Original Article

Haemoglobin status of adult women of two ethnic groups living in a peri-urban area of Kolkata city, India: a micro-level study

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A micro level study on the haemoglobin status of 127 Munda (a tribe) and 174 Poundrakshatriya (Pod) (caste) women were conducted in the peri-urban area of Kolkata City, India. The two ethnic groups were selected in order to find out whether populations residing in the same habitat, with similar medical and health care facilities have similar haemoglobin status. Results indicate that there exists very high percentage of anaemia in both the ethnic groups and 100 percent anaemia was observed among the Munda. Mean haemoglobin level was higher among the women of both the ethnic groups, consuming calorie, protein, iron and folic acid, above the recommended value (Indian Council of Medical Research, 2000).[25] Women below the age of 30 years were found to be more anaemic. Education (P <0.001), height (P <0.001) and weight (P <0.005) were significantly associated with the haemoglobin status of the Pod women. Haemoglobin level of both ethnic groups was found to increase with increase in Body Mass Index. Low socioeconomic condition, very low literacy rates, poverty and higher live births may have lowered the haemoglobin level of the women of the Munda population. However, women of both the ethnic groups were found to be anaemic in higher percentage than the state of West Bengal and all India (NFHS, 2000).[26] Linear regression analysis indicated that expenditure on food had positive effect on the haemoglobin level (P <0.05) of the Munda adult women, possibly due to better buying capacity. However, negative effect of food expenditure on the haemoglobin level was noticed among the Pod women (P <0.05), which may be due to disparity in food sharing within the households. Thus populations residing with similar medical and health care facilities revealed differences in the haemoglobin level. Differential expenditure pattern and food sharing practice seems to be the major factors responsible for the differences in haemoglobin status among the adult women in this present study. Very low intake of iron and heavy workload may be the reasons for this high percentage of anaemia. Moreover, hookworm infections need to be analyzed, as its prevalence is very high in India and South Asia. One hundred percent anaemia among Munda women is also very alarming. The results suggest that government policies should be intensified further at problem specific areas for the more vulnerable populations and literacy and antenatal care (especially iron supplementation) at various growing periods among the women should be intensified to eradicate anaemia.

Key Words: Munda and Pod women, anaemia, body mass index, peri-urban, nutrient intake, India

Introduction

Iron deficiency affects more than 3.5 billion people in the developing world.[1] The most highly affected population groups in the developing countries are the pregnant women (56%), school age children (53%), non-pregnant women (44%) and preschool children (42%). In both men and women, the prevalence of anaemia was highest among those with severe undernutrition.[2] Iron deficiency anaemia has recently been ranked as the third leading problem for 15-44 year old women.[3] Iron deficiency is normally the result of inadequate bioavailable dietary iron, increased iron requirement during a period of rapid growth (pregnancy and infancy), and /or increased blood loss such as gastrointestinal bleeding due to hookworm or urinary blood loss due to Schistosomiasis. Underprivileged environments and nutritional causes like vitamin B_{12} and folic acid deficiencies, account for the other causes of anaemia. The consequences of anaemia are reduced levels of energy and productivity, impaired immune function, reproductive failure (miscarriages, still births, prematurity, low birth-weight, peri-natal mortality etc.) and maternal death during childbirth.[4] Numerous studies have demonstrated that anaemia is not only detrimental to the health status of women themselves[1], but it can have negative effects on their pregnancy outcomes.[5] In both men and women, prevalence of anaemia was found to be highest among those with severe undernutrition (BMI <16 kg/m^2). Poor health and nutrition of women are associated with closely spaced pregnancies, that progessively reduce women's

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nutritional reserves to the point of nutritional depletion (Maternal Depletion Syndrome).[6,7] Iron deficiency has severe consequences among women in both their reproductive and productive roles. Low-income rural women in developing countries experience the highest rates of iron - deficiency anaemia and have among the most physically demanding work responsibilities (including weeding, threshing, pounding, fetching fuel etc.). Anaemia among women probably accounts for a significant loss of productivity and therefore of family welfare.[8] Several studies have shown a relationship between haemoglobin concentration and work output.[9,10,11] Work capacity may determine work output and hence income; but income may also affect dietary intakes and ultimately work capacity. The income elasticity effect has been shown to be associated to iron intake[12] and a significant correlation has been shown between energy and iron intakes.[13]

In India, chronic maternal undernutrition, anaemia and overwork among low-income groups (especially in the rural areas) result in very poor health status of the mothers.[14,15,16] Unequal access to food, heavy work demands and lack of nutritional needs (such as iron), make Indian women susceptible to illness, particularly anaemia.[17] Reduced bio-availability of iron due to low intake of enhancers like ascorbic acid, meat and flesh foods results in reduced iron absorption and low-income results in low intake of iron. This setting can lead to wide spread iron deficiency and anaemia, which is further exacerbated by poor environmental and personal sanitation and higher incidence of parasitic infestations.[17,18] A study by Bharati and Basu[19] among the Mahisya caste population revealed a negative relationship between haemoglobin level of the mother and fertility and off spring mortality. In rural areas around Hyderabad and Delhi, the prevalence of anaemia ranged from 40-70%, while in villages near Kolkata where hookworm infestations were common, more than 90% of the population was anaemic.[20] The Government of India started the National Anaemia Prophylaxis Programs in 1970 for reducing anaemia in vulnerable groups. An evaluation study conducted by the Ministry of Health and Family Welfare[21] revealed poor performance in all the States of India. The reasons include inadequate supplies of iron/folate tablets, poor supervision, and poor compliance of women due to lack of knowledge. Thus, anaemia is the outcome of a complex web of biological, social and economic factors, which are location specific and partly understood for a particular population group.

The state of West Bengal has a high percentage of anaemia (78.3%) among the women aged 15-49 years when compared with all India (74.3%) and states like Kerala (43.9%) and Manipur (45.2%) (when the cut-off point ≥12.0 g/dl for non-pregnant women was considered).[1] Moreover, the city of Kolkata also revealed a very high percentage of anaemia of about 97% among the women aged 15-44 years.[22] The uneven distribution of anaemia in various states and regions therefore suggests that there is an immediate need to study the local needs and problems in various states of the country, in order to implement the development programs successfully and bring equality in health status. This study uses the haemoglobin concentration to assess the prevalence of iron deficiency anaemia among the women of two ethnic groups living in a peri-urban area of Kolkata City, West Bengal, India. Therefore the study aims to:

1. Assess the haemoglobin status of the Munda and Pod women in the peri-urban area of Kolkata city and
2. To identify the socioeconomic, dietary, anthropometric factors associated with the haemoglobin status.

Materials and Methods

The study area was selected in the Peri-urban area to satisfy the prerequisite of the two ethnic groups. The peri-urban area has both the rural and urban character. The peri-urban area is assumed to be in a state of transition, adopting the urban facilities and interventions, leaving their traditional ways of livelihood. As a result, health problems are also assumed to be in transition, changing from the traditional problems of undernutrition to the modern types of problems like obesity and cardio-vascular diseases. The study is based on the haemoglobin status of adult women, the samples collected by researchers (PB and RG) for the project Micro-environment and Health for Indian Statistical Institute. The data were collected in the year 2000. No random sampling was applied for the collection of data at the household level. The area of study was intentionally selected on the basis of the distribution and concentration of the Munda and Pod populations. Data were collected from the peri-urban area. The basic criterion of selection was the maximum prevalence of Munda and Pod population from the other heterogeneous social environments consisting of populations of diverse ethnicities. Moreover, the Pod caste and Munda tribe are considered to be disadvantaged populations in terms of overall development (Government of India, 1950).

The Munda is an Austro-Asiatic tribe, while the Pod is a caste group, as defined by the Hindu social stratification system. Women of both ethnic groups are housewives as well as productive labourers. As farmer's wives they assist with planting, weeding and harvesting while others work in some landowner's field as daily wagers. Some sell vegetables in the "Haat" (weekly market). During the season of August to October the Munda women mostly go out for collection of Saluk and Samla (roots and stem of water Lilly) and sell them every alternate day to earn Rs. 40-60 per day.

A typical day for both the Munda and Pod women starts at 5 am - they start the day by washing their face and proceed to cook the morning and lunch meals. Then the women leave for the field and usually work from 8 am to 12 noon. After lunch (either given by the employer or taken from home) they work from 2 pm to 4.30 pm. This is mostly seen in the harvesting and transplanting season. During other seasons the remains of the rice husks are cut for fuel and stored for the working months - this task consumes nearly 3-4 hours of a woman's time per day. Cooking is again done in the evening. After completing the household chores (apart from animal care) the mothers go to sleep. During harvesting season, Munda women mostly cook in the early morning and in the evening. During other seasons they cook in the afternoon and night, depending upon the earning of the family. In case of the Pod, the mothers mostly go to their own field and come home in the noon for lunch. During other seasons, they either sell vegetables or stay at home.

Thus the study population can be described as traditional and partially exposed to development. Both ethnic groups differ in their culture and adaptation to the Government developmental programs. Living conditions are modest at best, and the environmental sanitation is poor. The low socio-economic status can be attributed to the marginal benefits of the primary sector and the lack of employment opportunities in the area. The health care practices are a mix of traditional remedies, religious practices and modern medicine.

Women of two ethnic groups (Munda and Pod) were selected in order to find out whether populations residing in the same habitat, with similar medical and health care facilities, have similar haemoglobin status. Married women aged 15-42 years were taken into account due to their childbearing age. Pregnant and lactating women were excluded from the study. A total of 127 Munda and 174 Pod women were studied. Of these, 105 Munda and 138 Pod women agreed to have their blood tested.

Analytical procedures

The mean and standard deviation of dependent and independent variables were compared. Relationships among the variables were analyzed using the SPSS-PC + software. T- test was used to assess differences between the means of various variables among the women of both ethnic groups. Correlation analysis was performed separately for each ethnic group to examine relationships among various socio-economic, demographic, anthropometric factors and haemoglobin levels of the adult women. Linear regression analyzed the relationship among the independent variables and the haemoglobin levels, separately for the women of both ethnic groups.

Haematological data

Blood samples were collected from 105 Munda and 138 Pod women by finger pricking. Oxyhaemoglobin was estimated immediately after collection of blood samples using a Sahli's haemoglobinometer. Blood samples were tested in the field for anaemia by PB and RG. Adequate controls were also tested during the study. Anaemic status of non-pregnant women was assessed by the classification of UNICEF/UNU/WHO/MI, 1999[1], taking 12.0 g/dl as the cut-off point.

Demography and anthropometry

A household questionnaire was completed to obtain information on age, sex, marital status, place of birth, occupation and education of household members from the head of the family, or where absent, from some other elderly member of the household. Fertility data were collected from married females on their reproductive life, which includes live births, dead children, reproductive wastage (abortion, still births etc.) and age at marriage. Anthropometric measurements were taken following the standard techniques of Weiner and Lourie.[23] Body mass index (BMI= weight in kg\height in meter squared) was used as an indicator of chronic energy deficiency (James *et al.*, 1988). [24]

Socioeconomic and dietary data

Schedules were used to gather information about women's household work and time allocation for various activities, leisure time activity etc. Type of diet consumed by the families was collected from the women for one single day. Each food to be cooked for each meal was weighed in a Salter pan type balance prior to cooking. Members of the families absent or guests were taken into account. The amount of nutrients of each food item consumed by each family member per consumption unit of the two ethnic groups were calculated according to Gopalan *et al*., 2000[25].

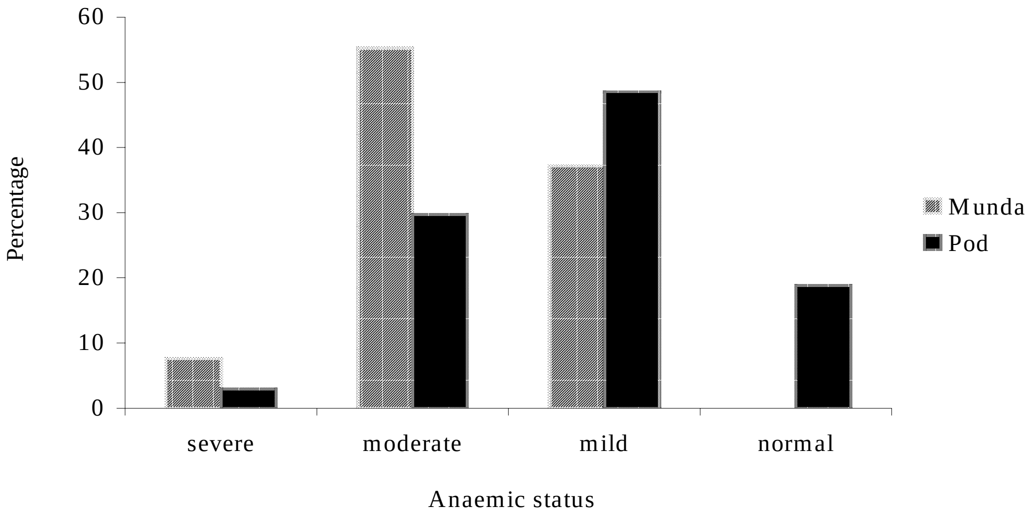

Figure 1. Gradation of haemoglobin of the two ethnic groups

Results

The haematological characteristics of the Munda and Pod women are presented in Table 1. In total, 81.16% of the Pod and 100% Munda women were anaemic (Hb <12.0 g/dl), with 7.6% of the Munda and 2.9% of the Pod women severely anaemic (Hb <7.0 g/dl). Anaemic status expressed as severe, moderate and mild for the women of the two ethnic groups is shown in Figure 1. A greater percentage of severe and moderate anaemia was observed among the Munda. Mild anaemia was more common among the Pod women. It is interesting to note that none of the Munda women had normal haemoglobin status (Hb ≥12.0). Considering the cut-off point for anaemia as ≥12.0 g/dl for non-pregnant women, the prevalence of anaemia was found to be significantly higher among the Munda women (χ^2 = 33.75, df = 3, P<0.001).

Table 1. Anaemic status of the women

Anaemic status	Munda		Pod	
	N	%	*N*	%
Severe (<7.0 g/dl)	8	7.62	4	2.90
Moderate (7.0 -9.9 g/dl)	58	55.24	41	9.71
Mild (10.0 - 11.9 g/dl)	39	37.14	67	48.55
Normal (>_12.0 g/dl)	0	0.00	26	18.84
Total	105	100.00	138	100.00
Mean	9.29		10.61	
χ^2=33.75, df = 3, P<0. 001				

Table 2. Anaemic status and mortality of the women of the two ethnic groups

Anaemic status	Infant mortality	
	Munda	Pod
Severe	25.00	-
Moderate	11.24	5.32
Mild	12.07	7.87
Normal	-	1.96
Total	12.62	5.69

The distribution of haemoglobin concentration in the sample (Fig. 2) indicates that haemoglobin concentration of the Pod women is more towards the normal level (12.0 Hb g/dl) when compared with the Munda women. The age groups of 20-24 years in Munda and 25-29 years among the Pod were mostly affected by severely, moderate and mild anaemia. Infant mortality (Table 2) was found to be highest among the severe anaemic Munda women (25.00), while in the case of the Pod women, normal women had the lowest infant mortality (1.96). Mean, standard deviation and t-test was used to see the differences between the various socio-economic, demographic, dietary factors and BMI with haemoglobin levels (Table 3). Significant differences were observed in the number of live births, household income, intake of protein, iron, folic acid, body mass index, weight and haemoglobin levels between the Munda and Pod women (P <0.001).

The haemoglobin level among the Munda and Pod women between various socio-economic, dietary and anthropometric factors is shown in Table 4. The mean haemoglobin value was lowest in the <30 year old women in both ethnic groups. Non-literate Pod women had a lower mean haemoglobin level (10.11 g/dl) than their literate counterparts. On the contrary, non-literate Munda women had a higher mean haemoglobin level than the literate women. A higher mean haemoglobin level was observed among the working Munda and non-working Pod women.

The mean haemoglobin level was lowest (9.02 g/dl) among the Munda women having <16.0 BMI, which progressively increased with increasing BMI. A similar trend was seen in Pod women. Women above 145 cms height had higher haemoglobin values in both ethnic groups. Higher haemoglobin values were observed among the Pod women who weighed more than 50 kg. Women with higher energy, protein, iron and folic acid intakes (above the recommended values)[24] had higher haemoglobin values in both ethnic groups.

Table 5 shows that significant differences in haemoglobin levels exists between literate and non-literate Pod women (P<0.001). Differences in haemoglobin levels were also noticed between the shorter and taller Pod women (less than or greater than 145 cms) (P <0.001). Pod women weighing more than 50kgs had significantly

Table 3. Summary of characteristics of the women of the two ethnic groups

Variables	Munda *N*	Munda Mean	Pod *N*	Pod Mean	t-test	df
Socio-demographic factors						
No. of live births	127	2.96	174	1.98	5.76**	299
Total activity time	127	1081.57	174	721.55	6.21**	299
Income	127	2824.15	174	3626.54	3.94**	299
Diet intake						
Calorie	94	2220.60	131	2423.64	1.61	223
Protein	94	51.38	131	64.19	2.88**	223
Iron	94	11.07	131	16.54	3.38**	223
Folic acid	94	81.00	131	114.94	4.87**	223
Anthropometric						
Body Mass Index	127	17.70	174	19.20	6.00**	299
Height	127	149.80	174	149.70	0.15	299
Weight	127	39.80	174	43.0	4.92**	299
Haemoglobin (g/dl)	105	9.29	138	10.61	6.70**	241

** Significant at 1% level P<0.001

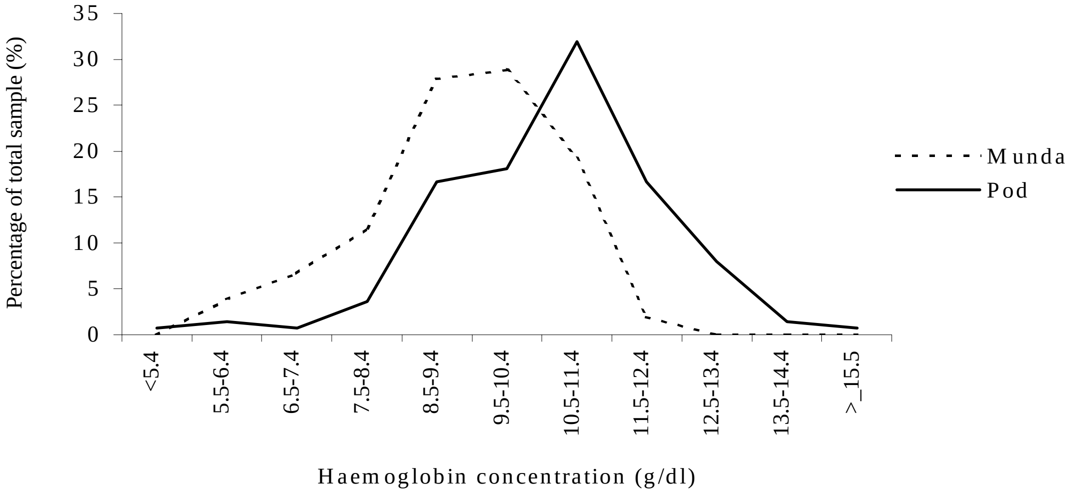

Figure 2. Distribution of haemoglobin concentration (g/dl) among the Munda and Pod mothers aged 14-42 years in the peri-urban region

Table 4. Haemoglobin status of women and factors

	Munda			Pod		
Factors	*N*	Mean	SD	*N*	Mean	SD
Age						
<20	13	9.21	1.37	19	11.44	2.40
20-30	71	9.20	1.37	107	10.47	1.51
30-40	20	9.64	1.32	11	10.37	1.73
≥40	1	9.50	0.00	1	12.30	0.00
Education						
Non-literate	10	9.31	1.35	56	10.10	1.68
Literate	95	9.15	1.44	82	10.95	1.64
Working status						
Working	47	9.41	1.41	61	10.41	1.51
Non-working	58	9.19	1.30	77	10.79	1.83
Body Mass Index						
<16.0	13	9.02	1.45	10	10.59	1.20
16.0-16.9	23	9.20	1.35	9	10.31	0.85
17.0-18.4	42	9.20	1.40	35	10.35	1.68
<18.5	78	9.17	1.38	54	10.39	1.48
≥18.5	27	9.65	1.22	84	10.75	1.82
Height (cms)						
< 145.0	16	9.16	1.38	31	9.91	2.04
≥145.0	89	9.32	1.35	107	10.81	1.53
Weight (kgs)						
<50.0	102	9.32	1.33	123	10.50	1.71
≥50.0	3	8.27	2.02	15	11.48	1.23
Diet intake (RDA, 2000)						
Calorie (kcals)						
<2225	57	9.25	1.33	41	10.53	2.10
≥2225	33	9.49	1.37	65	10.62	1.51
Protein (gms)						
<50	52	9.27	1.37	34	10.68	2.03
≥50	38	9.44	1.32	72	10.54	1.62
Iron (mg)						
<30	88	9.32	1.35	99	10.58	1.78
≥30	2	10.35	0.92	7	10.69	1.48
Folic acid (ug)						
<100	61	9.35	1.25	53	10.51	2.02
≥100	29	9.31	1.54	53	10.67	1.45

Table 5. Test of significance of haemoglobin level between various socioeconomic, anthropometric and dietary factors of the two ethnic groups

Factors	Munda		Pod	
	t	df	t	df
Education	0.349	103	3.00**	136
Work status	0.792	103	1.18	136
Body Mass Index	1.62	103	1.23	136
Height	0.416	103	2.67**	136
Weight	1.34	103	2.14*	136
Calorie	0.826	88	0.245	104
Protein	0.614	88	0.373	104
Iron	1.08	88	0.154	104
Folic acid	0.144	88	0.475	104

*Significant at 5 % (P<0.05), **Significant at 1% (P<0.001)

Table 6. Pearsons correlation among various dependent and independent factors among the adult women of the two ethnic groups

	Age	Live births	Total income	Total expenditure	Food expenditure	Habitual Expenditure	Total activity	Leisure	BMI	Hgb
Munda										
Age	1.00	0.749**	-0.107	0.115	-0.077	0.157	0.037	-0.011	- 0.174	0.085
LB		1.00	-0.059	0.134	-0.018	0.164	0.137	-0.029	- 0.097	0.118
Total Inc			1.00	0.447**	-0.058	-0.208*	-0.127	0.053	0.206*	-0.123
Total exp.				1.00	-0.210*	0.071	-0.161	-0.091	0.127	-0.097
Food exp					1.00	-0.691**	-0.002	0.140	0.034	0.285**
Hab. Exp						1.00	0.078	-0.135	-0.077	-0.087
Total act.							1.00	-0.198*	-0.141	0.038
Leisure								1.00	0.111	0.241*
BMI									1.00	0.089
Hgb										1.00
Pod										
Age	1.00	0.622**	0.161*	0.029	0.009	0.025	-0.031	0.092	0.006	- 0.030
LB		1.00	-0.095	-0.029	- 0.110	0.055	0.061	-0.029	-0.199**	- 0.108
Total Inc			1.00	0.479**	0.575**	0.199**	-0.188*	0.191*	0.185*	0.024
Total exp.				1.00	0.446**	0.241**	-0.006	0.029	-0.042	0.071
Food exp					1.00	0.140	-0.022	0.053	0.100	- 0.124
Hab. Exp						1.00	0.041	-0.091	-0.096	- 0.045
Total act.							1.00	-0.373**	-0.116	- 0.161
Leisure								1.00	0.071	0.026
BMI									1.00	0.146
Hgb										1.00

* Correlation is significant at the 0.05 level (2-tailed) ** Correlation is significant at the 0.01 level (2-tailed), LB=live births, Inc.=income, exp.= Expenditure, Hab.=Habitual, act. =Activity, BMI= Body Mass Index, Hgb= haemoglobin level

higher haemoglobin levels than the women weighing less than 50kg. Pearson's correlation among various socio-economic, demographic factors and BMI and level of haemoglobin is shown in Table 6. The correlation coefficient between age and number of live births was found to be positively associated in both ethnic groups (P<0.01). Number of live births was negatively associated with BMI (P<0.01) among the Pod women, indicating that with increase in live births, body mass index decreases. Total income was found to be positively associated with BMI in both ethnic groups (P<0.05). On the other hand, total expenditure was found to be negatively associated with expenditure on food (P<0.05) among the Munda, while positively associated among the Pod population (P<0.01). Expenditure on food was also found to be negatively associated with habitual expenses (P<0.01) and positively associated with haemoglobin levels of the Munda women. Habitual expenses, like spending money on liquor, was negatively associated with expenditure on food (P<0.01) among the Munda, while no such relationship was observed among the Pod. Time spent outside the home for work was negatively associated with leisure time (Munda- P<0.05, Pod- P<0.01) in both ethnic groups. Haemoglobin level was found to be significantly associated with expenditure on food (P<0.01) and leisure time (P<0.05) among the Munda women. Table 7 indicates that the linear regression coefficient (b ± standard error) for age, number of live births, total income, total expenditure, expenditure on food, expenditure on habitual expenses, total activity time, leisure time and Body Mass Index in relation to haemoglobin level. Expenditure on food was found to affect the haemoglobin level differentially among the two ethnic groups. Among the Munda women with an increase in expenditure on food, haemoglobin level was found to increase, while the reverse was found in the Pod women. Time spent in leisure was also found to be

Table 7. Linear regression coefficients of adult women of both ethnic groups in relation to haemoglobin level

Model	Unstandardized coefficients β	Standard error	Standardized coefficients β	t	Significance *P*
			Munda		
Constant	5.44	1.97		2.764	0.007
Age	0.004	0.041	0.015	0.098	0.922
Live birth	0.051	0.121	0.063	0.422	0.674
Total income	-0.000	0.000	-0.117	-0.765	0.446
Total expenditure	0.000	0.000	0.063	0.416	0.678
Food expenditure	0.003	0.012	0.363	2.59	0.011
Habitual expenses	0.015	0.012	0.173	1.21	0.231
Total activity	0.000	0.000	0.044	0.433	0.666
Leisure	0.004	0.002	0.226	2.20	0.030
BMI	0.000	0.083	0.058	0.572	0.569
			Pod		
Constant	10.41	1.75		5.95	0.000
Age	0.000	0.048	0.002	0.017	0.989
Live birth	-0.135	0.168	-0.094	-0.806	0.422
Total income	0.000	0.000	0.030	0.256	0.799
Total expenditure	0.000	0.000	0.163	1.69	0.093
Food expenditure	-0.000	0.000	-0.229	-2.14	0.034
Habitual expenses	-0.000	0.001	-0.046	-0.522	0.603
Total activity	-0.000	0.001	-0.167	-1.83	0.069
Leisure	-0.000	0.002	-0.028	-0.312	0.756
BMI	0.001	0.067	0.129	1.44	0.153

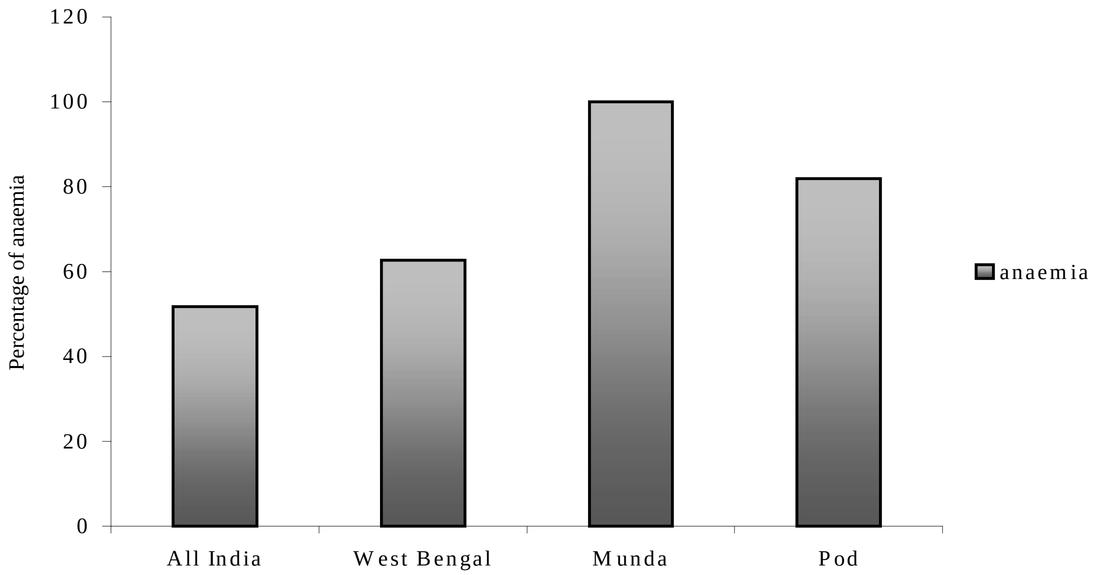

Figure 3. Comparison of anaemic status of the Munda and Pod mothers with India and West Bengal data

significantly affecting the haemoglobin level among the Munda (*P*<0.05).

Discussion

The study was undertaken to estimate the prevalence of anaemia among women of two ethnic groups in the peri-urban region of Kolkata (metropolitan city), India. Very few micro-level studies on health aspects, in the peri-urban areas, have been conducted in India. Therefore the study was designed to produce results for further research and public health interventions. Among the various ethnic groups covered during the preliminary investigation, the vulnerable ones (the schedule caste and tribes as recognised by the government of India) were isolated. The most alarming is that none of the Munda women had normal haemoglobin levels (≥12.0g/dl). Severe, moderate and mild anaemia was mostly observed in the 25-29 year age group among the Munda and 20-24 year age group among the Pod population. The lowest haemoglobin level was noticed among the <30 year old women (Table 4). This is the child bearing and rearing period making them more prone to anaemia. However the Munda women suffer more from severe, moderate and mild anaemia than the Pod women. High rates of live births, heavy workload and poor diet (shown in Table 3) are probably responsible for this anaemic condition among the Munda women.

However, a greater percentage of women of both populations were found to be anaemic than the all India level[26] and the state of West Bengal (Fig. 3).

Analysis of various micro-level factors demonstrated that consistent differences exist in socio-economic, dietary and anthropometric measurements between the two ethnic groups. This peri-urban area lacks proper sanitation and deteriorating infrastructure with respect to socio-economic conditions. The living standards of the Munda is poor. Increased expenditure on alcohol and illiteracy (Tables not shown) are common among the Munda. As a result, the Munda women have to work hard to earn their living. The needs of the family are so great that pregnant Munda women keep working after six months of pregnancy and resume work soon after child birth (tables not shown). In contrast, the Pod population possess land and the women therefore do agricultural activities near their home and tend to remain at home during pregnancy. High rates of live births and low intakes of protein, fat and iron among the Munda women are quite common. Repeated pregnancies can lead to progressive depletion of iron stores. Thus the potential for a lower haemoglobin concentration and low BMI among the Munda women is quite high. This can be observed in Table 4 where the mean haemoglobin level increased with an increase in BMI. Leisure time was found to be significantly affecting haemoglobin levels of the Munda women. This suggests that a heavy work load may be contributing to lower haemoglobin levels because they are not getting sufficient time to rest, but need to work more for greater income. Low earnings may be reducing the quality of foods consumed resulting in anaemia.

Significant differences in haemoglobin levels were also observed among Pod women who were taller (height ≥145 cms) and heavier (≥50 kg). In case of the Pod population, significant differences (P <0.001) in haemoglobin levels were noticed between the literate and non-literate women. None of the women were found to be taking iron tablets (probably due to illiteracy) provided by the ANC (Antenatal care) members. This finding suggests that the efforts made by the government to improve iron status are not effective. Multiple regression analyses indicated that expenditure on food was an important determinant of the haemoglobin levels among the Munda women. Total expenditure of the Munda was found to be negatively associated with expenditure on food, indicating that the Munda population likes to spend more on other items rather than on food. Moreover the correlation coefficient (as indicated in Table 6) indicated that expenditure on food was negatively associated with habitual expenses, i.e. when expenditure on food increases, expenditure on liquor decreases and may have resulted in an increase in haemoglobin levels among the Munda. So Munda households spending more on food, instead of liquor, seems to have a positive effect on the haemoglobin status among their women. But among the Pod population, the correlation coefficient was positively associated with expenditure on food. However, linear regression analysis revealed that expenditure on food was negatively affecting the haemoglobin level of the Pod women. Disparity in sharing of food is quite common in India and in West-Bengal.[27-29] A study by Basu *et al*.,[30] on food sharing revealed that there exists differences in food sharing among the adult males and females in the households of the Chakpota village. The Pod population may have disparity in food sharing as caste populations in India show more disparity in food sharing than the tribes.[31,32]

The problems of anaemia, which is highly prevalent in South Asia, including India, is not so easy to eradicate unless the population becomes aware and changes their belief systems and attempt equality in food sharing. From the present study it can be concluded that the problem of anaemia is due to the factors (food expenditure, disparity in food sharing in the household, leisure time) which are population and location specific. Therefore primary education should be intensified and awareness programs should be imparted in order to bring equality in healthcare behaviour at the household level among various populations. Moreover, differences in mean iron intakes below and above the recommended value shows differences in mean haemoglobin levels in both ethnic groups. Very few women take iron in food above the recommended value (30 mg), which may be one of the reasons for the high prevalence of anaemia in both populations. Intensive facilities for iron supple-mentation during pregnancy and intermittent provision of iron should be strengthened. More extensive iron fortification of cereals like rice and wheat, might improve haemoglobin status via the staple food of this region of India. Thus, no single intervention will solve the iron problem, although fortification should play a central role. Supplementation of at-risk groups (including young children), fortification, dietary modification (equality of food sharing), parasitic disease control and the overall education of policymakers, professionals and the public, all have their place.

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