Research Article

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Cord blood analysis for quicker understanding of health status of community

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ABSTRACT

Background: Cord blood screening of a community could be an easy approach to get an understanding of health status of a community. Hematological and genetic analysis of cord blood is well accepted for gathering information on anemic, congenital defects, infections and genetic disorders in neonate. This information is then used for treatment and preventive therapy. In countries like India, which largely vary in its community setups and its hygiene, the nutritional parameters such studies would be helpful in formulation of customized strategies for upbringing of health in these communities.

Methods: In this study we have conducted and compared cord blood haematology screening at rural and urban regions of Odisha which differ specifically in their socio-economic status and genetic but not in other parameters like climatic and environmental status. The rural neonates of Odisha are from low income groups and reside in comparatively unhygienic conditions than urban neonates with middle income background.

Results: It was observed that the two populations differ in their lymphocytes and granulocytes counts suggesting differences in infection status of neonates. A difference in mean cell volume and mean cell hemoglobin values were also observed indicates genetic differences in genes related to hematology.

Conclusions: Our data shows the effectiveness of cord blood screening of a community to get an assessment of its health status and suggests similar studies on cord blood screening for other parameters like nutritional status of a community. Information so obtained may be used as preventive therapy for stunting, malnourishment etc. to a particular community.

Keywords: Newborn, Haematology, Lymphocytes, Nutritional status

INTRODUCTION

Haematological values depend on multiple factors such as age, gender and genetics of the individual, environmental, and social-economic factors.1 Cord blood haematology of a neonate not only depends on the genetics of the newborn but also on maternal genetics, environment and socio-economic status of the mother. Environmental factors like smoke, lead and benzene

pollution has also been shown to have an impact on haematological profile of the individuals residing in regions with high levels of these elements.3,4 Environmental influence of pollution has also been seen to be transmitted to the fetus through exposed mothers.⁵⁻⁸ The haematological indices like RBC, MCV, MCHC and PCV and also nutritional status were significantly correlated between parents and their newborns, indicating involvement of socio-economic or genetic factors. 9,10

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These previous studies suggest that neonatal haematological parameters are influenced by genetic, socio-economic status as well as various environmental factors experienced by the pregnant mother. These factors are known to differ in rural and urban regions that may act as a modifier of morbidity related to hemoglobinpathy conditions among children from these regions. Therefore, objective of the present study was to determine any significant difference that may exist between haematological parameters of umbilical cord blood of normal neonates from rural and urban areas of Odisha, India. The results of this study could be further extrapolated to haematological diseases and morbidity pattern specific to rural and urban areas.

However, in this study we hypothesize that any difference in cord blood haematology of communities considered in this study would be due to difference in their socio-economic status and genetics only. Other parameter i.e., environmental condition is more or less similar as both the populations are from Odisha and the urban population is from Bhubaneswar, Odisha, India, which has not undergone much urbanization leading to high levels of pollution, which may affect cord blood parameters. Therefore, a cord blood haematological comparison between this rural and urban community of Odisha is considered.

METHODS

The study was approved by the institutional ethical committee. Informed written consent was taken from the parents of all the neonates for hemoglobinpathy screening. It was a cross-sectional comparative study of haematological parameters of the cord blood collected from district hospital, Kalahandi, Bhawanipatna, and from capital hospital, Bhubaneswar, Odisha, India. Total 144 cord blood samples from normal neonates were collected under sterile condition. Samples from capital hospital, Bhubaneswar represents urban neonatal population whereas a sample from district hospital Kalahandi, Bhawanipatna represents rural neonatal population. Capital hospital is situated in the city of Bhubaneswar and receives delivery cases from nearby areas. These cases belong to middle income group whereas district hospital, Kalahandi is situated in the centre of Bhawanipatna town surrounded by several villages and therefore receives cases from these villages with low income groups.

Haemoglobin (Hb), mean cell haemoglobin concentration (MCHC), red blood cell count (RBC), mean cell volume (MCV), mean cell haemoglobin (MCH), haematocrit (HCT), white blood cell (WBC), lymphocytes (LYM), monocytes (MON), granulocytes (GRA), red blood cell distribution width (RDW), thrombocytes (THR), mean platelet volume (MPV), plateletcrit (PCT), platelet distribution width (PDW) were measured by using automated cell counter MS4 (Melet schloesing laboratories, Germany).

All the cord blood samples were analysed for quantification of Hb type by using Hb variant classic (Bio Rad, USA), β -thal short program. Based on the time of elution (retention time) normal or variant haemoglobin was identified. Those found to be having any β -hemoglobinpathy condition was excluded from the study to avoid variation in haematological profiles due to such conditions.

The mean values, range and standard deviations of the mother's age, neonatal weight and haematological values were calculated. Association and correlation between various haematological parameters of two geographical setups was carried out using SPSS version 17. Non-parametric analysis was carried out to find the data distribution for continuous variables. Non-normally distributed variables were subjected to univariate Mann-Whitney analysis, and for normally distributed Students't-test were applied. Multivariate regression analysis was carried out for removing the effect of confounding factors like sex on association with haematological parameters.

RESULTS

A total of 144 cord blood samples, 100 from district hospital, Kalahandi and 44 from capital hospital, Bhubaneswar were collected for the study and analysed. Mean weight of male and female neonates was shown to be significantly higher in urban as compared to rural area (p=0.026). There was no difference in sex ratio between the neonates born at the two locations (Table 1).

Table 1: Demographic details of study subjects.

	Male neonate		Female neonate		Mean Age±SD of Mother (year)
	Number (%)	Mean Wt±SD	Number (%)	Mean Wt±SD	
Urban (n=44)	20 (45%)	3.01±0.53	24 (54%)	2.96±0.46	25±3.69
Rural (n=100)	44 (44%)	2.84±0.46	56 (56%)	2.72±0.39	24±4.1

Values of weight, WBC, MCV, MCHC, MPV and PDW were not found to be normally distributed and therefore subjected for Mann-Whitney tests. Normally distributed parameters were checked for association by T-test. LYM, GRA, MCV and RDW were found to be significantly different between these two groups on adjusting for sex. The p-value obtained stands multiple corrections. MON, MCH and MPV showed a trend of association. Median

LYM, RDW and MPV was low in urban cord blood when compared to rural, whereas, median GRA and MCV was low in rural than in urban (Table 2). Haematological associations were adjusted with maternal age and found that associations like THR, PCT and PDW did not stand adjustment. Higher percentages of neonates from rural region had above normal range of LYM and lower GRA counts (rural=67%, urban=36%).

Table 2: Haematological differences	between urban and	d rural core	d blood	d samples.
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Haematological parameter	Urban (Mean ±SD)	Rural (Mean ±SD)	P value
WBC (thousands/mm ³)	10.38±5.7	9.58±4.3	
LYM%	62.15±14.9	70.5±13.5	1.9E-04* [#]
MON%	4.3±1.7	4.9±1.9	0.007#
GRA%	32.85±15.3	23.9±12.9	1.5E-04* [#]
RBC (million/ mm ³)	3.97±0.73	4.12±0.74	0.08
MCV (fl)	107.75±9.15	99±13.8	7e-06* [#]
HCT (%)	41.9±7.94	41.3±5.8	
MCH(pg)	32.9±5.5	30.3±4.2	0.007#
MCHC (g/dl)	32.25±4.2	31±3.7	
RDW	10.3±0.78	10.9±0.7	0.001*#
HB (g/dl)	12.9±2.2	12.8±1.7	
THR (million/ mm ³)	189.5±96.3	213±84.6	0.05
MPV (fl)	8.4±0.4	8.6±0.5	0.01#
PCT%	0.16±0.08	0.195±0.07	0.03
PDW	8.65±3.7	9.5±3	0.07

^{&#}x27;*' p-value stands multiple correction; '#' remained significant on adjusting for maternal age

A significant difference in levels of HbA2 (p=0.019; OR=5.12; 95% CI=1.30 - 20.06) was observed between cord blood samples from urban and rural area. Cord blood samples obtained from urban area showed an overall low median level of HbA2 than rural. No significant difference was observed in HbF and HbA0 levels. A significant positive correlation with LYM (p=0.001, r²=0.295) and a negative correlation with GRA p=0.004, r²= -0.255) was observed with HbA2.

DISCUSSION

Cord blood haematology is a reflection of neonatal genetic effect and maternal factors. Major maternal factor, her socioeconomic status, has been reported to have an effect on cord blood haematology. 11 Proportion of anaemia in pregnant mothers was documented to be high in rural India than in urban. 12 This could be due to difference in nutritional factors and socio-economic status of these two regions. Other maternal factors such as mode of delivery have an impact on cord blood haematology.2 Therefore, in our study we considered only vaginally delivered normal neonates in order to control cord blood haematological difference due to this factor. All these studies suggested that maternal socioeconomic status will have a greater impact on cord blood haematology and thus, the two communities (selected for this study) with big socio-economic differences would be ideal communities for our study. In our study a significant difference was found between weight of neonate from urban and rural regions (Table 1). This difference might be the reflection of better socio-economic status of neonates of urban region.

Although, all blood parameters were observed to be within normal range in the two population studied, as the neonates recruited in the study are normal individuals but, LYM, GRA, MCV and RDW were observed to be significantly different (Table 2). Mean LYM was observed to be high and mean GRA as low in rural neonates whereas vice-versa was true for neonates from urban area. Low LYM along with high GRA is an indication of infection in children 13 which was found to be more common in newborns from rural area suggesting a higher exposure to infection. This suggests differences in immunity status among urban and rural neonates (Table 2). Moreover, it indicates necessity of prophylactic treatment to patients from a rural area for diseases like sickle cell anaemia or β-thalassemia to protect them from further infections. In addition, HbA2 values also correlated positively with LYM and negatively with GRA.

It is documented that alpha-thalassemia gene significantly reduces MCV and MCH levels. ^{14,15} A low MCV and MCH in rural neonates indicate the involvement of genetic mutations like alpha-thalassemia which needs to be tested. In a separate pilot study in our lab, on screening for alpha thalassemia mutations among SCD patients from these regions we found homozygous and combination mutations (- $\alpha^{3.7}$ /- $\alpha^{3.7}$; - $\alpha^{3.7}$ /- $\alpha^{4.2}$) to be higher in rural patients than in urban (Data not shown). This suggests involvement of

genetic variation in haematological differences in rural and urban region. We presumed that maternal age might also have an effect on haematological parameters of the neonates. Mean age of the mothers of these neonates was found to be similar in both the regions and therefore, as expected not much variation was seen in the associations when adjusted for maternal age (Table 2).

CONCLUSION

Our data indicates that the haematological profile of a neonate may not be negatively affected by environmental pollution which is commonly seen in urban regions of India (as suggested by their blood parameters) rather by the socioeconomic, genetics and infection status of the mother. Rural neonates of Odisha are from low income groups and are prone to getting infections due to unhygienic conditions. These conditions could add to the morbidities in neonates harbouring mutations leading to hemoglobinopathies such as SCD or β -thalassemia which are known to be prevalent in this part of the country. Therefore, this study suggests a provision of prophylactic treatment to the patients of hemoglobinopathies from rural regions of India in order to prevent them from various infections leading to health crisis.

Similar studies of cord blood screening for nutritional status of a community can be conducted and deficient nutrition can be administered as preventive therapy for stunting, malnourishment etc. to a particular community.

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Institutional Ethics Committee

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