oraon females of North 24 Parganas and to find out the concomitant factors associated with anaemia, especially socio-economic and food habit variables.

Materials and Methods

Population

The present study was restricted to a single ethnic group, i.e. Oraon, to eliminate a possible ethnic/genetic effect in health traits. Oraons are the 2nd largest scheduled tribe population of West Bengal (Census of India 2011). Oraons of the present study live in rural and urban areas of the Barrackpore subdivision, North 24 Parganas. Three settlements namely Kuliagarh, Debok and Budhuria (under Naihati police station of Barrackpore subdivision) in the rural areas and four Oraon settlements namely Pansila, Kalyan Nagar, Peiyara Bagan (under Khardah police station and Mohendranagar under the Ghola police station) in the urban areas were entirely included as being inhabited exclusively by Oraons. No statistical sampling was adopted for the selection of households/individuals because it would create suspicion in the field, which ultimately hampers data collection. Prior rapport with the members of the community was established be-

fore data collection and every adult was informed about the aim of the study. In the present paper, data on females were used, as females (especially of child bearing ages) suffer more from anaemia because, as indicated by published literature, females show a higher prevalence of anaemia. Data were collected form 309 adult Oraon females, out of whom 171 were rural and 138 urban.

Data types

Data includes demographic information, socio-economic information, food habit data and Haemoglobin level of each individual. Demographic information included age, area of living and marital status; and was collected using a well-tested household census. Socio-economic information includes educational attainment, occupational pursuits and economic status and was collected using a standard questionnaire/schedule. Data on household characteristics and household assets were collected following standard questionnaire, while the NFHS-3 (2007) method was used to calculate the wealth index score (WIS). Wealth index is an indicator of the level of wealth that is consistent with expenditure and income measures. Wealth index score was calculatted for each household and all the members of a household poses same wealth index score, then divided into two parts to assess the economic status on the basis of its median value. Data on food habit variables included the number of days per week of fruits and vegetables, animal protein and dairy products consumptions, and were collected using a well-tested questionnaire. Data on the haemoglobin level (g/dL) were collected following the HemoCue method and standard techniques (Nkrumah et al. 2011). HemoCue is a battery operated and portable haemoglobin photometer (HemoCue, Angelhom, Sweden), suitable for use in the field situation. Capillary blood was collected from the fingertip of the participants using a sterile lancet. The first two drops of blood were discarded; the third drop was then collected in a new micro cuvette, which is filled with blood automatically by capillary action. Care was taken to avoid air bubble in the micro cuvette cavity. After filling the cavity of the micro cuvette the extra blood on the surface was wiped out with tissue paper. The micro cuvette was then placed in the holder of the HemoCue machine and the tray pushed gently into the photometer. The micro cuvette container was resealed immediately after each use. Haemoglobin level was displayed on the screen within a minute and the displayed value was recorded. The standard universal precautions were adopted while collecting the blood samples (PATH, 2005).

Classification of data

The females of the present study were classified on the basis of their area of residence as rural or urban. Marital status of females was classified as married or single (unmarried, widow or separated). Educational status of females was classified as non-literate (never attended school) and literate (have formal education). Occupations of females were classified as laborer (working as agricultural labor or maid; and sedentary (student, engaged in household work only). Economic status was based on the wealth index score (WIS) and divided into two groups: low or high. Status of live birth was classified into three groups: no live birth, 1–2 live birth and ≥3 live birth. Food habit variables included consumption of fruits and

vegetables, consumption of animal protein and consumption of dairy product, and were classified as 'yes' – consume frequently and 'no' – do not consume. Women who consume fruits and vegetables daily were considered as frequent consumer; women who consume fish/meat/egg at least twice a week were considered as frequent and women who consume milk/sweets/cards daily were considered as frequent consumers (because a traditional dietary pattern consists of high consumption of fruits and vegetables rather than animal protein). Haemoglobin level was classified as normal, mildly anaemic, moderately anaemic and severely anaemic following the classification of the World Health Organization (WHO 2011). All the classifications used in the study are given in Table 1.

Analysis of data

Frequency of the anaemic status across socio-demographic groups and across food habit groups was calculated as was frequency of the anaemic status by the haemoglobin level. Mildly, moderately and severely anaemic females were pooled together and denoted anaemic status whereas the rest were denoted as normal. Binary logistic regression was performed between the anaemic status with socio-demographic and food habit variables. In binary logistic regression the haemoglobin status in terms of the anaemic (mildly, moderately and severely anaemic) and normal was considered as dependent variable while the socio-demographic (age, education, occupation, economic status, area and marital status) and food habit variable (fruit and vegetable consumption, animal protein consumption and consumption of milk or milk products) were regarded as independent variables. For the purpose of the logistic regression all the anaemic individuals (severe, mild and moderate) were pooled as anaemic and coded "1" and normal individuals were coded "0". Age and economic status were added in the analysis as continuous variables and all the other variables were considered as categorical variables. Three types of logistic regression were performed: bivariate, multivariate, and step-wise to know the best predictor variables among all the socio-economic and food habit variables. The data were analyzed using SPSS version 16.0 (SPSS Inc., Chicago, IL, USA).

Results

Table 1 shows the classification criteria of socio-economic and food habit variables and the WHO classification of the anaemia. Socio-economic variables like the marital status, education, occupation, economic condition and other were all grouped into dichotomous variables for convenience in statistical analysis.

Table 2 shows the frequency of Oraon females having different categories of the anaemia on the basis of the haemoglobin level by area of residence. The mean age of rural females was 35.73±12.79 and of urban females it was 34.72±12.87. The age range of rural women was 18 to 71 years whereas the age range of urban women was 18 to 66 years. Majority of the females showed a moderate (43.9% rural and 50.0% urban) and a mild anaemic status (28.1% rural and 27.5% urban). Very few females showed a severe anaemic status (4.1% rural and 8.0% urban). Only 24.0% of rural and 14.5% of urban females showed a normal haemoglobin level.

Table 3 shows the age changes in haemoglobin level of rural and urban

Table 1. Classification of socio-economic data, food habit variables and haemoglobin level

Socio-economic status	Groups
Area	Rural
	Urban
Marital Status	Married
	Single (unmarried, widow, separated)
Educational Status	Non-literate
	Literate
Occupational Status	Labourers (agricultural, maid)
	Sedentary (household work, student, unemployed)
Economic status (Wealth Index Score[WIS])	Low (WIS <- 0.1201973
	High (WIS ≥ - 0.1201973)
Food habit variables	
Fruits and vegetable consumption (daily)	Yes
	No
Weekly animal protein consumption (at least twice)	Yes
	No
Consumption of milk product (daily)	Yes
	No
Haemoglobin level	
Haemoglobin level (mg/dL) (WHO, 2011)	Normal (Male ≥13.0, Female ≥12.0)
	Mild anaemic (Male 11.0–12.9, Female 11.0–11.9)
	Moderate anaemic(8.0–10.9 Male and Female)
	Severe anaemic (<8.0 Male and Female)

Table 2. Anaemic status of Oraon females on the basis of haemoglobin level

Oraon females	Category of anaemic status (WHO 2011)							
	Severe		Moderate		Mild		Normal	
	n	%	n	%	n	%	n	%
Rural (n = 171; 18–71 years Mean age: 35.73±12.79 years	7	4.1	75	43.9	48	28.1	41	24.0
Urban (n = 138; 18–66 years Mean age: 34.72±12.87 years	11	8.0	69	50.0	38	27.5	20	14.5

Table 3. Age-related changes in haemoglobin level in rural and urban females

Oraon females	Age group (years) and mean level of haemoglobin (mg/dL)			
	18–29	30–39	40–49	≥50
	Mean±SD (n)	Mean±SD (n)	Mean±SD (n)	Mean±SD (n)
Rural (n = 171; 18–71 years Mean age: 35.73±12.79 years	10.80±1.46 (73)	11.37±1.77 (41)	10.55±1.33 (31)	11.14±1.50 (26)
Urban (n = 138; 18–66 years Mean age: 34.72±12.87 years	10.52±1.32 (59)	10.33±1.73 (28)	10.48±1.78 (33)	10.98±0.80 (17)

Table 4. Anaemic status of Oraon females across socio-economic and lifestyle variables

Socio-economic and lifestyle variables			Total females		Anaemic status	
			n	%	n	%
Area	Rural		171	55.5	130	76.0
	Urban		138	44.5	118	85.5
Marital Status	Married	Rural	133	77.8	101	75.9
		Urban	99	71.7	83	83.8
	Single	Rural	38	22.2	29	76.3
		Urban	39	28.3	35	89.7
Occupation	Laborers	Rural	109	63.7	81	74.3
		Urban	46	33.3	40	86.9
	Sedentary	Rural	62	36.3	49	79.0
		Urban	92	66.7	78	84.8
Educational status	Non-literate	Rural	90	52.6	67	74.4
		Urban	50	36.2	43	86.0
	Literate	Rural	81	47.4	63	77.8
		Urban	88	63.8	75	85.2
Economic status	Low	Rural	123	71.9	91	73.9
		Urban	34	24.6	28	82.3
	High	Rural	48	28.1	39	81.2
		Urban	104	75.4	90	86.5
Status of live births (number of children)	No	Rural	27	15.8	21	12.3
		Urban	27	19.7	25	18.1
	1–2	Rural	91	53.2	75	43.9
		Urban	71	51.8	59	42.7
	≥3	Rural	53	30.9	34	19.9
		Urban	39	28.5	33	23.9
Weekly fruit and vegetable consumption (daily)	Yes	Rural	85	49.7	65	76.5
		Urban	71	51.4	63	88.7
	No	Rural	86	50.3	65	75.6
		Urban	67	48.5	55	82.1
Weekly animal protein consumption (at least twice a week)	Yes	Rural	108	63.2	88	81.5
		Urban	109	78.9	93	85.3
	No	Rural	63	36.8	42	66.7
		Urban	29	21.0	25	86.2
Consumption of frequent dairy products (daily)	Yes	Rural	62	36.3	44	70.9
		Urban	54	39.1	45	83.3
	No	Rural	109	63.7	86	78.9
		Urban	84	60.9	73	86.9
Energy consumption (ICMR, 1989)	<Recommendation	Rural	147	85.9	110	74.8
		Urban	121	87.7	102	84.3
	≥Recommendation	Rural	24	14.0	20	83.3
		Urban	17	12.3	16	94.1

females. Females were classified in four age groups each of ten years cohorts. The mean values in all the age groups shows that rural females pose higher mean values than the urban females. Also, the trend of mean value across the areas indicated that the majority of the females were mildly anaemic category. Results of Anova is non significant (p=0.07 for rural and 0.85 for urban group, respectively).

Table 4 shows the anaemic status of Oraon females across socio-economic and lifestyle variables. The first two column represent total number of females and their respective percentage in rural and urban areas and the last two column shows number of anaemic females and their percentage in that area. The rest number of females in that area have normal haemoglobin level, number of which are not provided in the table. The first two column represent total number of females and their respective percentage in rural and urban areas and the last two column shows number of anaemic females and their percentage in that area. The rest number of females in that area have normal haemoglobin level, number of which are not provided in the table. Anaemia is prevalent across all the socio-economic categories along with food habit variables. Comparatively, more percentage of urban females (85.5%) were anaemic than rural females (76.0%). Comparatively, a higher percentage of urban married (83.8%) and single (89.7%) females were anaemic than rural married (75.9%) and single (76.3%) females. Considering occupation, anaemia was more prevalent in the urban group of both laborers (86.9%) and sedentary (84.8%) females were more in percentage than rural group of both laborer (74.3%) and sedentary (79.0%) females. A higher percentage of urban non-literate (86.0%) and literate (85.2%) females was found to be anaemic than of rural non-literate (74.33%) and literate (77.78%) females. A higher percentage urban low economic category (82.3%) and high economic category (86.5%) females was anaemic than those of rural low economic category (73.9%) and high economic category (81.2%). A higher percentage of females who gave birth to 1–2 children (43.9% rural and 42.7% urban) were anaemic than the women who did not give any live births and who give live birth to 3 or more children. Anaemia was also prevalent among females who consume fruits and vegetables (76.7% rural and 88.7% urban) daily and who do not (75.6% rural and 82.1% urban). Consumption of animal protein (81.5% rural and 85.3% urban) and no consumption of animal protein (66.7% rural and 86.2% urban) failed to change the trend of anaemia and the percentage of urban anaemic females was higher than that of the than rural group. Even the consumption of dairy products has no effect on the trend, as the proportion of anaemic urban females (83.3%) was higher than that of rural females (70.9%). Among females who consume more energy than recommended, more percentage of urban females (94.1%) were anaemic than rural females (83.3%). However, in each trait, rural females show low percentages of anaemia than urban females.

Table 5 shows the result of binary logistic regression of the anaemic status with different socio-economic and food habit variables of the Oraon women. Mildly, moderately and severely anaemic females are clubbed together and denotes as anaemic whereas the rest were denoted as normal. In the bi-variate model,

the anaemic status was significantly associated with urban residence (p=0.039) and infrequent consumption of animal protein (p=0.034). In the multivariate model, the anaemic status was significantly associated with age (p=0.04), infrequent consumption of animal protein (p=0.041) and dairy products (p=0.047). In the step-wise model, the anaemic status is significantly associated with infrequent consumption of animal protein only (p=0.034). However, the multivariate model correctly predicted 80.6% of cases.

Discussion

Present study was aimed to determine the prevalence of anaemia among Oraon females of North 24 Parganas and to understand the association between anaemia and concomitant factors like

Table 5. Results of bi-variate, multivariate and step-wise logistic regression of anaemic status with different socio-economic and lifestyle variables of the Oraon women

Variables		Bi-variate		Multivariate		Step-wise	
		Odds ratio (95% CI)	*p*-value	Odds ratio (95% CI)	*p*-value	Odds ratio (95% CI)	*p*-value
Age		0.98 (0.96;1.00)	0.083	0.97 (0.94;0.99)	0.041		
Economic condition		1.29 (0.96;1.74)	0.094	1.22 (0.79;1.89)	0.373		
Area	Rural (Ref.)						
	Urban	0.54 (0.29;0.97)	0.039	0.68 (0.33;1.38)	0.284		
Occupation	Labourers (Ref.)						
	Sedentary	0.76 (0.43;1.33)	0.332	0.93 (0.45;1.93)	0.847		
Educational status	Non-literate	1.21 (0.64;2.13)	0.498	0.586 (0.259–1.494)	0.200		
	Literate (Ref.)						
Marital Status	Married	0.78 (0.39;1.53)	0.468	0.72 (0.35;1.49)	0.383		
	Single (Ref.)						
Frequent animal protein intake	Yes (Ref.)						
	No	1.88 (1.05;3.36)	0.034	1.98 (1.04;3.76)	0.036	1.88 (1.05;3.36)	0.034
Frequent dairy product intake	Yes (Ref.)						
	No	0.70 (0.39;1.24)	0.227	0.53 (0.28;0.99)	0.047		
Frequent fruit and vegetable intake	Yes (Ref.)						
	No	0.79 (0.45;1.39)	0.425	0.75 (0.42;1.37)	0.356		
Energy consumption	<Recommendation	0.53 (0.19;1.40)	0.199	0.51 (0.18;1.39)	0.189		
	≥Recommendation (Ref.)						
R^2 (Nagelkarka)		N.A.		0.094		0.022	
Model correctly predicted		N.A.		80.6		80.3	

socio-economic, food habit and other variables. Data were collected from 309 Oraon females that included socio-economic variables like education, economic condition and food habit variables and haemoglobin level. Results indicate that around 80% of Oraon females are anaemic, irrespective of any socio-economic condition. The prevalence of anaemia was high across all the socio-economic groups irrespective of food habit variables. Anaemic status of females of the present study showed consistent (bi-variate, multivariate and step-wise model) association with infrequent consumption of animal protein.

Around 80% of females were anaemic in the present study which is corroborative with Schedule tribes (ST) of India (78.6% females) (NNMB rural report 2006), but higher than NFSH-3 data on ST's of India (68.5% females) (Govt. of India 2010). The prevalence of anaemia among women of the present study was higher than in a few other studies (Ismail et al. 2016; Kamath et al. 2013), and lower than the studies of Shrinivasa et al. (2014). Khambalia and colleague (2011) reported a higher prevalence of anaemia among indigenous populations is a global phenomenon and the present study also corroborates with that statement.

Prevalence of anaemia was high across all the socio-economic groups which is corroborative with the study of Ghosh and Bharati (2003) among women of Kolkata, West Bengal. It may be intuitively understandable that poor socioeconomic condition reduces the purchasing power of essential foods (say animal protein), that ultimately affects the haemoglobin level. Ghosh (2009) also reported high prevalence of anaemia across different socio-economic groups among women of eastern India. Bharati and colleagues (2004) also reported a high percentage of anaemia among females across all economic groups and opined that income has a minimal or no effect on the haemoglobin status as it is rather unequal food sharing, food taboo, unhygienic living condition and some other cultural factors that may contribute to the high prevalence of anaemia among females of all the economic groups.

In the bi-variate model, the anaemic status showed a significant association with urban residence and infrequent consumption of animal protein. In the multivariate model, the anaemic status was associated with age, infrequent consumption of animal protein and dairy products. In the step-wise model, the anaemic status was associated with infrequent consumption of animal protein only. It is observed that few leaves, vegetables and fruit plants grew in kitchen garden, abandoned land and in paddy fields which rural people used to collect for eating. Also, rural people collected snail, mushroom as a source of protein. However, urban people need to buy every food items. Therefore, they remain more deprived. Bharati and colleagues (2008) reported that urban and well-off Indian women suffered less from anaemia. Rammohan and colleagues (2011) also reported that a poor consumption of animal protein increased the risk of anaemia, but rural and well-off women had reduced chances of being anaemic than their urban counterparts. Bentley and Griffiths (2003) also found that poor urban women showed the highest prevalence of anaemia. Thus, the present study corroborates with many published studies conducted among females. In the present study anaemia is significantly associated with age which is corroborative

with other studies on Indian population (Uria-Alvarez et al. 2014).

The study indicates consistent association between the anaemic status and non-consumption of animal protein. It may happen due to the food habit of tribal people, who generally consume rice as staple food with no or very little vegetables and protein. This habit also shows effect in their anaemic status. Poor nutritional status of Indian females is also reported by several other studies, like Rammohan and colleagues (2011), who reported that non-consumption of meat, fish and eggs was associated with lower odds of being moderately or severally anaemic. Shridhar and colleagues (2014) reported a poor bio-availability of vitamin B12 in a typical Indian vegetarian diet which enhances the chances of anaemia and this finding was supported by others (Bhardwaj et al. 2013; Menon et al. 2011). Thus, the results of the present study also corroborative with the previous studies.

Concluding, the trend of higher percentage of anaemia among indigenous females is prevalent now as it was even 20 or more years ago. The role of food habits, availability of food and economic condition of the people cannot be ruled out. In reviewing the high prevalence of anaemia across the world, especially African and Asian regions, McLean and colleagues (2008) mentioned that anaemia is the result of interaction between/among several factors that may vary from one population to another and thus, knowledge on the causes of anaemia is required to fully interpret data on prevalence and to design appropriate intervention program to reduce it.

Although there are certain limitations in the present study like a small sample size, the present results cannot be claimed to be a general phenomenon for all the indigenous groups of India, which needs more data on several indigenous groups inhabiting several pockets of India. It would have been better to include more socio-economic and physiological variables along with data on micronutrient intake to get a more comprehensive understanding about the association between anaemia and food habits. However, present study indicates a trend which is in line with other studies on Indian populations that nutrient deficiency is one of the determining factors for high prevalence of anaemia.

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Authors' contributions

Both the authors are equally responsible for the content and writing of the paper.

Conflict of interest

There is no conflict of interests regarding publication of this paper.

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