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Ezenwosu OU
Udorah MI
Udechukwu NP
Ibe BC

Indications and socio-demographic determinants of blood transfusion among children attending secondary health facilities in South-East Nigeria

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Ezenwosu OU (✉)
Department of Paediatrics,
University of Nigeria Teaching Hospital, Ituku-Ozalla, Enugu, Enugu State/
Annunciation Specialist Hospital, Emene, Enugu State, Nigeria
Email: osita.ezenwosu@unn.edu.ng

Udorah MI
Department of Padiatrics,
Annunciation Specialist Hospital, Emene, Enugu State, Nigeria

Udechukwu NP
Department of Paediatrics,
Mile 4 Hospital, Abakaliki, Ebonyi, State/
Federal Teaching Hospital, Abakaliki, Ebonyi State, Nigeria

Ibe Bede C
Department of Paedaitrics,
University of Nigeria Teaching Hospital, Ituku-Ozalla, Enugu, Enugu State/
Mother of Christ Specialist Hospital, Enugu State, Nigeria

Abstract *Background:* The complications associated with blood transfusion can be reduced by carefully preventing the conditions necessitating transfusion especially the common ones. Studies are therefore needed to identify these indications but the available ones in Nigeria are from tertiary hospitals. This study therefore aimed to determine the common indications for blood transfusion among children attending secondary health facilities in South-East Nigeria. It also assessed the socio-demographic factors which influenced blood transfusion.
Methods: Children aged >1month to 18years admitted into the paediatric wards of three secondary care hospitals with indications for blood transfusion were recruited. Questionnaires for documentation of admitting and final diagnoses as well as socio-demographic profiles were administered. Socio-economic status of each child was calculated using occupational and educational attainment of each parent. Pre- and post- transfusion haemoglobin were determined via the use of an autoanalyser.
Results: Majority (61.9%) of the children transfused were in 1 - <5 year age group. The commonest indications for blood transfusion were Severe Malaria (60%), Sepsis (15.2%) and Bronchopneumonia (5.7%). Age of the children had a significant negative linear relationship (r = -0.783. p = 0.000) while socio-economic status had a significant association (X^2 = 49.77, p = 0.000) with number of children transfused. However, no relationship existed between gender and number transfused (X^2 = 0.086, p = 0.770).
Conclusion: Severe Malaria is the commonest indication for transfusion in children attending secondary health facilities in South East, Nigeria. Most of the children transfused are the under-5s from the low socio-economic class.

Key words: Transfusion, Children, Indications, Secondary facilities

Introduction

The transfusion of blood delivers principally red blood cells which are important components of blood involved primarily in the transport and delivery of oxygen to the tissues in exchange for carbon dioxide, hence restoring or maintaining oxygen delivery to vital organs and tissues.[1] It also delivers other blood products which play other vital roles in the body. Blood transfusion is usually indicated in children with severe acute or chronic anaemia.[2] Severe anaemia is defined as haemoglobin (Hb) or haematocrit levels <5g/dl or <15% respectively.[3] Aside severe anaemia, children with other degrees of anaemia may receive transfusion if clinical evidence of abnormal cardio-circulatory or respiratory function exists,[2,4] or optimization is required prior to surgery or chemotherapy.[2]
In essence, generally, blood transfusion is indicated in children with anaemia. However, since anaemia is a common manifestation of many conditions (and not a disease itself),[5] these conditions resulting in anaemia are indirectly the indications for blood transfusion. Different conditions have been identified in different localities as the common indications for transfusion. In addition, age -related aetiological factors in anaemia which may result in blood transfusion have also been documented.[5] Whyte and Jefferies[4] in Canada, found perinatal haemorrhagic shock and anaemia of prematurity as the most frequent indications for blood transfusion in neonates. In Ibadan, Nigeria, the main indications for transfusion in this age group (neonates) is anaemia of prematurity.[6] In older children, Ambroise and colleagues[7] working in a tertiary hospital in India noted that blood transfusions were frequently given for the treatment of non-infectious conditions like injury and poisoning. Elsewhere, in two district hospitals in Tanzania,[8] malaria-associated anaemia

accounted for 98% of the blood transfusions. In Nigeria, studies from tertiary hospitals in different regions viz North,[9] South-South,[10] and South-East[11] documented sickle cell anaemia (SCA), malaria and malignancies respectively as commonest indications for blood transfusion. No study on anaemia and blood transfusion in children in secondary level hospitals was found. These secondary level hospitals are the first port of care for the children. This study is an attempt to fill the gap.

Despite the known benefits of blood transfusion, it is not without risks. These, usually known as adverse effects or complications, range from immediate to delayed reactions which are usually more in children than in adults. Furthermore, though most bloods for transfusion are usually screened, there are still possibilities of transfusion-transmitted infections including hepatitis B virus (HBV), hepatitis C virus (HCV), human immunodeficiency virus (HIV) and malaria.[12,13] These risks can generally be reduced by carefully preventing the conditions following which transfusions may be indicated especially the common ones. Studies are therefore needed to identify these conditions, so that appropriate preventive measures could be instituted. It is hoped that the findings of this study will help to direct attention on these common causes with the aim of preventing them so as to help reduce incidence of blood transfusion and ultimately reduce risks associated with blood transfusion.

Materials and methods

This is a prospective and observational study of children who received blood transfusion during the period of study. These children were enrolled consecutively in three different secondary faith-based (missionary) healthcare facilities located in two states viz Annunciation Specialist Hospital Emene, Enugu; Mother of Christ Specialist Hospital, Enugu both in Enugu State and Mile four Hospital Abakaliki, Ebonyi State. Children aged >1month to 18years admitted into the paediatric wards of these hospitals with indications for blood transfusion and who were subsequently transfused were recruited. Excluded from the study were those indicated for transfusion but eventually not transfused and those whose parents declined consent.

At the three sites, the following information were obtained, on admission, using a questionnaire – age, sex, date of birth, address, presenting complaint, admitting diagnosis, maternal and paternal educational level and occupation. Pre-transfusion Hb was determined by assessing the Hb level prior to transfusion. Socio-economic status of the children was calculated using the occupational and educational attainment of both parents or their substitutes proposed by Oyedeji as described by Ikefuna and Emodi.[14] On transfusion, volume transfused as well as number of transfusions over the admission period were documented. Twenty four hours after transfusion, post transfusion Hb was done and documented. All the three hospitals have standard laboratories where Hb is done via the use of an autoanalyser.

Ethical clearance was obtained from the Ethics and Health Research Committee of the Annunciation Specialist Hospital Emene before commencement of the study. This ethical clearance was adopted by the other two hospitals. Also, written informed consent was obtained from the caregiver of each participant or the legally accepted representative before enrolment. All information/data were safely secured.

Data obtained were analysed using SPSS version 22. Data presentation were by tables and graph. Frequencies were compared in appropriate contingency tables and significance of differences evaluated by chi-squared test. The relationship between two numerical variables was tested using Pearson's Correlation Coefficient while association between proportions was tested with Chi square. Level of significance was taken as $p < 0.05$

Results

During the study period, 105 children who had blood transfusion and who also met the inclusion criteria were enrolled. They were made up of 54 males and 51 females with male:female ratio of approximately 1:1. Their ages ranged from 29days to 16 years. The mean age was 3.29 years ±3.16 while the median age was 2years.

As shown in Table 1, majority (61.9%) of the transfused children were under-5s, followed by the school-aged (17.2%) while the least were in the adolescent age group.

Majority of the transfused children 65 (61.9%) belonged to the lower socio-economic class while only 6 (5.7%) were of the upper class. Also, most of the children 58 (55.2%) presented from the rural areas whereas 30 (28.6%) and 17 (16.2%) presented from semi-urban and urban areas respectively. The differences were statistically significant ($X^2 = 49.8$, p = 0.00 and $X^2 = 25.1$, p = 0.00 respectively) (Table 2).

Table 1: Age and sex distribution of subjects

Age group (years)	Sex		
	Males	Females	Total (%)
< 1	8	7	15 (14.3)
1 - <5	35	30	65 (61.9)
5 - <10	6	12	18 (17.1)
10 - <15	4	2	6 (5.7)
≥15	1	0	1 (1.0)
Total	54	51	105 (100)

Table 2: Socio-economic class and place of abode of subjects

Socio-economic class*	Place of Abode†			
	Urban	Semi-urban	Rural	Total (%)
Upper	2	3	1	6 (5.7)
Middle	8	16	10	34 (32.4)
Lower	7	11	47	65 (61.9)
Total	17	30	58	105 (100)

*$X^2 = 49.8$, df = 2, p = 0.00; †$X^2 = 25.1$, df = 2, p = 0.00

The commonest presenting symptoms were fever (93.3%), cough (18.1%), weakness (15.2%), vomiting (15.2%) and convulsion (15.2%). As shown in Table 3, the commonest indication for blood transfusion was Severe Malaria (60%), followed by Sepsis (15.2%) and Bronchopneumonia (5.7%).

The mean pre-transfusion Hb was 5.10 ± 1.86g/dl and the mean post-transfusion Hb was 9.0 ± 2.4g/dl. The mean volume of blood transfused was 224 ± 121ml at mean rate of 16ml/kg body weight.

Figure 1 is a scatter plot with line of best fit of the number of children transfused by age. The correlation coefficient (r) of their relationship was strongly negative and statistically significant. In other words, age had a statistically significant negative linear relationship with number transfused (r = -0.783, p = 0.000). The interpolation line shows that transfusion was given most to 2 year olds than others.

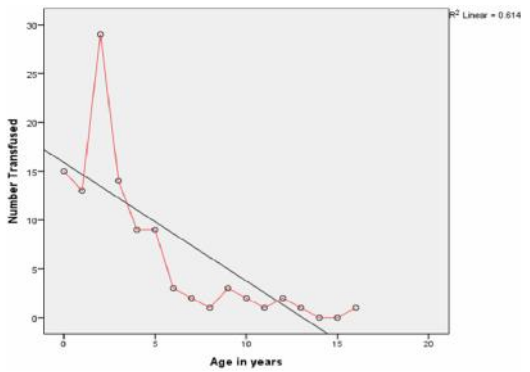
Table 3: Diagnosis of Transfused Children

Diagnosis	Frequency	%
Severe Malaria	63	60.0
Sepsis	16	15.2
Bronchopneumonia	6	5.7
Meningitis	5	4.8
Sickle cell anaemia	4	3.8
G6PD deficiency	2	1.9
Enteric fever	2	1.9
Leukamia	2	1.9
AGN	1	1.0
HIV	1	1.0
Beckwitt Syndrome	1	1.0
Neuroblastoma	1	1.0
Pulmonary TB	1	1.0
Total	105	100

Table 4: Effects of variables on transfusion

Variables	N (%)	X^2	*P*
Sex			
Males	54 (51.4)	0.086	0.770
Females	51 (48.6)		
Place of Abode			
Urban	17 (16.2)	25.09	0.000
Semi-urban	30 (28.6)		
Rural	58 (55.2)		
Socio-economic class			
Upper	6 (5.7)	49.77	0.000
Middle	34 (32.4)		
Lower	65 (61.9)		

Fig 1: Scatter plot with interpolation line and line of best fit of the number of children transfused by age



Discussion

In this study, majority of the transfused children belonged to the under-5 age group while the least transfused were adolescents. This was also the experience of Pedro et al[15] in Kenya as well as Ino-Ekanem and Bassey[10] in South-South Nigeria. This highest frequency of blood transfusions in under-5 children could be explained by the fact that this is the commonest age group with the highest incidence of severe malaria with anaemia in children.[5,8,10,15] Though the adolescents experience growth spurts which is expected to affect their blood level negatively,[5] their least transfusion seen in this study may be explained by their ability to take care of themselves especially nutrition wise unlike infants and pre-school children.

The common indications for transfusion were severe malaria, sepsis and bronchopneumonia respectively. The finding of malaria as the commonest indication for transfusion is in agreement with the findings of Mosha et al[8] in a study in district hospitals in Tanzania. In contrast, however, other workers[4,6,7,9,11] in and outside Nigeria found indications other than malaria as commonest conditions requiring transfusion. The difference may be methodological as some[4,6] studied neonates while others[7,9,11] who found injury, SCA and malignancy respectively as commonest indications studied older children but had their study setting in tertiary hospitals. The finding of severe malaria as the commonest indication in secondary health facilities may be because these facilities are closest to the patients and constitute their first port of call. Tertiary hospitals serve as referral centres. Thus majority with malaria and severe malaria including severe malarial anaemia necessitating transfusion are usually seen in the secondary centres while chronic and complicated conditions are referred to the tertiary centres.[16] With other common diagnoses requiring transfusion noted in this study (sepsis and bronchopneumonia), it is obvious that infections still constitute important factors to consider in any program seeking to reduce the incidence of anaemia requiring blood transfusion and the risks associated with blood transfusion especially in our environment. This is unlike the developed countries where infections have been drastically reduced.[17]

Fever was the commonest associated symptom noted in the transfused children. This is consistent with previous findings,[18] and may not be unrelated with the documented evidence that fever is the most frequent symptom associated with severe malaria[3] which was the commonest indication for transfusion in this study.

The least mean pre-transfusion Hb were noted in children with SCA. This underscores the severity of anaemia SCA children face when acute conditions resulting in crisis worsen their hitherto low steady state Hb. It also highlights the need for more emphasis on their routine haematinics, prophylactic anti malarial and regular follow up.[19]

Generally, the mean pre-transfusion Hb of 5.1g/dl improved by a mean of 3.9g/dl after transfusion with mean volume of 220ml of blood. This is similar to the

expected optimal rise in Hb in transfused children (of 4g/dl) as recommended by Morley.[1] The difference between our mean rise of 3.9g/dl and 3.1g/dl noted by Ughasoro et al[11] in a tertiary hospital could be because majority of their transfused children had malignancy. The continuous negative effect of malignancy and cytotoxics on bone marrow and haemopoeisis is well known and may continue even after transfusion.[20]

Our study noted a strong negative linear relationship between age and rate of transfusion as the rate of transfusion reduced with increasing age. This is in agreement with the findings of Simbauranga and colleagues[21] as well as Davies and co-workers.[22] Indirect association between severe malaria and age could be a plausible explanation for this as severe malaria mainly affects younger children and declines with age following increasing protection from specific acquired immunity.[23] Conversely, as earlier documented by Davies et al,[22] sex was found not to be associated with transfusion in this study. Possibly, this could be because none of the common aetiologic conditions leading to anaemia in this study and others[4,6-11] are sex-linked.

Interestingly, we documented a higher incidence of transfusion in children from lower socio-economic class. It was also not surprising that majority were from the rural areas. Expectedly, people from rural areas have been linked with low socio-economic status.[24] Similar findings of higher rates of transfusion in children from low socioeconomic class were also documented in studies from South-West, Nigeria[18] and India.[25] In addition to increased rate, this and previous studies[18,25] documented significant relationship between transfusion in children and socioeconomic status. Simbauranga et al[21] as well as Schellenberg and colleagues[26] corroborated this by documenting increased risk of severe anaemia in low socioeconomic status. This relationship may be due to association of socioeconomic status with nutrition/ nutritional status[24] which impacts directly and indirectly on haemopoeisis. As severe malaria has been identified as a common indication for transfusion, another speculated relationship is a possible association between socioeconomic status and proximity to malaria vector breeding site which are typically seen in low socioeconomic settings.[26]

Conclusion

Severe malaria is the commonest indication leading to transfusion in children attending secondary health facilities in the South East, Nigeria. Ensuring implementation of preventive measures against malaria will reduce the financial and material resources lost with its treatment and transfusion as well as reduce drastically the potential complications associated with transfusion. The major target groups should be people of low socioeconomic status and pre-school children. Simple interventions using insecticide treated nets (ITNs) and health education will go a long way in achieving these.

Limitations of the study

The prevalence of blood transfusion was not determined in this study. This is because the number of admissions during the study period was not documented due to poor record-keeping.

The haemoglobins (Hb) of the donors of the transfused blood were not known. Determining the donor Hb will help in appropriate interpretation of the post transfusion Hb against the pre-transfusion value.

Authors' contribution
EOU: Conception, design, literature search, statistical analysis, manuscript preparation
UMI: Conception, data acquisition, data analysis, manuscript review
UNP: Conception, data acquisition, manuscript review
IBC: Conception, definition of intellectual content, manuscript editing, manuscript review
Conflict of interest: None
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