Original Article

Haematological screening and its correlation with sociodemographic profile among the indigenous communities in and around Puducherry

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Abstract

Background: Haemoglobin disorders are unique and important health challenges for tribal populations. Hence, this study was undertaken with the aim to screen for haematological disorders, particularly anaemia and haemoglobinopathies, and to assess the sociodemographic profile in indigenous communities residing in and around Puducherry. **Methods:** This was a community-based cross-sectional study conducted in both urban and rural areas of Puducherry district. We included 556 participants through convenient sampling. Trained research associates visited community to enrol eligible participants and sought information on sociodemographic parameters, health status, and disease profile, using a structured questionnaire; 2–3 ml of blood was collected in ethylene diamine tetra acid anticoagulant for analysis of haematology parameters. **Results:** Median age of participants was 28 (17–42) years. Majority (58.8%) of the participants were female, married (52.8%). On thalassemia screening, none of the study participants had any haemoglobinopathy. The burden of anaemia among the study population was 38.7% (95% CI: 34.6–42.8%) and was higher among the female participants in both adolescent (54.5%) and adult (57.8%) age groups. The next common haematological abnormality observed was eosinophilia 21.4% (95% CI: 18–25%), more prevalent among males in the age group of 30–60 years. **Conclusion:** More than half of the women were anaemic. Multidimensional planning and implementation are needed to improve the socio-economic profile and overall health of this vulnerable population.

Keywords: Anaemia, eosinophilia, haemoglobinopathy, indigenous communities, tribal population, thalassemia

Introduction

Indigenous or tribal population in India accounts for 8.2% of the total population, inhabiting widely varying ecological and geo-climatic conditions, predominantly in rural and remote areas, with different cultural and socio-economic backgrounds.[1,2] Their geographically isolated habitats and limited integration into the mainstream of socioeconomic activities have led to their lower educational and economic attainment with poor effect on their health and health-seeking behaviour.[3] Diseases affecting this population vary from area to area, depending on the environmental and social conditions and cultural practices prevalent in each area.[4] Climate and environmental factors are directly or indirectly associated with the sociocultural practices of the habitats and together have an important influence on their evolutionary history.

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Among haematological diseases in the community, anaemia is widely prevalent. As per World Health Organization (WHO), anaemia is a serious global public health problem, particularly in low-income settings, especially prevalent in young children and women of childbearing age. Iron deficiency is thought to be the most common cause of anaemia globally, but other nutritional deficiencies, chronic inflammation, parasitic infections, and inherited or acquired disorders affecting haemoglobin synthesis, red blood cell (RBC) production, or RBC survival can all cause anaemia.[5]

Thalassemia and other haemoglobinopathies (production of structurally defective genes) are the most common monogenic disorders in the world. Haemoglobinopathies and thalassemias are more common in the Indian subcontinent.[6] A large hospital-based screening study conducted in West Bengal reported the prevalence of beta-thalassemia and haemoglobinopathy (HbE trait) as 4.6% and 3.02%, respectively.[7] The high frequency of haemoglobin disorders compared with other monogenic diseases can be attributed to several factors such as natural selection, whereby the disease carriers have been protected during evolution from severe malaria, high frequency of consanguineous marriages, and epidemiological transition.[8]

Haemoglobin disorders are unique and important health challenges for tribal population of India in the Northeast, West Bengal, Odisha, Madhya Pradesh, and Andaman and Nicobar Islands.[9] As there is a high prevalence of haemoglobin disorders among the tribes and there is no previous study among the tribes located in and around Puducherry, this study was undertaken with the aim to screen for haematological disorders, particularly anaemia and haemoglobinopathies, and to assess the sociodemographic profile in the indigenous communities residing in and around Puducherry.

Methodology

Study setting

We conducted a community-based cross-sectional study in Puducherry district located along the eastern coast of southern India. The population of Puducherry district is 0.98 million that accounts for 76% of the total population of Union territory with majority residing in urban areas. The district has sex ratio of 1029, life expectancy (68.35 years), and literacy rate of 85.44%. Puducherry stands seventh in Human Development Index compared to other Indian states.[10] This survey was conducted in both urban and rural areas where the indigenous communities reside in isolated geographic areas of Puducherry district which was identified from available census data, online resources, and enquiry from the community settlements.

Study permission and participants

Before start of the study, approval was sought from the Adi Dravidar and Tribal Welfare Departments of Tamil Nadu and Puducherry. The study was approved by the institute scientific advisory (JSAC/48/2017/75) and ethics (JIP/IEC/2017/0291) committees. We visited all the areas where the tribal population were located in and around Puducherry. All adolescents including few older children and adults residing in study area were enrolled in this study after taking informed written consent/assent wherever applicable. We included 556 participants through convenient sampling where the tribal population located.

Data collection and sampling procedure and tool

Trained research associates visited community/home to enrol eligible participants and sought information on sociodemographic parameters, health status, and disease profile, using a questionnaire developed for the study. Thereafter, 2–3 ml of blood was collected at home of the study participants in ethylene diamine tetra acid anticoagulant vial by venepuncture using a disposable syringe under all aseptic precautions for haematology analysis.

Sample processing

All blood samples were transported within 4 h in an icebox to the haematology laboratory of pathology department and all investigations were carried out using standard procedures. Complete blood count (CBC) which included haemoglobin level (Hb), haematocrit, RBC indices, white blood cell (WBC), and platelet counts was estimated by automated haematology analyser (XT4000i, Sysmex corporation, Kobe Japan) and a Leishman-stained peripheral smear was examined. Blood grouping was performed by slide method using standard antisera. The samples were further analysed in automated high-performance liquid chromatography (ADAMS A1C HA-8180T, ARKRAY, Inc., Kyoto Japan) in batches for screening of haemoglobinopathies and thalassemias.

Operational definitions

As per WHO, haemoglobin level of ≥11 g/dl was considered to be normal, 9.0–10.9 g/dl, 7.0–8.9 g/dl, and <7.0 g/dl were considered to be mild, moderate, and severe anaemia, respectively.

The cut off values used for RBC count, red cell distribution width, packed cell volume, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration, WBC, and platelet counts were as per standard criteria.

HbA_2 (<1.5: low, 1.5–3.79: normal, ≥3.8: increased), HbF (0–2: normal, >2: increased), HbA_{1c} (4–6: normal, >6: increased), and any variant haemoglobin peak would be considered abnormal. In conjunction with other RBC parameters, high HbA_2 would be considered as suggestive of β thalassemia trait, low HbA_2 would be considered as suggestive of α thalassemia trait, and presence of variant haemoglobin fraction would suggest a haemoglobinopathy.

Table 1: Sociodemographic characteristics of the study population (*n*=556)

Personal characteristics	Both gender (*n*=556) *n* (%)	Male (*n*=229) *n* (%)	Female (*n*=327) *n* (%)
Age categories			
<18	144 (25.9)	78 (34.1)	66 (20.2)
18–29	147 (26.4)	72 (31.4)	75 (22.9)
30–60	139 (25.0)	65 (28.4)	160 (48.9)
>60	126 (22.6)	14 (6.1)	26 (7.9)
Religion			
Hindu	554 (99.6)	228 (99.6)	326 (99.7)
Muslim	1 (0.2)	1 (0.4)	0 (0)
Christian	1 (0.2)	0 (0)	
Caste/Community			
OBC-vanniar	1 (0.18)	1 (0.4)	0 (0)
Scheduled caste	237 (42.3)	101 (44.1)	136 (41.6)
Scheduled tribes			
Kuruman	102 (18.3)	42 (18.3)	60 (18.3)
Narikuravar	98 (17.6)	52 (22.7)	46 (14.1)
Malaikuravan	71 (12.7)	24 (22.7)	47 (14.4)
Irular (Vettaikaran)	42 (7.5)	9 (3.9)	33 (10.1)
Irular	5 (0.9)	0 (0)	5 (1.5)
Marital status			
Married	294 (52.8)	92 (40.2)	202 (61.7)
Unmarried	234 (42.1)	136 (59.4)	98 (30.0)
Divorced	1 (0.2)	0 (0)	1 (0.3)
Widow	27 (4.9)	1 (0.4)	26 (7.9)
No. of children (min–max)	(1–9)	(1–7)	(1–9)
Educational status			
No formal education	184 (33.1)	55 (24.0)	129 (39.4)
Primary	102 (18.3)	40 (17.5)	62 (19.0)
High school	194 (34.9)	94 (41.1)	100 (30.6)
Higher secondary	56 (10.1)	29 (12.6)	27 (82.3)
Graduate and above	20 (3.6)	11 (4.8)	9 (2.7)
Occupation			
Student	141 (25.4)	73 (31.8)	68 (20.8)
Unemployed	155 (27.8)	40 (17.5)	115 (35.2)
Hunting	2 (0.4)	1 (0.4)	1 (0.3)
Farming	26 (4.7)	6 (2.6)	20 (6.1)
Self-employed	25 (4.5)	9 (3.9)	16 (4.9)
Labourer	204 (36.7)	99 (43.2)	105 (32.1)
Others	3 (0.5)	1 (0.4)	2 (0.6)
Income (Rs.)/Annum (*n*=258)			
Up to 10,000	247 (95.0)	107 (93.0)	140 (97.9)
10,001–20,000	8 (3.1)	5 (4.4)	3 (2.1)
20,001–30,000	2 (0.7)	2 (1.7)	0 (0)
Above 30,000	1 (0.4)	1 (0.9)	0 (0)

Statistical analysis

Data were entered in Microsoft Excel and the analysis was done using STATA version 14.0. Categorical variables such as age groups, gender, residence, marital status, education, occupation, and other sociodemographic characteristics were summarised as proportion and continuous variables such as haematological profiles were summarised as mean (SD) or median (IQR). The distribution of blood parameters was summarised as proportions. Anaemia and eosinophilia prevalence were summarised as proportion with 95% CI. Binomial family and log link were run for identifying the factors associated with anaemia and eosinophilia; adjusted prevalence ratio (aPR) with 95% CI was reported.

Results

Sociodemographic characteristics of the study population

Median age of participants was 28 (17–42) years in the study population [male: 22 (16–37) and female 32 (20–47) years]. Majority (58.8%) of the participants were female, married (52.8%), and belonged to scheduled caste (42.3%).

Almost all the married participants had history of consanguineous marriage. More than one-third (35%) of the population had completed high school. Nearly 30% of them were unemployed and more than 95% of the population had income less than Rs. 10,000 per annum [Table 1].

Haematological profile of the study participants

The mean (SD) value of the haematological parameters is represented in Table 2. The mean values of both CBC and Hb HPLC parameters overall were within the normal range for both male and female population. On categorisation of the important CBC parameters, most of the parameters were in the normal range except MCV and MCH which was low in a sizable proportion of the study participants (27.5% and 33.2% in males and 37.6% and 50.5% in females, respectively) indicating microcytic hypochromic indices likely due to iron deficiency. Deviations in the haematological screening parameters are summarised in Table 3.

The burden of anaemia among the study population was 38.7% (95% CI: 34.6–42.8%) and was high among the female participants in both adolescent (54.5%) and adult (57.8%) age groups. More than half of the female participants were anaemic 57.1% (95% CI: 51.6–62.6%). Apart from anaemia, the next most common haematological abnormality observed was eosinophilia 21.4% (95% CI: 18–25%). The prevalence of eosinophilia was marginally more among males across all age groups. It was also found to be that the eosinophilia was more prevalent among males in the age group of 30–60 years [Table 4].

On thalassemia screening, none of the study participants had any haemoglobinopathy or α- or β-thalassemia carrier state. All the HPLC parameters such as HbA0, HbA2 level, and HbF levels were normal; HbA1c level was found to be increased among 7.4% of the population.

Table 2: Mean values of haematological parameters of the study population (*n*=556)

Parameters	Male (M±SD)	Female (M±SD)
Haemogram		
Haemoglobin (g/dl)	13.9±1.8	11.4±1.6
Red blood cell count ($\times10^{12}$/L)	4.9±0.5	4.4±0.5
Red cell distribution width CV (%)	13.7±1.6	14.6±2.4
MCV (fL)	83.0±6.9	80.9±8.1
MCH (pg)	28.1±5.3	26.0±5.3
MCHC (g/dl)	33.5±1.7	32.1±2.4
PCV (%)	41.3±5.4	35.8±5.1
WBC count ($\times10^{9}$/L)	8.1±2.2	8.3±2.4
Platelet count ($\times10^{9}$/L)	277.6±69.2	296.4±79.8
HPLC		
HbA_0 (%)	89.4 (89–89.8)	89.3 (88.8–89.7)
HbA_2 (%)	2.9±0.22	2.7±0.29
HbF (%)	0 (0–0)	0 (0–0.1)
HbA_{1c} (%)	5.3 (5.1–5.5)	5.4 (5.2–5.6)

The most common blood group in the study population was B positive followed by O positive [Figure 1].

Relationship between sociodemographic features and haematological profile of the study participants

Table 5 shows the factors associated with anaemia, eosinophilia, and anaemia among female study participants. Unadjusted model was run with age, gender, marital status, education, occupation, and income. Out of this education had *P* -value more than 0.20 with anaemia, hence it was excluded from the multivariate analysis. After adjusting with the above parameters, the prevalence of anaemia was higher among females. The same set of variables were used to assess the factors associated with eosinophilia, where we found marital status, occupation, and education *P* -value were

Table 3: Haematological parameters of the study population (*n*=556)

Categories	Male (*n*=229) *n* (%)	Female (*n*=327) *n* (%)
Haemoglobin levels (g/dl)		
Normal (≥11)	201 (87.7)	140 (42.8)
Mild anaemia (9–10.9)	16 (6.9)	85 (25.9)
Moderate anaemia (7–8.9)	11 (4.8)	86 (26.3)
Severe anaemia (<7 g)	1 (0.4)	16 (4.9)
Red blood cell counts ($\times10^{12}$/L)		
Decreased (<4.2)	11 (4.8)	102 (31.2)
Normal (4.2–5.6)	200 (87.3)	222 (67.9)
Increased (>5.6)	18 (7.9)	3 (0.9)
Red cell distribution width (%) (*n*=536)		
Decreased (≤11.4)	2 (0.9)	1 (0.3)
Normal (11.5–14.5)	185 (81.9)	197 (63.5)
Increased (≥14.6)	39 (17.3)	112 (36.1)
PCV levels (%)		
Low (<35)	24 (10.5)	117 (35.8)
Normal (35–45)	160 (69.9)	204 (62.4)
High (>45)	45 (19.6)	6 (1.8)
MCV levels (fL)		
Low (<80)	63 (27.5)	123 (37.6)
Normal (80–100)	164 (71.6)	203 (62.1)
Increased (>100)	2 (0.9)	1 (0.3)
MCH levels (pg)		
Low (<27)	76 (33.2)	165 (50.5)
Normal (27–32)	141 (61.6)	154 (47.1)
Increased (>32)	12 (5.2)	8 (2.5)
MCHC levels (g/dl)		
Low (<30)	5 (2.2)	45 (13.8)
Normal (30–36)	211 (92.1)	279 (85.3)
Increased (>36)	13 (5.7)	3 (0.9)
WBC levels ($\times10^{9}$/L)		
Leukopenia (<4.0)	9 (3.9)	16 (4.9)
Normal (4.0–11.0)	194 (84.7)	265 (81.0)
Leukocytosis (>11.0)	26 (11.3)	46 (14.1)
Platelet count ($\times10^{9}$/L) (*n*=554)		
Thrombocytopenia (<150)	3 (1.3)	7 (2.1)
Normal (150–450)	220 (96.9)	304 (93.0)
Thrombocytosis (>450)	4 (1.8)	16 (4.9)

more than 0.20. After excluding the parameters in multivariate analysis, the participants in the age group of 30–60 years had more prevalence of eosinophilia. The factors associated with anaemia among female study participants are given in Table 5.

Discussion

Indigenous communities are vulnerable to many health challenges due to their lower socioeconomic and educational attainments. Haematological disorders are one among the several health issues which can affect them. One such is hereditary disorders of globin chains: thalassemias and haemoglobinopathies, which are known to have high prevalence in certain geographically insulated population. However, in the current study we found that, on thalassemia/haemoglobinopathy screening, none of the study participants had haemoglobinopathy or β-thalassemia carrier state. On screening of other haematological parameters, we found that anaemia was prevalent among them to the tune of 38.7% (95% CI: 34.6–42.8%), which was more so among the female study participants (57.1%). It was also found that 25.9%, 26.3%, and 4.9% were mild, moderate, and severe anaemic, respectively.

The anaemia prevalence of the current study is in line with the global prevalence and the National Family Health

Table: 4 Prevalence of anaemia and eosinophilia (*n*=556) among age and gender categories

Age category	Gender	Anaemia *n* (%)			Eosinophilia *n* (%)
		Mild	Moderate	Severe	
<18 years	Male	12 (15.4)	2 (2.6)	0	18 (23.1)
	Female	20 (30.3)	14 (21.2)	2 (3.0)	11 (16.7)
18–29 years	Male	1 (1.4)	5 (6.9)	0	20 (27.8)
	Female	22 (29.3)	16 (21.3)	5 (6.7)	6 (8.0)
30–60 years	Male	1 (1.5)	3 (4.6)	0	20 (30.7)
	Female	38 (23.7)	41 (25.6)	8 (5.0)	34 (21.2)
>60 years	Male	2 (14.3)	1 (7.1)	1 (7.1)	2 (14.3)
	Female	5 (19.2)	15 (57.7)	1 (3.8)	8 (30.7)
Total	Male	16 (6.9)	11 (4.8)	1 (0.4)	60 (26.2)
	Female	85 (25.9)	86 (26.3)	16 (4.9)	59 (18.0)

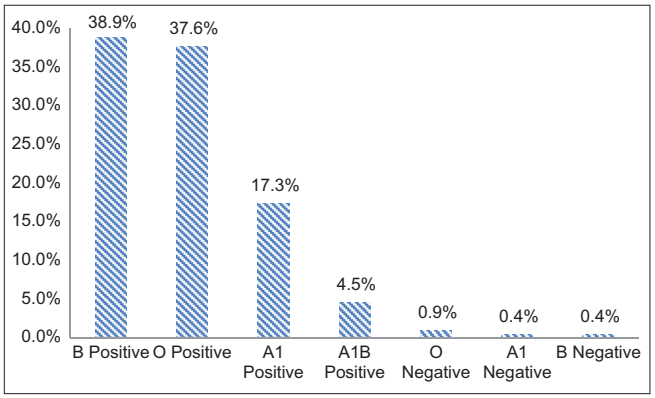

Figure 1: Blood group distribution of the indigenous population in and around Puducherry (*n* = 556)

Table 5: Prevalence of anaemia and eosinophilia as per sociodemographic characteristics of the study participants

Variables	Anaemia aPR (95% CI)	Eosinophilia aPR (95% CI)	Anaemia among female aPR (95% CI)
Overall prevalence^	38.7% (34.6–42.8%)	21.4% (18–25%)	57.1% (51.6–62.6%)
Age categories			
<18	2.4 (0.7–8.0)	2.1 (0.7–6.4)	1.1 (0.2–5.7)
18–29	1	1	0.4 (0.1–1.2)
30–60	0.6 (0.5–0.9)*	1.7 (0.9–3.3)*	1
>60	1.1 (0.6–1.9)	1.6 (0.5–5.1)	1.3 (0.6–2.9)
Gender			
Male	1	1.2 (0.7–2.0)	NA
Female	6.0 (3.2–11.2)*	1	NA
Marital status			
Married	2.1 (0.9–4.7)	–	1.9 (0.3–10.8)
Unmarried	1	–	1
Widow/Divorce	3.2 (1.3–7.7)	–	2.3 (0.3–15.1)
Educational status			
No formal education	–	–	–
Up to high school	–	–	–
Higher secondary	–	–	–
Graduate and above	–	–	–
Occupation			
Student	1.1 (0.8–1.5)	–	1.6 (0.5–4.5)
Unemployed	1.2 (0.9–2.1)	–	0.8 (0.4–1.7)
Self-employed	1.3 (0.9–1.7)	–	1.3 (0.7–2.7)
Labourer	1	–	1
Income (Rs.)/Annum (*n*=258)			
Up to 10,000	1.4 (0.7–2.7)	0.5 (0.2–1.3)	–
Above 10,000	1	1	–

*Statistically significant, ^prevalence (95% CI)

Survey (NFHS-5).[11,12] A study from eastern and North-Eastern India shows higher prevalence of anaemia among tribal population compared to the present study, the difference could be due to the variation of population characteristics and the level of health-related awareness.[13] A systematic review from Kerala and the other studies from Kerala and Karnataka were also in line with the findings.[14–16] However, a community survey from Puducherry reports less prevalence of anaemia (22.8%) among the general population;[17] it indicates that the burden of anaemia is higher among the indigenous population. The difference may be due to the variations among social groups.

The current study shows that more than half of the female study participants were anaemic; this was in congruence with the NFHS-5 key indicators of Puducherry.[12,14] A study from Karnataka reports 89% of the tribal women were anaemic; though the current study finding had lower prevalence than this. Still it indicates that burden of anaemia among tribal women were higher as per WHO guidelines. Hence, a plan to implement comprehensive strategy on maternal, infant, and young child nutrition among the tribal population is urgently needed. The current study also indicates that around 30% of women of reproductive age were anaemic; it affects the continuum of care and increases the risk of maternal mortality. Hence, it is important to provide equity-based care to the tribal population in order to achieve the global target of anaemia by 2025.[18] We have also found that the prevalence of anaemia was 2.5 times higher among the adolescents, though it was not statistically significant. To address the issue, it is important to improve nutritional requirements among these children. Focussing upon the nutrition programming for tribal children will provide a guide to improve the adolescence health.[19]

The second most common haematological disorder among the study population was eosinophilia 21.4%. A study conducted in North India reports that the prevalence of eosinophilia ranges between 1% and 6% among the rural population. The current study shows a higher prevalence. The higher prevalence could be due to greater prevalence of parasitic and fungal diseases among the indigenous population. We also found that the prevalence of eosinophilia was more among males as compared with females. In adjusted analysis after adjusting for other sociodemographic characteristics, we found that prevalence of eosinophilia was 1.7 times significantly higher among the age group of 30–60 years. This implies that the prevalence was higher among the working population both in males and females. It could be due to exposure of dust particles in their environment leading to allergic reactions, which in turn could lead to increase in the eosinophil count. Implementation of behaviour change communication, through organised tribal community, peer education, and providing the livelihood promotion will provide the support to modify their lifestyle.

Strengths and limitations

The study was conducted among the indigenous population where similar studies have not been done. Since this study gives the prevalence of anaemia and other derangements of other basic haematological parameters in a vulnerable population, this could be considered the strength of the study. As the current study uses convenient sampling for including the participants, the generalisability of the study is limited; this could be considered a limitation of the study.

Conclusion

The burden of anaemia was high among the study population, and more than half of the tribal women were anaemic. The second most common haematological disorder was eosinophilia, the prevalence being higher among males in the age group of 30–60 years. Burden of thalassemia and haemoglobinopathies was found nil in the study participants which can be considered as lower compared to other regional studies among indigenous populations.

Future Direction

As the survey was conducted in the area where similar study had not been conducted, this study provides information regarding existing burden of common haematological diseases, especially anaemia among the tribal community in and around Puducherry. This could help the policy makers for implementing strategies for treatment and control. As the current study using convenient sampling, future research can be undertaken in a larger population to increase the generalisability of the findings and a follow-up study can be conducted on the same population by providing interventions to improve the haemoglobin level.

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Institute Ethics Committee Approval Number: JIP/IEC/2017/0291.

Key points

1. More than half of the tribal women were anaemic.
2. Eosinophilia was the second most common haematological disorder and higher in males.
3. On thalassemia screening, none of the indigenous population were found to have any haemoglobinopathy.
4. Policy makers should focus on the vulnerable population to ensure the provision of equitable care.

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Conflicts of interest

There are no conflicts of interest.

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