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Editorial

Original articles

EDITORIAL

NEWBORN HEALTH – A CALL FOR ACTION

Lulu M Muhe, MD, PHD

A newborn or neonate is an infant from age 0 to 28 days. WHO defines the term "live birth" for any human that once wholly extracted from the mother showed any sign of life such as voluntary movement, heartbeat, or pulsation of the umbilical cord. (1) This definition applies for any gestational age and however brief the time is. (1) The WHO recommends a declaration of birth, dead or alive, from 22 weeks post-menstrual age. A stillbirth is "a baby who dies after 28 weeks of pregnancy, but before or during birth". (2) Within the stillbirth's group, intrapartum-related stillbirths or "fresh stillbirth" are "neonates that show no signs of life at delivery and weigh more than 500 g or are greater than 22 weeks of gestation with intact skin and no signs of disintegration in utero". (3) Their death is assumed to have occurred within 12 hours before delivery, likely from a hypoxic event. These latter deaths alone are estimated at 1.3 million. (4) However, the precise post-menstrual age is an information many low- and middle-income countries (LMIC) lack. Although this definition appears clear in theory, in practice, multiple factors and recall bias lead to uncertainty in LMIC.

The newborn age group suffers more than infants and older children from under-developed immune system (infections with normal flora), conditions associated to maternal, and obstetric risk factors and conditions related to immaturity of vital organs such as the lungs. As a result, newborn health is characterized by health problems related to :

- maternal health such as hypertension, diabetes, malnutrition
- complications of pregnancy, childbirth, and delivery, for example, pre-eclampsia and eclampsia, asphyxia etc.
- complications of prematurity (prematurity is defined as those born before 37 completed weeks of gestation) such as immature lungs presenting as respiratory distress syndrome

Most of the underlying causes of neonatal deaths are the same for stillbirths i.e., related to maternal health, complications of pregnancy, labour, and delivery.

Epidemiology

Worldwide, newborn health problems are over-whelming. While rich countries have reduced neonatal mortality by a factor of 10 (5), the poorest regions and conflict zones suffer the highest neonatal mortality. Today, these figures are expected to have worsened with the recent COVID-19

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pandemics bringing a shortage of basic care (6) and equipment, as well as twice as likely preterm delivery of infected pregnant women. (7-8)

Today, from the 130 million live births globally, an estimated 2.4 million neonates died in 2020 (9). Nearly the same number of babies die in utero i.e., before delivery (referred as stillbirths). There were nearly 2 million stillbirths in 2019 globally. Notwithstanding the efforts of the past 20 years with the Millennium Development Goals and Sustainable Development Goals, the neonatal period remains the most likely period for a child to die. Global neonatal mortality accounts for nearly half of the under-5-year mortality and occurs for 98% in LMIC. (5) In addition, due to the very high immediate postnatal mortality, the risk of underreporting remains major [10], [11]; many newborns die indeed before being given a name and registered, recorded at best as stillbirths. Accounting for both stillbirths and neonatal deaths is estimated to double the 2.5 million deaths. [12][13] The newborn period of life is the most vulnerable time of a child's survival. Children face the highest risk of dying in their first month of life. In Ethiopia, the neonatal mortality rate for 2019 was 33 per 1000 livebirths (EMDHS) and it has not been decreasing in the previous 3 years (MOH HSTP II). (14)

Neonatal diseases are associated with long term complications and the societal cost of underestimating and neglecting neonatal disease carries large disability and chronic disease burden over into adulthood. Neglected neonatal disorders are the leading cause of DALY in children globally. (15)

Causes of neonatal deaths and risk factors

Many of neonatal deaths (75%) occurs during the first week of life, and about 1 million newborns die within the first 24 hours. Prematurity, birth asphyxia, infections and birth defects cause most neonatal deaths in 2017. (16)

Prematurity has been described as one entity among causes of under-five mortality or neonatal mortality. However, preterm neonatal deaths could be related to prematurity (also referred as preterm related complications) that are specific to the fact that the neonate is born prematurely, or the deaths could be due to other conditions such as congenital abnormalities that may cause death in the full-term infant or even beyond the neonatal period. The prematurity specific conditions include respiratory distress syndrome (RDS) or previously referred as hyaline membrane disease, necrotizing enterocolitis (NEC), and intraventricular hemorrhage (IVH). (17) A large multi-center Ethiopian study (SIP project) showed that RDS contributes to 45%, Infections to 30 and asphyxia to 14% of all preterm deaths. (17)

Important risk factors to increased neonatal mortality include inadequate and absent prenatal care, presence of complications during pregnancy, congenital malformation in the assessed pregnancy, Apgar < 7 at the fifth minute, low and very low birth weight, gestational age ≤ 37 weeks, and caesarean delivery mortality, absence of partner, maternal age ≥35 years, male gender, multiple gestation. (18)

Interventions for prevention and care

Preventive interventions need to bridge the continuum of care from pregnancy, through childbirth and the neonatal period, and beyond. Lack of positive health-related behaviour, education, and poverty is an underlying cause of many neonatal deaths, either through increasing the prevalence of risk factors such as maternal infection, or through reducing access to effective care.

Pregnant women need to attend antenatal check-up regularly to identify any complications and take immediate measures. Pregnant women need to take immunizations such as for rubella, Hepatitis B and tetanus. In settings where HIV is prevalent, they need to be supported with prevention programs against HIV as well as other sexually transmitted diseases, prevention and treatment of substance use and smoking cessation.

Other specific strategies include:

Before pregnancy: prevention of too early, unwanted, or rapid successive pregnancies and adequate nutrition, including iron and folic acid supplementation, and treatment of anaemia

During pregnancy: management of pregnancy complications and in malaria settings, intermittent preventive therapy for malaria.

During childbirth: monitoring of progress of labour, maternal and foetal wellbeing with partograph, immediate newborn care and antibiotics for pre-term premature rupture of membranes (pPROM)

In the newborn period: promotion of exclusive Breastfeeding, immunizations (BCG, HepB, rotavirus, pentavalent vaccines), thermal care, hygienic cord care and in high HIV settings PMTCT.

In Ethiopia, these services are given in packages of essential newborn care such as the community-based newborn care (CNBC) package consisting of:

- Antenatal care
- Thermal care: Drying, warming, skin-to skin, promotion of skin-to-skin contact (also called Kangaroo Mother Care), delayed bathing

- Early initiation and exclusive breastfeeding-,
- Infection control: clean birth practices, hand washing, clean cord, and skin care.
- Management of possible serious bacterial infections
- Management of preterm and/or low birth weight neonates
- Feeding support, growth monitoring (measuring weight, length of neonates and plotting against a standard curve to detect and treat malnutrition
- Early postnatal home visits, counselling and identification and care of sick neonates.

The Integrated management of childhood illness strategy is adopted and is being implemented in Ethiopia. The component on care of sick newborns provides detailed guidance on how to manage the sick newborn for severe signs, infections, respiratory distress syndrome in addition to the essential newborn care package.

Challenges

All countries and all stakeholders, acting in collaborative partnership, committed to the 17 Sustainable Development Goals (SDGs) and 169 targets to meet by 2030. (19) SDG 3 is specific to health and SDG 3.2 targets child health. SDG 3.2 states:

• By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 livebirths and under-5 mortality to at least as low as 25 per 1 ,000 livebirths

Over the past decade, substantial progress has been made in newborn health and in preventing stillbirths, including in countries with the highest burdens of mortality. More mothers and their babies can now access effective health care, during and after pregnancy. Yet we are far from our goal of ending preventable newborn deaths and stillbirths by 2030. Half of all under-5 deaths still occur in the first month of life, and 2 million stillbirths occur every year. While the global neonatal mortality is declining to meet the SDG 3.2, it is not declining in many LMIC.

Challenges in addressing newborn health care to meet SDG 3.2 include:

- Human resource: shortage of staff, mix of skills of staff
- Low service utilization
- Poor quality of service

- Lack of or inadequate resource- infrastructure such as space, and supplies such as medicines
- community barriers: several context-based community engagement approach by
- partners, national and regional community sensitization, Newborn health month
- Most supportive supervisory visits to health posts covered antenatal care and promotion of facility delivery but very few addressed newborn and sick young infant care.
- The referral practice including universal offer of referral, use of referral slips, and providing pre-referral treatment according to the national guideline needed support

Coverage of the known interventions to tackle newborn health issues has been low in many LMIC. In Ethiopia, in a survey of 98 health facilities only 27% of health facilities had a heat source in their delivery room, about 12% of health facilities did not assess the babies breathing at birth. ONLY 66% had basic equipment for neonatal resuscitation. (20) The coverage of such interventions, including antibiotics for sepsis and resuscitation at birth, need to be scaled up along with improvement in supportive infrastructure and general newborn care including capacity building of nursing staff and clinicians, as well as optimal breastfeeding and parenteral nutrition. (21). RDS was responsible for 45% of preterm mortality in the SIP study. (17) Interventions specific to RDS such as continuous positive airway pressure (CPAP), and blended oxygen need to be available to have an impact on the high neonatal mortality observed in Ethiopia as well as the long-term complications such as blindness due to retinopathy of prematurity.

Call for action

Neonatal health should be considered beyond survival and treated as a high priority. The enormous number of deaths hides an even more significant number of children who develop impairment.

Tackling the leading overlapping causes of neonatal mortality need further understanding of the underlying predispositions and pathologies, and therefore focused research on causes and cost-effective interventions is needed. Implementation research on education and training is key to facilitate scale up of interventions and sustainability.

More visibility, more efforts, and more funding are urgently needed to reduce the millions of preventable newborn deaths and ensure that all children reach their full potential. Reducing neonatal mortality and morbidity is much more than investing in neonates; it is constructing and

perpetuating a stable society and a thriving economy. Clearly interdependent with maternal and child health, but with specific needs and intervention strategies, neonatal health merits its own specific global healthcare target. The time has come to address the human rights of the most vulnerable, the newborn.

There is a need for policy change to invest in interventions targeting the major causes of neonatal mortality to meet the SDG target of reducing neonatal mortality rate to below 12 per 1000 (19). Further research is required to develop effective and affordable interventions to meet SDG 3.2 target.

- To strengthen the supportive infrastructure and high impact low-cost interventions including skin-to-skin thermal care (KMC), early and exclusive breastfeeding, parenteral nutrition, blended oxygen for preterms and expand /strengthen warm chain system
- To improve capacity of health professionals to provide adequate and advanced inpatient quality newborn care
- To strengthen and improve treatment of the common causes of preterm neonatal deaths by ensuring access to CPAP, effective antibiotics (by monitoring antimicrobial susceptibility regularly) and prompt and effective resuscitation
- To Strengthen the community based newborn care approach and community engagement
- To enhance the infection prevention and control activities
- To support all activities across the continuum of care
- To strengthen the political commitment for the neonatal mortality reduction to the level
- best
- Using the existing Health Extension platform, to strengthen the social mobilization activities

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ORIGINAL ARTICLE

CLINICAL PATTERNS OF CHILDREN WITH RHEUMATOLOGICAL DISEASES IN TIKUR ANBESSA SPECIALIZED HOSPITAL, ADDIS ABABA, ETHIOPIA: A RETROSPECTIVE OBSERVATIONAL STUDY

Tilahun Seifu*

ABSTRACT

Background: *Pediatric rheumatologic diseases are heterogeneous group of disorders with different disease manifestations among various populations. There are no reports of studies on pediatric rheumatologic diseases among Ethiopians. We present here in and define the clinical patterns of pediatric rheumatologic diseases encountered at Tikur Anbessa Specialized Hospital, in Addis Ababa University (AAU), Ethiopia.*

Method*: Hospital records of patients with a diagnosis of pediatric rheumatologic diseases with onset at the age of 16 years or less were reviewed between Sept. 2019 and Sept.2020. Diseases were classified based on the international league of associations for rheumatology (ILAR) diagnostic criteria.*

Result*: A total of 52 patients with pediatric rheumatologic disorders of onset at age of 16 years or less were included in the study. The average age at disease onset was 5.9 yrs (range 1-10 years). The average age at first visit to hospital was 9.14 yrs (range:3-12 yrs) and with a female to male ratio of 1.8:1. Rheumatoid factor negative arthritis, 33 %, was the most frequent type of rheumatologic diseases. Systemic onset arthritis was found in 12% of the cases. Systemic Lupus Erythematosus (SLE) was found in 6%, 6% had Henoch-schonlein Purpura and One child had scleroderma. Polyarticular RF +ve 14 %, Oligoarticular JIA 20 %, JDM (juvenile dermatomyositis) 8 % and other vasculitis 2% were other findings. ANA (antinuclear antibody) was found in 25%.*

Conclusion: *Polyarticular rheumatoid factor negative Juvenile Idiopathic arthritis was a predominant type of rheumatological diseases. Timely consideration and diagnosis based on ILAR are recommended to guide care rheumatological diseases. Further studies and training opportunities in the field are recommended to uncover the national burden of the disease.*

Keywords: *Pediatric Rheumatological diseases, Juvenile Idiopathic Arthritis, Systemic Lupus Erythematosus, Comorbid diseases, Addis Ababa University, Rheumatological disorders.*

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BACKGROUND

Reports on the prevalence and incidence of pediatric rheumatologic diseases suggest variability among different ethnic and geographically distinct populations [1-6]. Pediatric rheumatologic diseases are an immune mediated diseases of childhood characterized by inflammation of joints, striated muscles, skin and internal organs. Despite the improvement in treatment outcome and mortality rates among pediatric rheumatologic diseases and treatment related damage remains a major challenge and significantly affect the quality of life of affected individuals [7, 8].

Gene expression profiling studies have identified different immune mechanism in distinct subtypes of the disease, and can help to redefine disease classification criteria. Immunological studies have shown that systemic juvenile idiopathic arthritis is an acquired autoinflammatory disease, and have led to successful studies of both interleukin-1 and interleukin-6 blockade [9]. ANA, Rheumatic factor and HLA testing options should also be offered for such patients [1].

Juvenile Idiopathic Arthritis is the most common childhood rheumatologic disorder with the prevalence of 16-150 per 100,000 children. It is characterized by chronic arthritis of unknown etiology, lasting at least 6 weeks with the onset before 16 years of age [9]. Less resourced countries face a unique set of challenges in caring for children with rheumatologic diseases, which limit the ability to deliver high quality care to patients with JIA and other rheumatologic diseases in children.

There are no studies or reports on the rheumatological disorders from Ethiopia. In this paper, we detail the spectrum and epidemiological subtypes of Pediatric rheumatologic diseases among Ethiopian children seen at a tertiary level hospital. Diagnostic and classification difficulties engendered by limited diagnostic procedures, late presentation to hospital and irregular follow up are highlighted.

METHODS

Study design and settings

This retrospective review of medical records of patients with Pediatric rheumatological diseases was carried out at Tikur Anbessa Specialized Hospital (TASH) from September 2019 to September 2020. TASH is owned by Addis Ababa University and it is a national referral center located in Addis Ababa, Ethiopia. Several Speciality and subspeciality services are provided. Our Rheumatology clinic attended by the Rheumatologist & pediatric attached residents treats 6-10 patients weekly.

Source Population

All Pediatric rheumatologic patients attending follow up at Pediatric rheumatology clinic at TASH.

Study population

All Pediatric rheumatologic patients attending follow up at Pediatric rheumatology

clinic at TASH and whose medical records could be retrieved. Clinical, haematological, immunological, radiological & other relevant findings from the history were obtained from the medical records of study subjects. International league of associations for rheumatology (ILAR) diagnostic criteria was used for classification of the rheumatological diseases. Patients were thus recategorized as systemic arthritis, oligoarthritis, polyarthritis (RF +ve& RF - ve), SLE & others.

Patients who had signs & symptoms of other than rheumatologic diseases such as acute rheumatic fever, septic arthritis, malignancy, HIV infection or metabolic diseases were excluded from the study after careful scrutiny of respective case records. During the recruitment period 58 medical records were reviewed, then 52 cases who fulfilled the inclusion criteria were enrolled in the study.

Ethical considerations

This study was approved by the Pediatrics Department Research and Ethics committee, School of Medicine, Addis Ababa University.

Data collection

Medical records were reviewed and parameters including age at diagnosis, gender, ethnicity, treatment course, joint swelling, fever, rash, ESR, ANA, RF, CRP, systemic manifestations & others. Accordingly, the clinical criteria for probable diagnosis of Pediatric rheumatological diseases were used. Data were collected using structured questionaries.

Medication adherence was assessed with multiple questions developed by the clinic & patients were defined as adherent if they reported taking all doses of their medication in a typical week. Disease activity was assessed on history reported from the caregiver & physician's clinical scale .

Data analysis

Data was analyzed using SPSS (Statistical Package for Social Sciences) version 23 software. Mean & interquartile ranges were used for descriptive statistics for quantitative variables. Frequencies were computed for qualitative variables. For comparison between categorical variables, cross-tabulation with formulation of Fisher's exact (chi square) statistic was used. The two-sided p-value <0.05 were considered to be statistically significant.

RESULTS

This study included 52 Pediatric rheumatological patients. The Pediatric rheumatologic disease subtypes are shown in Table 1. There were 33 girls & 19 boys with a female to male ratio of 1.8:1. The overall average age at disease onset was 5.94 (range :1-10 years) and the majority of the patients presented late with average age at first visit to hospital being 9.14 years (range:3-12 years). Polyarticular Rheumatoid Factor -ve JIA, 33%, was the most frequent type.

Oligoarthritis was found in 20%, while 14% &12% were polyarticular RF +ve & systemic onset JIA, respectively. SLE was found in 6% & only one child ,2%, was determined to have other vasculitis, and 6% (3) children had HSP (Henoch-schonlein Purpura). The majority of oligoarticular JIA had onset in early childhood while a majority of polyarticular JIA had onset in late childhood. Oligoarticular disease affected the lower limbs predominantly. Only one child had Scleroderma.

At presentation the pattern of joint involvement was asymmetric in those with oligoarticular disease & symmetric in polyarticular and systemic onset JIA Fever, rash, eye involvement (acute/chronic uveitis and conjunctivitis), ESR and anaemia were the main noted extra-articular clinical features in JIA cases. Fever of at least two weeks duration was observed in all systemic JIA (See table 1). Clinical remission on medication has been documented in 30 patients out of 38 JIA patients (78.9%) who are still prospectively being followed in the established Pediatric rheumatologic clinic in TASH.

Table-1. Clinical sub types of rheumatological diseases in TASH, Addis Ababa, Ethiopia (no=52)

	Total No (%)	**Female: male ratio**	**Mean age at disease onset (yrs)**	**Age range at onset (yrs)**	**Mean age at presentation (yrs)**	**Age range at presentation (yrs)**
Overall	52(100%)	1.6 :1	5.54	1-10	8.4	2-14
Systemic JIA	6(11.5%)	1:1	4	1-6	6.5	3-10
Polyarticular JIA RF -ve	17 (32.69%)	2.4:1	6	1-10	8	2-14
Polyarticular JIA RF +ve	7(13.45%)	1.3:1	8	5-10	10.6	8-12
Oligoarticular JIA	10 (19.23%)	1:1	5.7	2-10	8	3-12
JDM	4(7.69%)	3:1	7.7	5-10	10	7-12
Reactive arthritis	1(1.92%)	0:1	7	7	7	7
SLE	3(5.76%)	3:0	8.6	8-9	10.3	9-12
HSP	3(5.76%)	2:1	8	7-9	8	7-9
Vasculitis	1(1.92%)	0:1	9	9	10	10

JIA (Juvenile Idiopathic Arthritis), SLE (Systemic lupus erythematosus), HSP (Henoch schonlein purpura), JDM (juvenile dermatomyositis)

Table-2: Clinical profiles of children with rheumatological diseases at presentation TASH, Addis Ababa, Ethiopia (no=52).

	Systemic on set JIA No (%)	**Polyarticular JIA N (%)**	**Oligoarticular JIA No (%)**	**JDM No (%)**	**SLE N (%)**	**HSP N (%)**	**Vasculitis Takayasu No (%)**	**Overall No (%)**
Fever	6(100)	8(33.3)	2(20)	2(50)	3(100)	2(66)	-	25 (48.07)
Rash	3(50)	1(4.2)	1(10)	3(75)	3(100)	3(100)	-	15 (28.84)
ESR	5(83.3)	19(79.2)	7(70)	3(75)	3(100)	2(66.6)	1	36 (69.23)
ANA	1(16.6)	4(16.7)	4(40)	1(25)	3(100)	0	-	13(25)
RF	2(33.3)	7(29.2)	1(10)	1(25)	1(33.3)	0	-	10 (19.23)
Arthritis	6(100)	24(100)	10(100)	3(75)	2(66.6)	1(33.3)	-	45 (86.53)
X-ray	4(66.6)	18(75)	7(70)	2(50)	2(66.6)	1(33.3)	1	41 (78.84)
Ex.Art.	6(100)	10(41.7)	7(70)	4(100)	3(100)	3(100)	1	38 (73.07)
Eye	2(33.3)	2(8.3)	2(20)	0	0	0	-	7(13.46)
Infections	3(50)	3(12.5)	3(30)	2(50)	3(66.6)	2(66.6)	-	17 (32.69)

Table 3: Comorbid diseases found in children with various rheumatologic diseases TASH, Addis Ababa, Ethiopia (no=52)

No	System Involved	No.of patients	Specific diseases
1	CARDIOVASCULAR	5	common AV canal, PHPN, dilated CMP, TOF, CRHD
2	INFECTIOUS:	6	Septic arthritis, disseminated tuberculosis, pneumonia, hepatitis
3	SYNDROMES:	2	down, Marfan
4	DRUG RELATED	3	drug induced hepatitis, fungal infections
5	HEMATOLOGIC	6	Transient neutropenia, severe anaemia, chronic Idiopathic thrombocytopenic Purpura (ITP)
6	DERMATOLOGIC	4	Seborrheic dermatitis, fungal infections, erythema nodosum
7	RAYNAUDS PHENOMENON	1	Raynaud's Phenomenon
8	OCULAR:	7	conjunctivitis, ectopia lentis, strabismus, bilateral uveitis
9	SKELETAL	3	Pectus carinatum, cervical ankylosis, kyphoscoliosis
10	RENAL:	3	Lupus nephritis, stage 2 chronic kidney diseases (CKD), Hypertension (HPN)
11	MALNUTRITION:	3	Severe Acute Malnutrition (SAM)
12	NEUROLOGIC:	3	Flaccid paralysis, hemiparesis, fascial palsy
13	ENDOCRINE	2	hypothyroidism, hypoparathyroidism
14	EFFUSIONS	2	Pulmonary pericardial

AV (atrioventricular), PHPN (pulmonary hypertension), CMP (cardiomyopathy), TOF (tetralogy of fallot), CRHD (chronic rheumatic heart diseases)

Fig-1 Scleroderma in a 6 yrs old child (with family permission)

Fig-2 Oligoarticular JIA in an 8-yr- old child (with family permission).

PATIENT CLINICAL OUTCOMES

The majority of documented JIA children in remission 18 out of 30 (60%) were with polyarticular RF (-ve) disease. Four of the patients in remission were polyarticular RF +ve disease. Three of the patients with HSP also improved & two of the SLE patients being followed up in the established Pediatric rheumatologic clinic were also in clinical remission.

All the three of the SLE patients were females and 3 of the 4 JDM (Juvenile Dermatomyositis) patients were females. Creatinine Kinase (CK) was elevated in 3 of the 4 JDM patients. Muscle biopsy was performed in 2 (50%) of these patients and showed characteristic features including perifascicular atrophy, fiber degeneration& perivascular inflammation consistent with JDM.

Our retrospective observational study of patients included 34 with Juvenile Idiopathic Arthritis (JIA),3 with SLE,6 with Systemic onset JIA, 4 with JDM & 3 patients with HSP. Patients were 2-14 years old at presentation (mean 9.14 years) and 64 % were females.

Diagnoses included Polyarticular RF -ve JIA 33%, oligoarticular JIA 20%, Polyarticular RF +ve JIA 14 %, Systemic Onset JIA 12 %, JDM 8 %, SLE 6 %, HSP 6 % and other vasculitis 2 %. Mean age at disease onset was 5.3 years.

Three SLE patients (6%) were included in the study: one was from Oromia, one from Amhara and one from Addis Ababa. Organ involvement distribution was: renal involvement in one patient, cardiac one and chronic ITP & bleeding in one patient, skin involvement in 2 patients & arthritis in 2 patients. Antidouble stranded DNA antibody was found in one patient. Most of the patients were screened with CBC, ESR, RF, ANA& X-RAY. X-RAY of joints revealed that 41 (79%) patients had abnormal joint findings including periarticular osteoporosis, effusions& proximal & distal phalangeal erosions.

Twenty-eight had comorbid diseases associated with their rheumatologic manifestations (Table 3). Most of the patients were investigated with ANA, RF etc. Among the clinical features observed 45 of them 86 % had arthritis. Twenty-five of them (48 %) had fever. ANA was positive in 13 (25 %) of patients. RF was positive in only 10 (19 %) of patients. Infections were observed in 17 (32.6 %) of patients. Extra-articular manifestations were observed in as many of the clinical features of the patients (76 %).

The majority of patients in this series 36 (72 %) of the 52 patients coming to follow up had clinical remission on medication. In demographics by age distribution in years the median age was 9 yrs (95% CI: 8-9; SD is 2.97); the mean duration of follow up in yrs was 3.5 yr. (95% CI, 3 - 4; SD, 1.42)

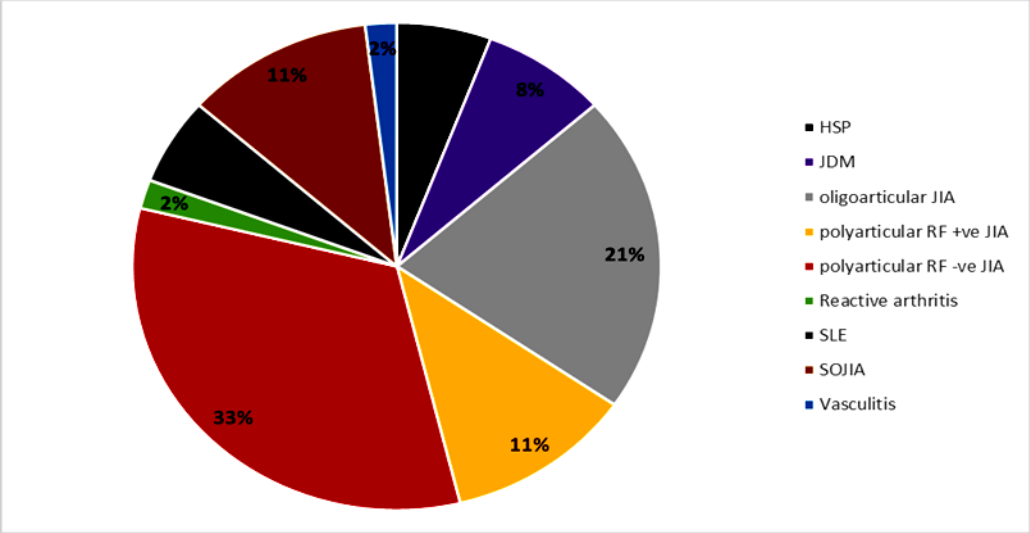

Fig -3 Clinical subtypes of rheumatological diseases

Table-4 Determinants of disease activity in children with rheumatological diseases TASH, Addis Ababa, Ethiopia (no=52)

Characteristics		**Rheumatology Subtype**				**Total**	**Pearson X^2**	**P-Value**
		Oligoarticular JIA	Polyarticular RF –ve JIA	Polyarticular RF +ve JIA	Other			
Gender	Female	6	12	4	11	33		
	Male	4	5	3	7	19	0.59	0.899
Total		10	17	7	18	52		
Residence	A. A	3	6	4	12	25		
	Out of A.A	7	11	3	6	27	5.14	0.16
Total		10	17	7	18	52		
Response for treatment	Improved	7	11	2	14	34		
	Not Improved	3	6	5	1	18	5.5	0.14
Total		10	17	7	18	52		
Joint disability, damage	No	10	6	2	16	34		
	Present	0	11	5	2	18	20.68	0.001
Total		10	17	7	18	52		

In the above table: Joint disability was associated with the type of rheumatological disease (P-value =0.001) while gender, residence, response to treatment didn't show any association with the type of rheumatological disease.

DISCUSSION

Our study on the Pediatric rheumatological disorders is the first to report the disease profile in Ethiopia. We have used the ILAR classification criteria for disease classification. The overall average age at disease onset was 5.94 years (range :1-10 years) and the majority of the patients presented late with average age at first visit to hospital being 9.14 years (range:3-12 years). Polyarticular JIA is the major documented form of rheumatological disorders. The heterogeneity in nomenclature of the disease ,the lack of diagnostic tests & the differences in diagnostic criteria have made it difficult to understand fundamental epidemiological comparisons such as incidence ,prevalence & clinical manifestations.The current international league of associations for rheumatology (ILAR) JIA classifications is contributing to a more uniform nomenclature & nosology, and thus improving comparative disease diagnosis & epidemiology across countries & ethnic populations[1,5].

We chose to adopt the ILAR classification criteria for this study. This study covered a total period of 2 years & has yielded 52 cases of pediatric rheumatology diseases cases. The prevalence of polyarticular sero negative disease (33% in this study) is among the highest reported worldwide, f followed by oligoarticular disease (20 % in this study), the most common subtype described in studies from Europe & North America (6,7). This finding is in keeping with other studies from the developing world UK (20), where evidence for a lower incidence of oligoarticular disease has been noted (7-13). The noted difference could be related to the study setting, and health seeking behaviour. Genetics could also play in this.

The gender distribution in our study were almost comparable. Caucasian studies documented a higher female occurrence, almost five times higher in females. Social and cultural rather than biological reasons may lie behind this observation. It is highly likely that so called 'milder ' cases of JIA cases might never reach a tertiary care facility in many developing world settings. In developed world children with pediatric rheumatologic diseases will usually be reviewed in a hospital setting and have access to diagnostic and therapeutic facilities not yet available in most parts of our country.

It is apparent that differences in prevalence of pediatric rheumatologic diseases in Ethiopia from those reported in the industrialized west may simply be the result of a selection bias imposed by a dearth pediatric rheumatology service and expertise. In this context it is of interest that in true community-based studies in the developing world the prevalence of oligoarticular disease matches or exceeds that of polyarticular disease (14-19).

In Caucasian& Indian studies the majority of subjects ERA(Enthesitis related arthritis) are B27 positive & the prevalence of ERA is much higher than our study & this is likely due to the virtual absence of the B27 gene study in our country .The extra-articular features were as expected,apart from the poor ophthalmic outcomes in those with chronic uveitis .As pediatric rheumatology knowledge increases amongst doctors & other care providers in Ethiopia leading to the application of standard diagnostic & classification criteria , prevalent cases are likely to continue to resemble those reported elsewhere. Clinicians working in parts of Ethiopia where rheumatological services are non-existent or rudimentary face enormous challenges. These include a wide differential diagnostic list and a limited arsenal of diagnostic procedures to aid them in reaching a definitive diagnosis.

Limited training in pediatric rheumatology and working in an environment burdened with infectious diseases , their differential diagnostic list is frequently limited to possible infectious causes for rheumatological problems .Distinguishing common rheumatic fever from rarer pediatric rheumatologic subtypes is one example and unless clinicians are well trained to recognize the distinctive features of the two conditions, they will have doubts about diagnosing pediatric rheumatologic diseases[3,4] .

TABLE 5: Epidemiological comparison of JIA in developing and developed countries [UK (20); SA, (21)]

	Ethiopia	**South Africa**	**UK**
No in studied series	34	78	572
Systemic JIA (%)	13.7	7.7	14.7
Polyarticular JIA RF –ve (%)	45.5	14	19.5
Polyarticular JIA RF +ve (%)	18.1	26.9	5.2
Oligoarticular JIA (%)	22.7	26	43.7
Eye involvement	15.9	-	20
ANA positivity (%)	20.4	4.48	33

In our setup milder pediatric rheumatologic patients are not referred to our clinic and be attributed to trauma or thought to be infective & children with persistent or more severe joint symptoms may be subjected to unnecessary long term steroid treatment with its ugly complications. Therefore, increasing training & awareness of pediatric rheumatologic diseases among clinicians in Ethiopia should lead to improvement in reporting & adherence to the standard diagnostic criteria & early referral to our pediatric rheumatological clinic and prompt treatment with a better prognosis of the disease.

A better understanding of the epidemiology and reports of clinical outcomes of Juvenile Dermatomyositis (JDM) is engendered by scarce data from the country. Delay in diagnosis of JDM may be the consequence of lack of access to clinicians skilled in diagnosing & managing JDM & similar conditions; and lack of access to diagnostic facilities such as EMG & muscle biopsy [8]. Future efforts should be directed at validating efficacy of methotrexate in pediatrics and adverse events and many candidate predictors should be investigated. Recently a review was published about genetic predictors of MTX (methotrexate) efficacy & toxicity in pediatric rheumatological diseases (22).

Approximately 1/3 of our patients report imperfect adherence to medications which is similar to other reported adherence rates among pediatric patients with chronic illnesses. The most common reasons provided for missing medications was forgetfulness, cost of medications & cost to follow up (23) This cohort of subjects include pediatric SLE patients with a female predominance of 100%. Our study had several limitations including a small sample size and retrospective approach. Additionally, lack of comprehensive record and history documentation for several subjects.

CONCLUSSION AND RECOMMENDATIONS

All categories of pediatric rheumatologic diseases were identified in Ethiopian children. Polyarticular RF -ve disease was the most common presentation. Late presentation coupled with the scarcity of specialized health services are issues with major implications for patient care and productivity.

Furthermore, there was persistent clinically active disease in a large proportion of this cohort (50%), putting them at risk of further disease complications. Establishment of a prospective cohort in future could be useful in providing better quality data for better outcome assessments in line with currently accepted international guidelines. Better trainings opportunities in the field will help earlier diagnosis and assist in generation of data for advocacy in the care for such patients.

ABREVIATIONS

JIA -Juvenile Idiopathic Arthritis

ILAR -International League of Associations for Rheumatology

ESR - Erythrocyte Sedimentation Rate

ANA -Antinuclear Antibody

ADSDNA Ab- Antidouble Stranded DNA Antibody

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ORIGINAL ARTICLE

CLINICAL PROFILE AND OUTCOME OF CHILDREN WITH COVID-19 ADMITTED AT EKKA- KOTEBE TREATMENT CENTER

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ABSTRACT

Background: *Understanding the clinical profile and outcome of pediatrics Coronavirus disease 2019 will help plan better prevention and treatment strategies taking the local context into consideration. The aim of the study is to assess the clinical characteristics and outcome of pediatrics COVID 19 patients admitted to Ekka Kotebe treatment center from March 20, 2020, to August 20, 2020*

Method*: This retrospective study included all children in Addis Ababa who tested positive for COVID-19 and were admitted at Ekka Kotebe treatment center from March to August 2020. The data was collected from the patient records of the participants who fulfilled the inclusion criteria. The collected data was analyzed using SPSS for windows version 25. The sociodemographic, clinical presentation and their outcome was analyzed using descriptive analysis for each data was done. The finding was presented in tables and graph.*

Result*: A total of 87 children were included in the study, of these 71 (81.6%) were from Addis Ababa. 64.8% (n = 57) of participants were male with a mean age of 10.8years while 11% (n = 10) were infants. About 45.5% (n = 40) had history of household contact. Comorbidities were noted in 10.3% (n = 9) children. More than two third (72.7 %, n = 64) of participants were asymptomatic. Of the 23 symptomatic children, fever (65%, n = 15) was most common followed by cough (6.8%, n = 6), sore throat (2.3%, n = 2). 69.3% (n = 61) stayed for more than 14 days but one of the participants had a fatal outcome.*

Conclusion: *Important number of children with COVID-19 had a household contact and presented asymptomatic or with a mild illness. Severe and critical illness were observed in those with comorbidity.*

Keywords: *Coronavirus disease 2019; severe acute respiratory syndrome coronavirus 2; Ekka-Kotebe, Ethiopia, Childhood/Children, Pediatrics.*

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INTRODUCTION

Severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2) causing coronavirus disease (COVID-19) has spread globally, posing immense challenges to every country's healthcare system (1).

The first adult case in Ethiopia was reported on March 1, 2020, at 48 years old Japanese man reported to have traveled from Japan to Burkina Faso and who then arrived in Ethiopia. By September, the number of cases has steadily increased to reach 75,360. As of September 8, children under the age of one represented 1% of the total caseload; children under the age of five made up 2% of the total caseload, and children aged 5-14 made up 4% of all positive COVID-19 cases. The overall positive cases were 28 percent as of the data released by the Ethiopian Public Health Institute (EPHI) in the COVID-19 Daily Situation Report of 2nd of January 2022.

In the first reports of coronavirus disease 2019 (COVID-19), the frequency of disease in children was lower than in adults. In a study in China, until January 29, 2020, less than 1% of all patients were younger than 14 years (2). For this reason, most of the guidelines focused on recommendations for adult patients, only a few recommendations were for children. Even though most patients were adults, few children presented with severe COVID 19 illness and needed hospitalization. In addition, children's immune response and the structural characteristics of their respiratory system differ essentially from those in adults (3–5) because of this the diagnostic criteria and management of children may not be similar with adults. There were reports from developed nations that only (1.7%) were children aged < 18 years. The previous findings in children with COVID19 might not have reported fever or cough as often as adults(6–8). However, since then more data has come out showing increased risk in children such as from the CDC whose data as of December 30, 2021, showed 15.8% of the cases in the United States were under the age of 18. (9)

Despite some publications, there is a scarcity of data on pediatric COVID 19 clinical presentation and outcome especially from developing nations, hence this research is aimed to determine the clinical characteristics and outcome of pediatric COVID 19 patients admitted to the dedicated treatment center in Ethiopia.

Materials and methods:

This was a retrospective study conducted at the dedicated COVID treatment center in Addis Ababa, Ethiopia. The study protocol was approved by Institute Ethics Committee. All consecutive children aged less than 18 years who tested positive for SARS-CoV-2 by real time reverse transcription-polymerase chain reaction (RT-PCR) from nasopharyngeal swab between March 2020 and August 2020 were included in the study.

The severity of COVID-19 is categorized as mild, moderate, severe, and critical based on clinical and/or radiological features (10). Mild cases included children with only upper respiratory symptoms. Children with lower respiratory involvement (clinical or radiological signs of pneumonia) but without signs of severe pneumonia or hypoxemia were categorized as moderate disease. Severe disease included children with clinical features of severe pneumonia and/or hypoxemia (SpO2 < 90% on room air) and those with severe diarrhea and dehydration. Presence of acute respiratory distress syndrome (ARDS) and/or multiorgan dysfunction was classified as critical disease. This study included children with all severity including asymptomatic children as per the prevailing admission policy.

The source data were the clinical charts, nursing records, for all patients with laboratory confirmed COVID 19 infection who were admitted to Ekka Kotebe hospital from March to August 2020. Clinical characteristics and treatment outcomes data was obtained by pre-tested data collection tool. The data was collected by two experienced data collectors from patient records after receiving training in data collection. For the purpose of data quality assurance, the data was checked for completeness on daily basis.

The collected data was coded, double-checked, and inputted into EPI-DATA version 3.0 computers and was analyzed using SPSS version 25. Descriptive statistics like mean, median, percent, frequency were applied to generate results.

Inclusion criteria:

All patients below the age of 18 years who were confirmed cases of COVID 19 were admitted to the treatment center during the study period.

Exclusion criteria:

Missed medical records and charts with incomplete data.

Ethical considerations

Ethical approval was secured from Ekka Kotebe Ethics Review Committee. Primarily the data was collected from the patient charts. For confidentiality purposes, the name of the participant was omitted from the data collecting tool and the chart was seen by the principal investigator. The information collected was kept confidential and was used only for the study purpose and maintained the data on the locked cupboard.

Result:

Socio-demographic and clinical characteristics

A total of 87 children admitted to the center were included in this study. The mean age was 10.8 years with a standard deviation of 5.7 years, 11% (10/87) of the participants were infants (<1 year), more than half (59.8%) of the participants were >10 years old. Almost half ($n = 40$, 45%) had a history of household contact. Three out of eighty-seven children (3.45%) had a travel history

abroad. Almost half of the participants (n= 42, 47%) had been vaccinated for their routine childhood vaccinations according to their age. Comorbidities were noted in 10.2% (n = 9) of the children. Almost three fourth (72.7%) were asymptomatic and admitted in the initial phase as a measure of isolation and for monitoring. Of the 23 symptomatic children, fever (62.5%) was the most common symptom followed by cough (25%). The majority (81.6%) of the participants were from Addis Ababa.

Table 1: Socio-demographic, clinical characteristics of patients admitted to Ekka Kotebe COVID 19 treatment center (n=87)

Characteristics		**Number**	**Percent**
Age	<1year	10	11.5%
	1-<5 years	7	8%
	5-10years	15	17.2%
	>10years	55	63.2%
Sex	Male	57	65.5%
	Female	30	34.5%
Type of contact	Family	40	46%
	Neighbor	5	5,7%
	International Travel history	3	3.4%
	Prison	7	8%
	Hospital admission	5	5.7%
	Workplace	1	1.1%
	Unknown	26	29.9%
Residency	Addis Ababa	71	79%
	Out of Addis Ababa	10	11.5%
	Unknown	6	6.8%
Routine childhood Vaccination status	Vaccinated	42	48.3%
	Partially vaccinated	3	3.4%
	Unvaccinated	26	29.9 %
	Unknown	16	18.4%
Symptomatology	Symptomatic	23	26.4%
	Asymptomatic	64	73.6%
Symptoms n=23	Fever	15	65.2%
	Cough	6	26.1%
	Sore throat	2	8.7%
	Total	87	100%

In the first two months after COVID 19 was first detected in the country, the number of a patients diagnosed to have COVID was small. A high number of participants were seen in the month of May in comparison to the other months.

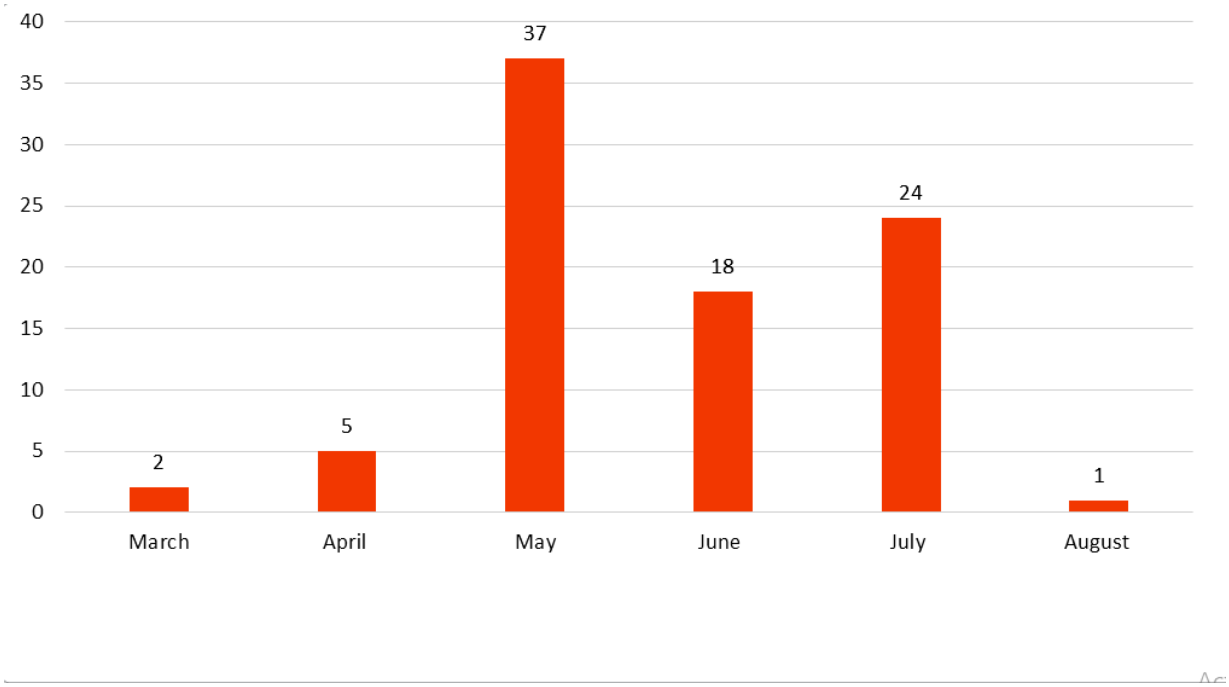

Figure 1: Number of children with COVID-19 admitted to the treatment center in each month at Ekka Kotebe treatment center (n=87)

The severity classification of COVID-19 was as follows; asymptomatic ($n = 61$, 70.1%), mild (n=23, 26.4%), moderate (n = 1, 1.1%), severe ($n = 1$, 1.1%), critical (n = 1, 1.1%). One child had underlying congenital heart disease with pneumonia another child had congenital heart disease and the critical patient who had a fatal outcome was a known non-Hodgkin's lymphoma patient. Almost all patients were admitted to the isolation ward but only one patient was admitted to the high dependency unit. Antibiotics (ceftriaxone and/or azithromycin) were used in 9 children. For one patient steroids were given. With an outcome of 86 children discharged improved, and 1 (1.1%) death. Length of hospital stay was less than14 days for 24 participants and more than14 days for 62 participants.

Table 2: Treatment and outcome of patients admitted to Ekka Kotebe COVID 19 treatment center (n=87)

Variables	Characteristics	Percent
Level of care		
Isolation ward	86	98.8%
High dependent unit	1	1.2%
Oxygen saturation		
< 85	6	6.9
85-90	15	17.2
>90	66	75.9
Outcome		
Discharged	86	98.9%
Died	1	1.1%
Length of stay		
< 14 days	25	28.7%
>14 days	62	7.13%
Severity of manifestation		
Asymptomatic	64	73.6
Mild	21	24.1%
Moderate	1	1.2%
Sever	0	0%
Critical	1	1.2%

DISCUSSION

Out of 87 RT-PCR confirmed COVID 19 cases of children admitted at Ekka Kotebe treatment center, between the month of March and August 2020, out of these 36.7% were children aged between 11 and 15 years. This finding is similar to a study conducted in U.S and Canada (11).

In the current study, death among the study population was very low (1.2%). This is similar with a study done by Jun Yasuhara showed no death report (12). But there were discordant in a study conducted in the United Kingdom and North America which had mortality rates of 1% and 4% respectively (13) which could be explained by the large sample size in their studies and admitted symptomatic patients.

More than two-thirds (65.5%, n = 57) of our study participants were males that is similar with another study done in Egypt male admission was predominant (14), while another study in China showed no difference in sex (10). Our study finding showed that the majority (73.6%) of the patients were

asymptomatic and 24.1% of children presented with mild symptoms and one of the participants (1.2%) developed a critical case, which is contrary to another study (11) that revealed a considerable proportion of children were diagnosed with a severe and critical illness with a need for Intensive care unit admission and invasive ventilation the explanation could be 83% participants from the US and Canada study had comorbidities.

Children are a very special group as they are much more dependent on their family as such inevitably having close family contacts, and so may be susceptible to cross-infection. Forty- six percent (40/87) of the participants in this study acquired the infection from their family, with one or more family members were infected which was similar to other studies (15)(16) were (68.6%) and another meta-analysis (16) of 39 studies showed 90% of children demonstrated clear evidence of transmission from a family member. Children with COVID-19 have prominently been reported to be either asymptomatic or with mild clinical symptoms compared to adults. That suggested pediatric patients generally have less severe symptoms than adults as shown in many studies (4,5,7,17). Our study has found similar findings the majority (73.6%) of the participants were asymptomatic at presentation, while discordant with a systemic review of 39 studies (18) which showed only 14.2% were asymptomatic children. The commonest symptom in this study was fever accounting for 65.2%, followed by 26% cough and sore throat 10%. In comparison to our study fever was found in 51.2% and cough was higher seen in 37% in the systemic review (13). While a study done in China showed fever was the presenting symptom in 77.9% and cough was in 32.4% of the study population (19),

Newborns acquire COVID 19 infection horizontally from their mother (13,19). In our study, there were 6 newborns admitted to the treatment center with most of them being asymptomatic. All of them were discharged with improvement. The finding was similar to the study done in China (20) where no fatal cases were reported in infants <28 days.

The major limitations of this study were that it was based on retrospective data with missing or incomplete data from the health facilities being a major problem.

Conclusion

A significant number (46%) of children with COVID-19 had a household contact and presented asymptomatic or with a mild illness. Severe and critical illnesses were observed in those who had comorbidities. Almost all had a good outcome with recovery leading to a hospital discharge however there was one death.

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ORIGINAL ARTICLE

MAGNITUDE AND DETERMINANTS OF STILLBIRTH IN MIZAN-TEPI TEACHING HOSPITAL, SOUTHWEST ETHIOPIA: UNMATCHED CASE CONTROL STUDY

Mahilet Berhanu Habte[1], Gurmesa Tura Debelew[1] , Selamawit Baye Bezabih[2]

ABSTRACT

Background: *The stillbirth rate is an important indicator of the quality of care during pregnancy and childbirth. It is one of a public health problem in low and middle-income countries including Ethiopia. Therefore, this study aimed to assess the magnitude and determinants of stillbirth in Mizan-Tepi teaching hospital, Ethiopia.*

Method*: Institutional based unmatched case-control study was conducted from January 2017 - December 31, 2019. Simple random sampling was used to choose 87 cases and 174 controls. Data were extracted from the medical records using a structured checklist. The collected data were entered into EPI data version 3.1 and exported to SPSS version 21 for analysis. Finally, multivariable logistic regression was used to identify determinants of stillbirth at 95% confidence and a P-value < 0.05.*

Result*: The stillbirth rate is 44 per1000 (95%CI: 38.9-49.7) in the study area. Previous history of stillbirth [adjusted odds ratio (AOR)=4.4, 95% CI: 1.36 - 14.4], referral status [AOR=2.3, 95% CI: 1.06 - 5.00], partograph use [AOR=4.0, 95% CI: 1.88 - 8.47], Antenatal care follow up [AOR=3.1, 95% CI: 1.51 - 6.40], history of obstetric complication [AOR=2.8, 95% CI: 1.38 - 5.80] and hemoglobin level of less than 11.5mg/dl [AOR=2.6, 95% CI: 1.28 - 5.56] were the independent factors affecting stillbirth*

Conclusion: *The magnitude of stillbirth in the study area was high. Therefore, concerted effort should be taken in improving partograph use, ANC visit, prevention of anemia, and overall strengthening maternal health service to prevent stillbirth outcomes.*

Keywords: *magnitude, determinants, stillbirth, Mizan-Tepi, Ethiopia*

Introduction

Stillbirth is one of the adverse birth outcomes, which is defined as a baby born with no signs of life at or after 28 weeks gestation [1]. It is a sensitive marker of health system strength measurement and progress in achieving sustainable development goals (SDG) [2].

Globally in 2015, there were 2.6 million stillbirths, with more than 7,178 deaths occurring per day which is unacceptably high. The majority of these deaths occurred in developing countries, 98% occurred in low

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and middle-income countries of which three-fourth occurred in sub-Saharan Africa and South Asia. The stillbirth rate in sub-Saharan Africa is approximately ten times that of developed countries [1, 3].

Ethiopia has made tremendous efforts towards improving maternal and child health conditions. Notwithstanding the expansion of free basic and comprehensive emergency obstetric care and prenatal care, stillbirth is still a public health problem in Ethiopia [4]. The 2016 Ethiopian demographic and health survey showed that the stillbirth rate was 11.8 per 1000 pregnancies at national and 20 deaths per 1000 pregnancies at Southern Nation Nationalities and Peoples Region (SNNPR), where the study was conducted. [5].

The long-lasting impact of stillbirth puts a significant burden on couples as well families. Its consequences will be grief, stigma, blame, marginalization, depression. Additionally, it causes marital instability and will hinder productivity in general. On the other side, it shows the poor quality of the health care system of the country. Therefore, the whole journey of pregnancy ends to a devastating and painful to mothers as well to families [6].

Several factors impede progress in the efforts to reduce the burden of preventable stillbirths. Compounding stillbirths with early neonatal deaths further obscure the specificity in addressing the associated factors of stillbirth [5&7]. Most stillbirths are believed to be preventable with high-quality service and evidence-based intervention during pregnancy and delivery. However, indicators in SDG show that stillbirth is a hidden agenda. Evidence from literature shows that: antenatal care (ANC) visit, place of delivery, preterm delivery, antepartum hemorrhage, prolonged labor, and infection are some of the factors that contribute to the high prevalence of stillbirth in Ethiopia [8-10]. However limited evidence exists as to why women who commenced their labor in health facilities end up with stillbirth. So, this study aimed to assess the magnitude and identify determinants of stillbirth in Mizan tepi teaching hospital which will be very helpful for decision-makers to design and implement strategies on evidence-based findings and increasing rate of live birth.

Methods and materials

Study design, setting and population

An institutional-based unmatched case-control study was conducted from January 01, 2017- to December 31, 2018, among mothers who gave birth in one of the teaching and referral public hospital to identify determinants of stillbirth. The study was conducted in Mizan-Tepi teaching hospital which is found in Benchi Maji Zone in southwest Ethiopia. Mizan-Tepi teaching hospital is the only one in the Benchi Maji zone and it gives different clinical services including maternal and child health services for about 1.5 million populations. The

maternity unit in the department of obstetrics and gynecology ward has one obstetrician/ gynecologist and three emergency surgeons.

For this particular study, the source population was all mothers who gave birth and neonates in pairs. Cases were mothers with stillbirth and controls were mothers gave to live birth

Cases were defined as fetal death after 28 weeks of pregnancy and Control were defined as live births after 28 weeks of pregnancy registered during the study period.

Inclusion and exclusion criteria

Inclusion criteria for cases

- All stillbirth deliveries attended in Mizan-Tepi teaching hospital from January 2017-December 2018
- Complete documentation of intra-partum care intervention available

Inclusion criteria for controls

- All live births attended in Mizan-Tepi teaching hospital from January 2017- December 2018
- Complete documentation of intra-partum care intervention available

Exclusion criteria for cases and controls

- Missed charts from the archive but, registered on registration book were excluded from the study
- Charts that didn't include the status of new born were excluded from the analysis

Sample size and sampling procedure

The sample size was determined using EPI info version 7.1 statistical software. The assumption for sample size determination were: labor length > 24hr [11] with estimated exposure among cases 43.8% and among controls 58.2% where AOR is 2.4, with 80% power and 95% confidence interval and 1:2 ratios for cases to controls. The total sample size was 270 (90 cases and 180 controls). All stillbirths' identification numbers that occurred between January 01, 2017- December 31, 2018, were taken from the delivery room registration logbook and a computer-generated simple random sampling method was used for the selection of cases.

Data collection tool and procedure

Data were extracted using a structured checklist from the medical records of mothers which is prepared based on the medical charts of the mother. Five data collectors and one supervisor were recruited and trained for one day on how to extract the data from medical records. The data collection process was closely monitored by the principal investigator.

Data processing and analysis

Data were coded, cleaned, and entered to Epi data version 3.1 and exported to SPSS version 21 for analysis. Descriptive statistics such as means and proportions were used to summarize the data as necessary. Bivariate logistic regression analysis was done to identify candidate variables for the multivariable logistic regression model at p-value 0.25. Model fitness was checked by Hosmer and Lemeshow test. Finally, variables at P-value < 0.05 were considered statistically significant in the final multivariable logistic

regression model. Adjusted odds ratio (AOR) with 95% CI was computed to determine the strength of association and identify determinants of stillbirth.

Result

Socio demographic characteristics

A total of 261 mothers (87 cases and 174 controls) were included in the study giving 96.7% retrieval rate. The mean age of the cases and controls was 27.1 (SD=6.63) and 24.04 (SD=4.46) respectively. Mothers residence among cases 72 (82.8%) and 81 (46.6%) controls were from rural areas.

Majority, 166 (63.6%) were Para I of which 46.0% were cases and 72.4% were controls. Most of them, 194 (74.3%) had labor duration less than 12hrs which includes 69 (79.3%) among cases and 125 (71.8%) among controls. Two hundred twenty-three (85.4%) labor was initiated spontaneously (74.7%) among cases and 90.8% among controls) (Table1).

Table 1: Obstetric characteristics of mothers who gave birth in Mizan Tepi teaching and referral hospital, in Benchi Maji Zone, south west Ethiopia, 2019. (n=261; cases: 87 and controls: 174)

Variables	Categories	Cases (n=87)	Controls (n=174)	Total (n=261)	p-value
Parity	1	40(46.0%)	126 (72.4%)	166(63.6%)	< 0.001*
	2-3	26(29.9%)	39 (22.4%)	65(24.9%)	
	≥4	21(24.1%)	9 (5.2%)	30(11.5%)	
History of still birth	Yes	18(20.7%)	8 (4.6%)	26(10.0%)	< 0.001*
	No	69(79.3%)	166 (95.4%)	235(90.0)	
	Yes	13(14.9%)	17 (9.8%)	30(11.5%)	0.22
History of abortion	No	74(85.1%)	157 (90.2%)	231(88.5%)	
	28-36	31(35.6%)	16 (9.2%)	47(18.0%)	< 0.001*
Gestational age	37-42	56(64.4%)	158 (90.8%)	214(82.0%)	
Initiation of labour	Spontaneous	65(74.4%)	158 (90.8%)	223(85.4%)	< 0.001*
	Induced	22(25.3%)	16 (9.2%)	38(14.6%)	
ANC follow up	Yes	26(29.9%)	130 (74.7%)	156(59.8%)	< 0.001*
	No	61(70.1%)	44 (25.3%)	105(40.2%)	
No. of ANC visits	1-3	23(29.9%)	78 (60.0%)	101(64.7%)	0.006*
	≥4	3(11.5%)	52 (40.05%)	55(35.3%)	
Current Obstetric complication	Yes	58 (66.7%)	47 (27.0%)	105(40.2%)	< 0.001*
	No	29 (33.3%)	127 (73.0%)	156(59.8%)	
Maternal RH factor	Positive	80 (92%)	159 (91.3%)	239 (91.5%)	0.86
	Negative	7 (8%)	15 (8.7%)	22 (8.5%)	
Level of hemoglobin	≤ 11.5	46 (52.9%)	37 (21.3%)	83 (311.8%)	< 0.001*
	>11.5	41 (47.1%)	137 (78.7%)	178 (68.2%)	

Magnitude of stillbirth

During the study period there were a total of 5636 deliveries. Among them, 5388 were live birth and 248 were Stillbirth. The overall stillbirth rate was 44 per1000 births with (95%CI: 38.9-49.7). Hemoglobin level was tested for all and 83(31.8%) mothers had <11.5mg/dl which were 46 (52.9%) among cases and 37 (21.3%) among controls. Among the reviewed records 62(71.3%) of cases and 53(30.5%) of controls were referred from other health facility for delivery.

Determinants of stillbirth

In the bivariate analysis, factors found to be significantly associated with stillbirth outcome were: residence, maternal age, parity, history of stillbirth, history of abortion, gestational age, referral status to facility, initiation of labor, partograph use, ANC follow up, history of obstetric complication and hemoglobin level.

After controlling for confounders using multivariate analysis, previous history of stillbirth, referral status, partograph use, ANC follow up, history of obstetric complication and level of hemoglobin level were identified as independent determinant factors of stillbirth outcome. Mothers who had previous history of stillbirth were more than four times at risk of experiencing stillbirth outcome than mothers who had no previous history of stillbirth [AOR=4.4, 95% CI: 1.36 - 14.4]. Mothers who were referred from other health facility were more than two times at higher risk of experiencing stillbirth outcome compared to their counterpart [AOR=2.3, 95% CI: 1.06 - 5.00]. Mothers whose labors were not monitored using partograph were four times more likely to experience stillbirth outcome than their counterpart [AOR=4.0, 95% CI: 1.88 - 8.47]. ANC follow up during pregnancy is an independent determinant factor of stillbirth; mothers who had no ANC follow up were three times more likely to experience still birth outcome compared to those had ANC follow up [AOR=3.1, 95% CI: 1.51 - 6.40]. Mothers those who had at least one obstetric complication during pregnancy or delivery were nearly three times more likely to experience stillbirth outcome than their counterpart [AOR=2.8, 95% CI: 1.38 - 5.80]. Furthermore, mothers with hemoglobin level of less than 11.5mg/dl were two and half times at higher risk to experience stillbirth compared to their counterpart [AOR=2.6, 95% CI: 1.28 - 5.56] (Table 2).

Table 2: Determinants of stillbirth outcome among mothers who gave birth in Mizan Tepi teaching and referral hospital in Benchi Maji Zone, south west Ethiopia, 2019.

Variable	Categories	Cases (n=87)	Controls (n=174)	COR(95% CI)	AOR(95%CI)	P-value
Place of residence	Urban	15(17.2%)	93(53.4%)	1.00	1.00	
	Rural	72(82.8%)	81(46.6%)	5.51(2.9-10.3)	2.08(0.93-4.6)	0.07
Age	<20	9(10.3%)	18(10.3%)	1.00	1.00	
	20-34	60(69.0%)	149(85.6%)	0.8(0.34-1.89)	0.7(0.13-3.76)	0.68
	≥34	18(20.7%)	7 (4.15%)	5.14(1.57-16.8)	8.67(0.41-179.7)	0.16
Parity	1	40(46.0%)	126 (72.4)	0.13(0.05-0.3)	0.3(0.1-1.35)	0.13
	2-3	26(29.9%)	39 (22.4)	0.28(0.11-0.7)	0.43(0.12-1.5)	0.19
	≥4	21(24.1%)	9 (5.2)	1.00	1.00	
History of still birth	Yes	18(20.7%)	8 (4.6)	5.4(2.24-13.0)	4.4(1.36-14.4)	0.013*
	No	69(79.3%)	166 (95.4)	1.00	1.00	
History of abortion	Yes	13(14.9%)	17 (9.8)	1.62(0.74-3.5)	0.7(0.23-2.1)	0.53
	No	74(85.1%)	157 (90.2)	1.00	1.00	
Gestational age	28-36	31(35.6%)	16 (9.2)	5.4(2.7-10.7)	1.8(0.65-4.92)	0.25
	37-42	56(64.4%)	158 (90.8)	1.00	1.00	
Referral status	From health fac.	62 (71.3)	53 (30.5)	5.66(3.21-9.9)	2.3(1.06-5.0)	0.013*
	From home	25 (28.7)	121 (69.5)	1.00	1.00	
Labour start	Spontaneous	65(74.4%)	158 (90.8)	1.00	1.00	
	Induced	22(25.3%)	16 (9.2)	3.34(1.65-6.7)	2.47(0.95-6.4)	0.63
Partograph use	Yes	16 (18.4)	102 (58.6)	1.00	1.00	
	No	71 (81.6)	72 (41.4)	6.28(3.3-11.6)	4(1.88-8.47)	<0.001*
ANC follow up	Yes	26(29.9%)	130 (74.7)	1.00	1.00	
	No	61(70.1%)	44 (25.3)	6.9(3.91-12.2)	3.1(1.5-6.4)	0.002*
Obstetric complication	Yes	58(66.7%)	47 (27.0%)	5.4(3.09-9.43)	2.8(1.38-5.8)	0.005*
	No	29(33.3%)	127(73.0%)	1.00	1.00	
Preeclampsia	Yes	11(12.6%)	10 (5.7%)	2.37(0.96-5.8)	1.43(0.2-9.97)	0.71
	No	76(87.4%)	164(94.3%)	1.00	1.00	
Hgb level	<11.5	46(52.9%)	37(21.3%)	4.5(2.38-7.24)	2.6(1.28-5.56)	0.008*
	>=11.5	41(47.1%)	137(78.7%)	1.00	1.00	

*significant at p value <0.05

Discussion

In this study magnitude of stillbirth was high. This is consistent with study conducted in Aksum hospital, Ethiopia in 2019 [12]. This similarity might be both studies were facility based. However, this finding was lower than study done in Jimma university specialized hospital, Ethiopia in 2011 [9]. The difference might be due to study period difference. Additionally, after post millennium development goal the Ethiopian government has done a lot in strengthening maternal and child health service.

In this study previous history of stillbirth were determinant of stillbirth. This finding is in line to similar study done in urban hospital of Dar es salaam Tanzania in 2009, Sub Saharan Africa in 2017 and systematic review conducted in low- and middle-income countries in 2014 [10,13,14]. The possible reason for this finding might be related to the maternal Rh-factor, which leads to erythroblastosis fetalis. The other reason might be that repeated pregnancy related complications which end in fetal deaths [15].

Referral status is an independent predictor of stillbirth in this study which in agreement with study conducted in a rural hospital in Gambia and rural hospital in Ghana [16-17]. This similarity could be explained, these studies also conducted hospital based and in rural setting.

In this study not using partograph were significantly associated with occurrence of stillbirth. The partograph use in this study is only 16 (18.5%) among cases where as 102 (58.6%) among controls. This is similar with other similar studies done in Aksum, Ethiopia in 2019 and a rural hospital in Ghana [12, 17]. This suggests that partograph use for labor monitoring helps to alert health care providers about the maternal and fetal well-being status and the progress of labor which is directing the possible type of intervention to be taken.

Not having ANC follow up was associated with stillbirth. This finding is supported with study conducted Tikur Anbessa hospital in Addis Ababa Ethiopia in 2008, Mutare district hospitals, Zimbabwe in 2014, Ekiti State University Teaching Hospital, Nigeria in 2017 and systematic review in low- and middle-income countries [14, 18-20]. This could be justified by the fact that during ANC visit mothers can get information on birth preparedness and complication readiness, maternal nutrition and supplementation which can improve the health status and awareness level of mothers. This implies that strengthening maternal health service would reduce the stillbirth outcome.

Preterm and preeclampsia are the leading obstetric complication in this study. Mothers those who had at least one obstetric complication during pregnancy or delivery were at increased risk to experience stillbirth outcome. This is in line to study done in Butajra hospital southern Ethiopia in 2019, Gambia in 2010 and Mutare district hospitals, Zimbabwe in 2014 [16, 19 &21].

This could be due to the fact that obstetric complications like preterm are the leading cause of death. The others preeclampsia and eclampsia that occur before reaching term could have adverse birth outcome as the fetal lung not mature well. Premature rapture of membrane also results to death of fetus due to infections if not managed early.

Furthermore, hemoglobin level less than 11.5mg/dl was another determinant of stillbirth. This is supported by study done in Tigray region, northern Ethiopia in 2016 [22]. This could be explained that hemoglobin level is used to determine the diagnosis of anemia in low resource setting countries like Ethiopia. So the decrement in hemoglobin level during pregnancy would have the direct influence on fetus as the fetus is dependent on nutritional status of mother. Anemia during pregnancy is a risk factor for prematurity, preterm delivery, low for gestational age and poor fetal supply of oxygen and nutrient. On the other hand it tells the maternal nutritional status which could lead to growth restriction and finally death to fetus.

The program implication of the finding of this study supports WHO recommendation on health promotion interventions for maternal and newborn health and national strategy for newborn and child survival in Ethiopia which intends making all birth count. Therefore, strengthening maternal health service is important to reduce stillbirth. It demands scale up of emergency obstetric service and early detection of complication.

This study has its own limitation. There might be over representation of determinants because of commonly complicated cases referred to referral hospital. The other might be due to the secondary nature of data, the contribution of some important variables like maternal nutritional practice, wealth index and socio-cultural related factors were missed.

Conclusion

In this study magnitude of stillbirth in the Mizan-Tepi teaching hospital, Ethiopia was high compared to the national target for 2020. Previous history of stillbirth, referral status, use of partograph, ANC follow-up, obstetric complication and maternal hemoglobin level less than 11.5mg/dl were factors independently associated to stillbirth outcome.

Recommendation

To overcome the burden of stillbirth, concerted effort should be taken and strengthening appropriate maternal health service. Further research, a follow up study on large sample of pregnant women should be done for better understanding of stillbirth predictors.

Availability of data and materials

The authors agreed to provide any required data as per the guidelines of the Ethiopian journal of pediatrics and child health up on request.

Declaration

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

All authors contribute equally

Ethics approval

The study was conducted after ethical review and clearance of the proposal by the Institutional Ethical Review Board (IRB) of Jimma University Institute of Health (JUIH). Permission letter was obtained from chief executive officer and medical director of Mizan Tepi teaching and referral Hospital. There were no unique identifiers of mothers on the checklist and all the data collected were handled confidentially and were safely disposed.

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ORIGINAL ARTICLE

ASSESSMENT OF KNOWLEDGE OF NICU NURSES AND MIDWIVES IN NEONATAL RESUSCITATION IN FOUR URBAN HOSPITALS IN ADDIS ABABA, ETHIOPIA

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ABSTRACT

Introduction : *Resuscitation with bag and mask is a high-impact intervention that can reduce neonatal deaths in resource-poor settings. The quality of resuscitation and stabilization of a neonate immediately after birth has significant effects on neonatal morbidity and mortality. This study was done to assess the knowledge of neonatal resuscitation among Neonatal Intensive Care Unit (NICU) nurses and delivery ward midwives from select referral hospitals in Addis Ababa, Ethiopia.*

Method*: Data were collected from 172 midwife and NICU nurses from four referral hospitals in urban Addis Ababa between January and June 2017. Knowledge related to newborn resuscitation were assessed using a structured questionnaire prepared for the study. The collected data were analyzed using SPSS version 20.*

Result*: Seventy-six percent (n=131) of respondents were female. Among all respondents, 89.0% self-reported adequate knowledge of neonatal resuscitation (answers knowledge question above 80. Fifty-eight percent (n=99) of respondents had resuscitated newborns in the hospital setting while the rest in the clinics.*

Conclusion: *Within this study population, NICU and delivery wards nurses had good knowledge about neonatal resuscitation; however, they have in particularly poor knowledge of airway management .*

Keywords: *Neonatal Resuscitation, Ethiopia, Health Worker Capacity-Building, Health Systems Strengthening*

INTRODUCTION

Globally in 2017, 5.5 million children under five years of age died prematurely. Of these preventable child deaths, 2.5 million (46%) occurred in the first month of life, which is known as neonatal mortality(1). Most neonatal mortality happens in low and middle-income countries (LMICs), and mostly to babies born at home (2,3). The highest neonatal mortality rates are seen in sub-Saharan Africa. In Asia, prevalence rates are lower; however, this region accounts for over 60%

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of the estimated global total because of its large population and high fertility rates (4–6) (4, 5, 6). Worldwide, the common direct causes of neonatal death are considered to be preterm birth (28%), severe infections (26%), and asphyxia (23%). (7) Ethiopia's neonatal mortality rate is estimated at 48 per 1,000 live births in 2016 (8). One factor that contributes to Ethiopia's high neonatal mortality rate is home delivery, as opposed to delivering in a health facility.

The first moments of a newborn's life are critical and require effective emergency care to prevent lifelong consequences when there are difficulties. If there is difficulty with airway, breathing, and circulation there will be a need for neonatal resuscitation. Proper resuscitation requires essential equipment and knowledge about protocols to take before delivery. Prior knowledge of the gestational age of the newborn is helpful to anticipate the need for resuscitation because low birth weight and premature delivery are two factors that predispose infants to need resuscitative efforts (9).

The significant effects in mortality and morbidity are seen with quality of resuscitation and stabilization of a neonate immediately after birth. Quality of resuscitation is meant by having knowledgeable and skilled health professionals with institutional equipment and supplies coordinated system. Identifying the reasons for neonatal admission and mortality in a hospital setting is crucial to improving the quality of existing health worker practices and hospital systems (10).

Prior studies have demonstrated gaps between health systems quality and preparedness and newborn resuscitation rates and survival (11). Therefore, the objective of this study was to assess the capacity to perform newborn resuscitation, as well as individual and facility characteristics associated with provider knowledge and clinical skills, among Neonatal Intensive Care Unit (NICU) and delivery ward nurses and midwives from four referral hospitals in Addis Ababa, Ethiopia.

METHODS

Study Population

This cross-sectional study was conducted among four public referral hospitals in Addis Ababa, Ethiopia from January 2017 to June 2017. There are a total of thirteen government referral hospitals in Addis Ababa. Among these, three were excluded from the study: one was excluded because it does not provide delivery or neonatal care services (Emmanuelle Psychiatric Hospital), and two were excluded as permission was not granted (Medical Defense College Hospital and the Police Hospital). From the remaining ten hospitals, four were selected to participate in this study. The hospitals selected are the largest in the number of beds and each has a practicing neonatologist. Daily, eight to ten newborns from all categories of disease are admitted and, on average, one to two

newborns are resuscitated at these hospitals (Unit admission registration book). All midwives and nurses (n=180) selected to participate in this study had worked in the delivery room and/or NICU in these hospitals for at least six months. In delivery rooms of Ethiopian hospitals, midwives are the first responsible person, while in the NICU, pediatric nurses are the first responsible party. We excluded those who did not give consent to participate in the study and those who were on leave during the study period.

Survey Tool had three parts: demographic part containing 7 questions while the second part has 33 MCQ knowledge questions. All the questions were in English, and it was distributed to nurses and midwives while they were at the job in respective labor wards and NICUs. The clinicians were asked to complete the questionnaires. The tool was adopted from neonatal resuscitation guidelines. (12)

Operational Definitions

Knowledge: Good knowledge considers overall knowledge of questions. If a respondent answers greater than 80%, they were determined to have good knowledge. If participants answer less than 80%, it is poor knowledge. (13).

Neonatal resuscitation: Intervention after birth to 28 days of the baby to assist in breathing and circulation.

Data Collection

Data were collected using structured questionnaires adopted from the WHO guidelines. Current health professionals were recruited as enumerators for this study so they could elaborate on the content of the questionnaire to ensure participants had a thorough understanding of the questions. A total of four enumerators were selected and trained in the study protocols and methods before the data collection period. Data collection was managed and monitored by two supervisors.

Ethical clearance was obtained from the Department of Pediatrics and Child Health Research Publications Committee at the College of Health Sciences Addis Ababa University and also from respected hospitals. An information sheet was provided to participants and verbal consent was obtained from each. To ensure confidentiality, no personal identifiers (e.g., name) were recorded on the questionnaire.

Data Analysis

Data were verified, cleaned, and entered into Epi by the principal investigator and analyzed using SPSS version 20. Results from the univariate analysis were presented as descriptive statistics. For continuous variables, we present the means and standard deviations, and for categorical variables we present proportions.

RESULTS

A total of 180 midwives and NICU nurses from the four public referral hospitals met the inclusion criteria and were invited to participate in the study. The questionnaire was completed by 172 respondents for a response rate of 95.5%. Fifty-two percent of the respondents (n=91) were midwives, and 48% (n=81) were NICU nurses. Most respondents, 76.2% (n=131) were female and between the ages of 20-30 years (78.0%, n=135). Eighty-three percent of respondents (n=143) were BSc nurses with work experience, and 65.7% (n=113) had between 1 to 5 years of experience. The proportion of participants from each hospital was as follows: Hospital 1 (29.1%), Hospital 2 (22.0%), Hospital 3 (23.8%), and Hospital 4 (22.1%).

Table 1: Socio-demographic characteristics of NICU nurses and Midwives, working in delivery rooms at four selected hospitals, in Addis Ababa, Ethiopia 2017.

Variable	characteristics	Frequency ($N_{o=172}$)	Percent (%)
Sex	F	131	76.2
	M	41	23.8
Age	20-30	135	78.5
	31-40	31	18
	41 and above	6	3.5
Level of education	Diploma	24	14.0
	Degree	143	83.1
	Masters	5	2.9
Work experiences	1-5 years	113	65.7
	6-10 years	40	23.3
	11-15 years	13	7.6
	16 and above	6	3.5
Working department	NICU	80	46.5
	Delivery room	92	53.5
Hospital	Hospital 1	50	29.1
	Hospital 2	43	25.0
	Hospital 3	38	22.1
	Hospital 4	41	23.8

Resuscitation knowledge of midwives and NICU nurses

The mean knowledge score of all midwives and NICU nurses was 15.2 (scale of 15-19; SD=2.6). Among midwives and NICU nurses who participated in the survey, 68.6% (n=118) did not receive in-service training. A total of 154 (89.3%) of midwives and NICU nurses had good knowledge of the immediate preparation of newborn resuscitation.

Sixty-nine-point five percent (n=118) of the participant, had good knowledge of airway management. Regarding the pressure used during chest compression, 63.1% (n=108) of respondents had good knowledge.

Table 2: Distribution of knowledge score in terms of resuscitation steps of NICU nurses and Midwives, working in delivery rooms at four selected hospitals, in Addis Ababa, Ethiopia 2017

Resuscitation steps	**<80%**	**>80%**
Preparation	18 (10.5%)	154 (89.5%)
Airway management	54 (31.4%)	118 (68.6%)
Chest compression	64 (37.2%)	108 (62.8%)

The preparation, airway and chest compression knowledge of midwives and NICU nurses

On neonatal resuscitation, from the total of 172 participants, 68% (n=117) had good preparation to practice newborn resuscitation. The minority of the participants 35.5% (n=61) have good knowledge of airway management.

Most participants, 57.6% (n=99) have performed neonatal resuscitation in NICU or delivery room. Among participants, 71.5% (n=123) mentioned lack of all equipment during neonatal resuscitation, and 54.1%, (n=93) faced a lack of trained assistants.

Table 3: Distribution of preparation, knowledge of airway and chest compression in terms of resuscitation steps of NICU nurses and Midwives, working in delivery rooms at four selected hospitals, in Addis Ababa, Ethiopia 2017

Resuscitation steps	**Good**	**Bad**
Preparation	117(68%)	55 (32%)
Knowledge of Airway management	61(35.5)	111(64.5%)
Knowledge of Chest compression	115 (66.8%)	57 (33.2%)

In the logistic regression analysis of newborn resuscitation there is no significant association with working experience sex, and age-based on logistic binary regression but there is significant relation to the educational level and the p-value was less than (<0.05).

Table 4: Logistic regression analysis variable with practice of neonatal resuscitation of NICU nurses and Midwives, working in delivery rooms at four selected hospitals, in Addis Ababa, Ethiopia 2017

Variables	**Category**	**COR (95% CI)**	**(P-Value)**
Age	20-30 years		1000
	31-40 years	2.236(0.240-20.879)	0.480
	41 and above years	0.606(0.68-6.882)	0.748
Sex	Male	.818(0.393-1.704)	0.592
	Female	1.418	0.605
Profession	NICU Nurse	0.797(0.422-1.505)	0.484
	Midwife	1.429	0.489
Education	Diploma	0.667 (0.641-69.344)	0.112
	Degree	9.000 (0.978-82.857)	0.002*
Work experience	1-5 years	1.266 (0.221-7.254)	0.316
	6-10 years	0.833 (0.136-5.113)	0.791
	11-15years	2.333(.0.310-17.545)	0.844
Department	Delivery Room	1.300(0.688-2.456)	0.491
	NICU	1.759	0.115

*Educational level is statistically significant

The knowledge of the participant was assessed by correctly answered questions, if the participant answered more than 80% considered good knowledge and less than 80% considered poor knowledge.

The knowledge score total of NICU nurses that were 82 (80.2%) had good knowledge, while midwives count 91, from this 88 (96.7%) had good knowledge .

Table 5: The knowledge of NICU nurses and Midwives in four selected hospitals Addis Ababa, Ethiopia, 2017.

Type of profession	Knowledge (N=172)	
	Good	**Poor**
NICU Nurse	65 (80.2%)	16(19.8%)
Midwifes	88(96.7%)	3(3.3%)
Total	153 (89%)	19(11%)

DISCUSSION

Nursing is a profession that deals with human health and thus life. It, therefore, demands high professional knowledge for effective and efficient management of human health. In this study, the mean knowledge score of midwives and nurses was 15.2 SD=2.6. This finding was inconsistent with results from a similar study conducted in Gondar (northwest Ethiopia) 19.9 (SD=3.1). (13,14) The discrepancy could be due to the difference in the quality of training on neonatal resuscitation, the facilities available for neonatal resuscitation, and the level of health professionals.

The participants of this study 99 (57.6%) have practiced or participated in real neonatal resuscitation. A similar study was done in the Department of Pediatrics, University College of Medicine and JNM Hospital, Kalyani, West Bengal, India in 2014 showed among nursing staff was found that nursing staff has average knowledge (15).The findings in our study suggested that most of the participants (71.5%) responded there is a shortage of availability of equipment in the resuscitation area which is similar to the study conducted in Zimbabwe and South Africa (16,17).

In our study, knowledge of chest compression was 115 (66.8%). This finding was not in agreement with a study conducted in Afghanistan. This discrepancy might be due to the availability of simulation-based training, updating training, and certification process before graduation in Afghanistan which does not exist in our case. (18) This finding was similar to the study conducted in Western Nigeria. (19) This is considered due to the absence of standardized training during the undergraduate and postgraduate courses in both sets up.

Conclusion

The overall knowledge of participants on neonatal resuscitation was good, however their knowledge in airway management was not satisfactory.

Recommendation

- Include proper neonatal resuscitation training in pre-service training for all NICU nurses and Midwives to improve knowledge in neonatal resuscitation.
- Encourage simulation on newborn resuscitation regularly to improve in knowledge and skill of neonatal resuscitation.

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ORIGINAL ARTICLE

UTILIZATION OF BLOOD AND BLOOD PRODUCTS AMONG PEDIATRIC PATIENTS ADMITTED TO ST. PAUL'S HOSPITAL MILLENNIUM MEDICAL COLLEGE, ADDIS ABABA, ETHIOPIA

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ABSTRACT

Background : *Transfusion of blood components is an integral part of health care practice. Many times there will be injudicious use of blood and its products among physicians. There is limited data on blood product utilization and appropriateness in pediatrics.*

Objective: *To assess the appropriateness of utilization of blood products among pediatric patients.*

Method*: A cross-sectional study was conducted from January 1, 2018 to December 30, 2018 G.C. Data were collected from blood bank log book and patient charts. Pediatrics patients who were transfused with any form of blood product were included. Patient's age, gender, address, type of transfusion ordered, documentation of indications for transfusion, amount of transfusion was assessed based on the Blood Center of Wisconsin transfusion guideline .*

Result*: Five hundred and eleven (511) transfusion episodes were documented. The magnitude of pediatric blood product utilization is 12.5%. From this 31.4% transfusion was PRBC, 20.7% whole blood, 25.6% platelet and 19.6% FFP. From all transfusions, 28% are inappropriately transfused. 34.9% of whole blood, 34.5% of PRBC, 23% of FFP and 17.6% of platelets transfusions are inappropriate. Only 1/5th of the blood products taken for NICU were transfused.*

Conclusion: *There is significant inappropriate usage of blood products. PRBCs and whole blood were inappropriately utilized.*

Keywords: *Blood products, inappropriate utilization, blood discarded amount*

INTRODUCTION

Blood is essential for human survival. Until now, there is no effective substitute for blood. Hence, the transfusion of donated blood is the main stay of treatment in variety of medical/clinical conditions. Appropriate use of blood and blood products means the transfusion of safe blood products only to treat a condition leading to significant morbidity and mortality that can't be prevented by other means. The indications for transfusion are a major factor in determining blood utilization. (1)

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According to 2020 World Health Organization (WHO) report, 118.5 million units of blood were collected worldwide. Forty percent of this is from high-income countries where 16% of the world population lives in. This makes the rate of donations 31 per 1000 people. Coming to low-income countries, there are only 5 donations per 1000 people .More than half of the donated blood in developing country received by children under the age of 5 years, while older individuals are frequently transfused in developed countries. (2, 3)

In Ethiopia, Annually, an estimated 200,000 units of blood collected by the national blood bank. The daily amount of blood required in the country is 1,100 units; nearly 7900 units of blood shortage. (4).

Inappropriate transfusion practices can lead to serious consequences for recipients, including the transmission of infectious agents, non-infectious complications like allergic reaction and lack of blood, which is a major problem in many parts of the world as blood is a scarce resource. Clinicians should weigh the risks of transfusion against the benefits. (5) High proportion of inappropriate use of blood transfusion in both developed and developing countries is observed .(6-10) Evaluation of the pattern of blood component usage, its demand and good audit management is needed to ensure appropriate utilization of precious resources. Even though there are literatures on the appropriate use of blood and blood products worldwide, specific pediatric blood audit is lacking inEthiopia, hence this study is done to show the gaps.

Objective

This study was aimed to assess the level of appropriate utilization of blood and blood products among pediatric patients at Saint Paul's hospital millennium medical college (SPHMMC).

Methods

Study setting

This study was conducted at St. Paul's hospital millennium medical college. SPHMMC is a tertiary hospital under the federal ministry of health of Ethiopia. A one year cross sectional study was conducted from January 1, 2018 to December 30, 2018 G.C.

Study design and sampling methods

Using Purposive sampling technique, all pediatric patients who were admitted to pediatric department and transfused with any form of blood product from January1, 2018 to December 30, 2018 were included in the study.

Inclusion criteria

All admitted pediatric patients (less than 15 years) who took any form of blood transfusion in the study period were included.

Exclusion criteria

Neonates who underwent exchange transfusion and patients with lost medical record were excluded. Exchange transfusion was excluded because the bilirubin cut for exchange transfusion varies based on gestational age, postnatal age in hours and presence of risk factors.

Data collection

Data collection was done by using a structured and pre- tested questionnaire after ethical clearance was achieved from the SPHMMC research institutional review board. Two questionnaires were prepared, one for children above 4 month and the other for children age below 4 month which is based on Blood Center of Wisconsin transfusion guideline. The questionnaire included socio demographic factors like age, sex and weight, the units in the department, the indications for transfusion,type of blood product and amount of blood product taken by the patient. Using the blood bank log book, pediatric patients who received blood and blood products were identified and medical records were retrieved. Data was collected by trained general practitioner and the primary investigator rechecked the data collection form to ensure completeness and accuracy.

Data analysis

Data were entered to statistical package for the social sciences (SPSS) version 25 statistical package. Descriptive statistics were used to describe the independent variable. Blood Center of Wisconsin transfusion guideline was used to assess the appropriateness of transfusion. (Table 1).

If the indication is not according to the criteria and if laboratory results and/or documents which indicate the clinical condition of the patient at the time of transfusion are not available in the medical record, the transfusion will be taken as inappropriate. p-Value less than 0.05 was considered statistically significant. The discarded amount of blood and blood product was calculated by subtracting the amount given to the patient from the amount taken from the blood bank.

Operational definitions

1. Pediatric department: Pediatric emergency, PICU, NICU, pediatric ward, pediatric surgery and POPD.
2. Blood products; are PRBC, platelet, FFP, and cryoprecipitate.
3. Appropriate transfusion; is the transfusion of safe blood products only to treat a Condition leading to significant morbidity and mortality that can't be prevented by other means. (2)
4. Inappropriate blood transfusion; if the indication is not according to Blood Center of Wisconsin Pediatric Transfusion Guideline (11)

Table1: Criteria to level transfusion practice appropriate based on Wisconsin blood transfusion Guideline

		Age less than 4 months	**Age above 4 months**
Whole blood or PRBC transfusion	indication	A. Massive or acute blood loss B. Hgb ≤ 8 C. Hgb ≤ 10, with O_2 requirement of <35% or on CPAP< 6cm H2O, apnea, brady-cardia D. Hgb ≤12, FIO2 <35%, CPAP 6-8, deteriorating resp. Status, hypotension, or shock, recovering from major surgery. E. Hgb ≤ 15, HCT< 35% Cyanotic CHD	A. Massive or acute blood loss B. Hgb ≤ 4 C. Hgb ≤ 8 with urgent or emergent surgery, symptomatic tachycardia, tachypnea, or stable ICU patient D. Hgb ≤ 10 and severe brain injury E. Hgb ≤ 13 g/dl cyanotic CHD, severe pulmonary disease
	amount	A. 10-20 ml/kg	A. 5ml/kg B. 10-20ml/kg
Platelet transfusion	indication	A. Platelet count ≤ 50,000 with active bleeding or prior to invasive procedures B. Platelet ≤ 100,000 in critically ill preterm neonate with active bleeding C. Massive bleeding D. Plt ≤30,000	A. Platelet count ≤ 50,000 with active bleeding or prior to invasive procedures B. Platelet ≤ 100,000 in critically ill child with active bleeding C. Massive bleeding D. Plt ≤ 30,000
	amount	10-15ml/kg	10-15ml/kg
FFP transfusion	indication	A. DIC B. Coagulopathy C. Correction of vit- k deficiency D. Unexplained bleeding	E. DIC F. Coagulation factor deficiency (liver disease)
	amount	A. 10-20ml/kg	10-20ml/kg

Results

From the hospital blood bank log book registry a total of 6850 units of blood products were distributed to different departments in the hospital. Of which 859/6850(12.5%)were registered as blood taken by different units of pediatrics department. In the pediatrics department log book the number of children who were registered as transfused with blood or blood products were 511/859(59.5%). 511 units of blood products were transfused to 398 pediatric patients, 20 units were used for exchange transfusion and no documentations were found regarding the remaining units of blood products.

Indications of transfusion

Hemoglobin (Hgb) ≤8 g/dl (40.4%), platelet count ≤30,000 (46.8%) and unexplained bleeding (45.2%) were the commonest indications of PRBC/whole blood, platelet and FFP transfusion, respectively, for infants' age ≤ 4months.(Table 2). Among ages greater than 4 months; Hgb 4-8 g/dl with symptoms or admitted to ICU (49.4%), platelet ≤ 30,000 (51.7%) and disseminated intravascular coagulation (DIC) (66.7%) were the commonest indications of transfusion for PRBC/whole blood, platelet and FFP, respectively. (Table 3)

Table-2: Utilization of blood and blood products among pediatric patients admittedtoSt. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia, 2018:indications of blood and blood product transfusion for age ≤ 4-months, n= 238

Indication for PRBC/Whole blood	**Frequency/percentage**
Massive or acute blood loss	6(6.1%)
Hgb ≤ 8g/dl, HCT <24%	40(40.4%)
Hgb ≤ 10g/dl, HCT<30%, with O_2 requirement of <35% or on CPAP< 6 cm H_2O, apnea, bradycardia	34(34.3%)
Hgb ≤12g/dl, HCT<35%, CPAP 6-8cm, deteriorating resp. Status, hypotension, or shock, recovering from major surgery	19(19.2%)
Total	99(100%)
Indication for platelet transfusion	
Plt<30,000	36(46.8%)
Plt≤ 50,000 with active bleeding or before invasive procedures	24(31.2%)
Plt ≤ 100,000 in critically ill preterm neonate with active bleeding	16(20.8%)
Massive bleeding	1(1.3%)
Total	77(100%)
Indication for FFP	
DIC	18(29.0%)
Correction of vit-k deficiency	16(25.8%)
Unexplained bleeding	28(45.2%)
Total	62(100%)

Vit-K-vitamin K, DIC-disseminated intravascular coagulopathy,FFP-fresh frozen plasma, Hgb-hemoglobin,Plt-platelet, HCT-hematocrit, CPAP- continuous positive airway pressure

Table-3: Utilization of blood and blood products among pediatric patients admittedtoSt. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia, 2018: indications of blood and blood product transfusion for age more than 4-months n=130

Indication for PRBC/Whole blood	**Frequency/ percentage**
Massive or acute blood loss	4(4.8%)
Hgb ≤ 4 g/dl	27(32.5%)
Hgb ≤ 8 g/dl with symptomatic tachycardia, tachypnea or stable ICU patient.	41(49.4%)
Hgb ≤ 10 g/dl and severe brain injury	1(1.2%)
Hgb ≤ 13 g/dl cyanotic CHD, severe pulmonary disease	10(12%)
Total	83(100%)
Indication for platelet transfusion	
Plt ≤ 30,000	15(51.7)
Plt count ≤ 50,000 with active bleeding or before invasive procedures	10(34.5%)
Plt ≤ 100,000 in critically ill child with active bleeding.	4(13.8%)
Total	29(100%)
Indication for FFP	
DIC	12(66.7%)
The coagulation factor deficiency (liver disease)	6(33.3%)
Total	18(100%)

DIC-disseminated intravascular coagulopathy,FFP-fresh frozen plasma, Hgb-hemoglobin, Plt-platelet, HCT-hematocrit, CHD-congenital heart disease

For adolescent age 92% of the requested blood products were transfused while only 18.4 % were used for neonates the rest was discarded due to large blood volume per weight for neonates. (Table-4)

Table 4: Utilization of blood and blood products among pediatric patients admittedtoSt. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia, 2018: The amount of blood product received from the blood bank and transfused for specific age groups, 2018

Age	Amount Received (ml)	The amount transfused (ml)	Percentage (%)
Birth-28days	65,600	21,045	18.4
29days-1year	18,600	5,120	27.5
1year-10year	23,700	12,990	54.8
>10year	16,650	15,385	92.4

Socio-demographic characteristics

Three hundred six (59.9%) of blood products were taken by pediatric male patients and 205(40.1%) taken by females. Neonates took the higher number of blood product accounting 295(57.7%) of blood products, 60 (11.7%) for age 1month to 1 year, 90 (17.6%) for children age 1 to 10 years and 66 (12.9%) units of blood components were given to children with age above 10 years.

More than half of the blood product transfusion episodes happened in the neonatal intensive care unit (NICU) 263 (51.5%), and the remaining to pediatric emergency 112 (21.9%), pediatric ward 77 (15.1%), pediatric intensive care unit (PICU) 39 (7.6%), and pediatric surgery 20 (3.9%). (Table 5)

Table -5: Utilization of blood and blood products among pediatric patients admitted to St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia,2018: Distribution of blood products to specific pediatric department units

Department	PRODUCT (%)				Total
	WHOLE BLOOD	PRBC	PLATLETE	FFP	
EMERGENCY	26.4%	24.7%	20.6%	14.0%	21.9%
WARD	16.0%	17.8%	14.5%	10.0%	15.1%
PICU	7.5%	8.0%	5.3%	10.0%	7.6%
NICU	44.3%	46.0%	55.0%	64.0%	51.5%
SURGERY	5.7%	3.4%	4.6%	2.0%	3.9%

Among the blood products; 174units (34%) of packed red blood cells (PRBC), 131 (25.63%) units of platelets, 106 (20.74%) units of whole blood and 100 (19.56%) units of fresh frozen plasma (FFP) were used.

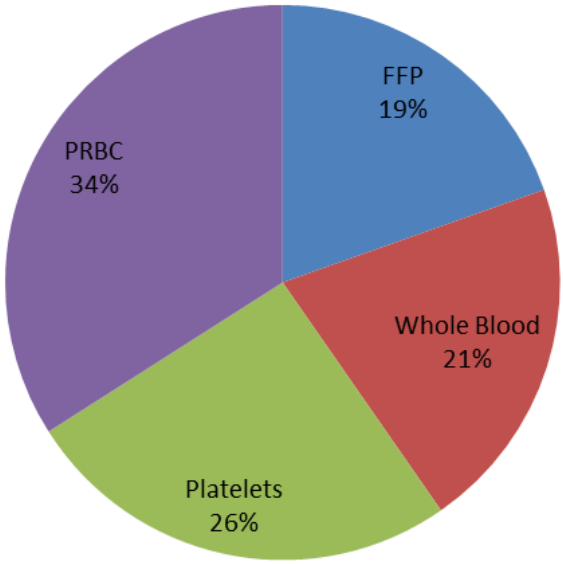

Figure 1: Utilization of blood and blood products among pediatric patients admitted to SPHMMC, Addis Ababa, Ethiopia, 2018: of blood products percentage of utilization

Appropriateness of transfusions

The magnitude of appropriate use of blood products in this study is 72%, Twenty-eight percent of blood product transfusion is inappropriate according to the criteria. Regarding Appropriateness of specific blood products, platelets (82.4%) and FFP (77%) were used better than PRBC (65.5%) and whole blood (65.1%). Inappropriate utilization was, 17.6%, 23%, 34.5% and 34.9% for platelet, FFP, PRBC and whole blood, respectively. This is statistically significant, with a p- value of 0.002. (Figure 2)

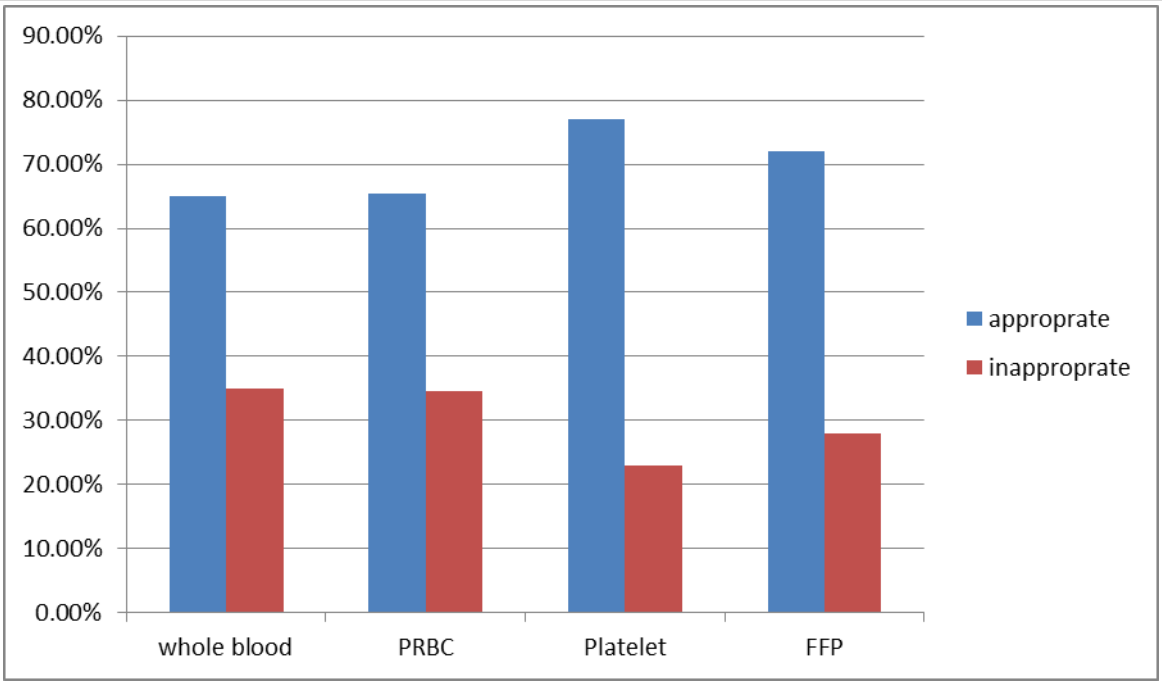

Figure 2: Utilization of blood and blood products among pediatric patients admitted to St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia, 2018: Distribution of blood products as per their appropriateness in utilization.

From the Specific units in the department, a high rate of appropriate utilization of blood products was seen in pediatric ward 60/77 (77.9%), PICU 30/39 (76.9%). pediatric surgery 15/20 (75%) and pediatric emergency 82/112 (73.2%) respectively, while NICU** is the leading unit in terms of inappropriate utilization 181/263 (68.8%), which is statistically significant with a p-value of 0.05.

DISCUSSION

In sub-Saharan Africa the donation rate of blood is 1-2% below the target set by WHO. (12) Despite this shortage, blood transfusion is among the top five over utilized medical treatments throughout the world.(13-15) Hence, in short of donation, to evaluate our transfusion practices, this study was undertaken.

In this study the consumption of blood products by the pediatric department in relation to other departments is 12.5% .in Zimbabwe a study on theProfiles of blood and blood component transfusion recipients, the magnitude of pediatric blood transfusion rate was documented to be 13.4 %.(16)and another Ethiopian study from southern part ,Jimma also demonstrate the pediatric blood transfusion rate of 15.5 %.(17).Even though the setup and population is quite different from us, in Turkey literature a magnitude of 15.3% reported. (10)More or less the consumption of blood and blood products in pediatrics is similar.

In Our study the most common reasons for blood transfusion is anemia with hemoglobin value of less than 8gm/dl.Transfusion practices in a large cohort of hospitalized children also showed the common reason to prescribe blood was anemia with mean hemoglobin level of 7.9 gm/dl(19)

In our finding, Packed RBC was the major component to be transfused, which is 34.1% followed by platelet 25.6%, which holds true in other countries' profiles too. For instance, two studies from Indian one by Vinayaka P. Hegade, and the other by Mumtaz Sharif, showed the rate of PRBC transfusion is highest 48.9% and 49% respectively. (11, 12) A study from Venezuela also demonstrated same, 53% of the transfusions were PRBC. (13) Unless the cause of anemia is blood loss, Packed RBC is preferred modality of transfusion to avoid volume overload.

In this study more than half of the transfusion episodes (57.7 %) happened in neonatal age groups. Compared to other county reports we have significant neonatal transfusion practice. From the study published by the International Journal of contemporary pediatrics and Indian journal of hematology and blood transfusion, prevalence of neonatal transfusion was 29.5% and 28.8% respectively; which is lower than our study. (11, 14) Hemorrhagic disease of the newborn, the significant rate of birth-related trauma and sepsis may explain the elevated rate of transfusion.

This study shows the practice of inappropriate blood and blood component transfusion to be 28% and 72 % of the transfusion was considered appropriate based on the criteria. .Which is comparable with a study done by Maaz et al. on blood component therapy in pediatric intensive care unit, which is 24.8%. (8).Mumtaz from Mumbai, India reported one third of the transfusion practice to be inappropriate, of the total 336 episodes of blood component transfusion ,244 episodes were appropriate and 92 episodes were inappropriate.(12)in contrast a report from Karnataka on the prevalence of inappropriate transfusion was 17 % which is lowest than any of the other studies. This could be explained by the nature of the study, it is a prospective date (11) Overall, the inappropriate blood transfusion practice seems to be universally unacceptable. We have to have a standard guideline and health care professionals should adhere to the protocols.

Whole blood (34.9%) and PRBC (34.5%) were the most misused blood components and Platelet (17.6%) was the least inappropriately used blood product. But in other reports, the most inappropriately transfused blood component was FFP. (5, 11, 14, and 15) the high prevalence of anemia in our setup and sepsis might contribute to specific misuse of whole blood and PRBC.

Among the pediatric units, the higher percentage of inappropriate transfusions was in NICU accounting 31.2%, The least is in pediatric ward accounting 22.1%. According to

the study by Arthuro et al. on appropriate use of blood products, NICU accounted for the largest percentage of inappropriate utilization of blood products 54.6% and the least was in pediatric ward 12.2%, similar with our findings. (13) Since ICU patients are more critical there is a tendency to transfuse them and liberal blood transfusion practice happens in critical patients.

We couldn't find similar studies on the average leftover amount of blood products discarded after transfusion, but our finding showed from the number of blood products taken from the blood bank for neonates; nearly 1/5th (18.4%) of it was transfused, and the rest discarded, while 92% of it was properly used for adolescents. This is due to absence of smaller blood bags.

Limitation:

The safety of blood and blood products were not assessed as part of appropriate transfusion and we used a secondary data.

Conclusion:

This study showed that the blood consumption rate by pediatrics department is comparable with other countries profile. Anemia is a common cause of transfusion and Packed RBCs and platelets were the most used blood products. More than half of the transfusion episodes are happening in neonatal age groups. There is a high inappropriate utilization of blood products and inappropriate utilization is highest in NICU among the specific pediatric department units. PRBCs and whole blood were misused most. Significant amount of blood is being discarded as a left over from the neonatal wards.

Recommendations

There should be a standard written protocol for blood product therapy in all pediatric department units, and it should be followed.

Smaller bag whole blood, PRBCs and FFP preparations are needed to decrease the number of discarded precious blood components.

An additional multicenter prospective study is needed to assess the safety of blood transfusion.

Acknowledgment

We would like to thank St Paul's Hospital Millennium Medical College blood bank.

Authors' contributions

All authors involved in writing the proposal and the manuscript. They have read and approved the final manuscript. Additionally, the first author did the analysis; the second and third author conceptualized the topic.

Disclosures

The authors declare no conflict of interest.

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Guidelines for Authors

The Ethiopian Journal of Pediatrics and Child Health (EJPCH) is the official Journal of the Ethiopian Pediatrics Society (EPS) and devoted to the advancement and dissemination of knowledge pertaining to the broad field of medicine in Ethiopia and other developing countries. Prospective contributors to the Journal should take note of the instructions of Manuscript preparation and submission to EJPCH, as outlined below.

Article Types accepted by EJPCH

- Original Articles (vide infra) on experimental and observational studies with clinical relevance.
- Brief Communications
- Case Series
- Case Reports
- Systematic Review
- Teaching Articles
- Editorial
- Correspondences/Letters to the Editor
- Monographs or set of articles on specific themes appearing in Special Issues of the Journal

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  - **A) Abstract** (vide infra)
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D) Results: should present the experimental or observational data in text, tables or figures. The data in Tables and Figures should not be described extensively in the text.

E) Discussion: The first paragraph should provide a summary of key finding that will then be discussed one by one in the paragraphs to follow. The discussion should focus on the interpretation and significance of the Results of the study with comments that compare and describe their relation to the work of others (with references) to the topic. Do not repeat information of Results section in this section.

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  - Type the references on a separate sheet, double spaced and keyed to the text.
  - Personal communications should be placed NOT in the list of references but in the text in parentheses, giving name, date and place where the information was gathered or the work carried out(e.g. personal communication, Alasebu Berhanu, MD, 1984, Gondar college of Medical Sciences). Unpublished data should also be referred to in the text.
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  - Reference to a book should contain author's or authors' name(s) and initials, title of chapter, names of editors, title of a book, city and name of publisher, year, first and last page numbers.

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- Teklu B. Disease patterns amongst civil servants in Addis Ababa: an analysis of outpatient visits to a Bank employees' clinic. Ethiop. Med J 1980; 18:1-6
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- Laird M, Deen M, Brooks S, et al. Telemedicine diagnosis of Diabetic Retinopathy and Glaucoma by direct ophthalmoscopy (Abstract). Invest Ophthalmol Vis Sci.1996; 37:104-5

Books and chapters from books:

- Henderson JW. Orbital Tumors, 3rd ed. Raven Press New York, 1994
- Clipard JP. Dry Eye disorders. In Albert DM, Jakobiec FA (Eds). Principles and Practice of Ophthalmology. Philadelphia: W.B Saunders: 1994. pp. 257-76

Website:

David K Lynch; laser History: Masers and lasers.

http://home.achilles.net/-jtalbot/history/massers.htmAccessed 19/04/2001

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- Statistical statements here are expressed as 5/8 (62.5%)
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- All pages should be numbered consecutively in the following order: Title page; abstract and keywords page; main manuscript text pages; reference pages; acknowledgement page; Figure-legends and Tables.
- The Metric system of weights and measures must be used; temperature is indicated in degrees Centigrade.
- Generic names should be used for drugs, followed by propriety brand name; the manufacturer name in parenthesis, e.g. diazepam (Valium, Roche UK).
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