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EDITORIAL

PEDIATRIC HIV EPIDEMIC: STATUS AND PROSPECTS IN ETHIOPIA

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Ethiopia has made encouraging progress towards human immunodeficiency virus (HIV)/ acquired immunodeficiency syndrome (AIDS) epidemic control over the past decade. In 2022, the rate of new infections decreased by 59% and the death rate by 52% compared to 2010 figures (1). HIV prevalence remains relatively high in urban areas, a three percent rate compared to under one percent nationally, with much variation by region and sociodemographic characteristics (2,3). The remaining gaps that need to be filled to achieve epidemic control include prevention among priority populations, provision of support services for persons affected by HIV to ensure retention in care, and enhancing pediatric services such as identification of new cases and improving treatment coverage (1-3). The mortality among those on antiretroviral therapy (ART) is high, ranging from 3.2%-22.9% (4,5) with a median survival time of 91.6 months, and 51% of the deaths occur within the first 2 years of treatment (5).

Among children 0-14 years of age in Ethiopia, the estimated number of HIV infections dropped from 140,000 in 2003 to 42,000 in 2021 (6,7). This is a remarkable achievement, but much remains to be done. Case identification will continue to pose a huge challenge, given the low HIV prevalence rate of 0.3% in urban Ethiopia among children. This will render early identification of cases difficult, delaying their rapid engagement in care and ART services. Moreover, we need to find innovative ways of overcoming this challenge, while mounting our efforts to fill the existing gaps in ART coverage in this age group, which stands at 48% vs 76% in adults (6,8). As indicated by a report from northern Ethiopia (9) viral suppression is at 73% vs the expected global target of 95% (10).

Decades of experience and available evidence have also shown that the HIV epidemic in children (and the youth) is a serious and complex problem. We know that children living with HIV get sicker than adults because of their less developed immune systems, get recurrent infections, and develop severe malnutrition. They are also at risk of developmental and psychosocial

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problems with far-reaching implications to the child, the family, and care providers. The HIV epidemic in Ethiopia has also contributed substantially to the large pool of orphans and the catastrophic consequences associated with orphanhood.

Over the years, we have learned about the critically important pitfalls, weaknesses, challenges, and issues requiring particular attention among children with HIV, which we need to address as the country moves towards the interim 95-95-95 targets to be achieved by 2025, and the strategy to end the AIDS epidemic by 2030 (11). First and foremost, we need to go the extra mile to identify children with HIV as this is inherently difficult and, more so, in the Ethiopia context where HIV prevalence is low. We need to intensify the existing testing services at all outlets to minimize missed opportunities (12), and also institute at scale newly initiated approaches like index testing, and caregiver-assisted self-testing (13) that get the service closer to where the affected children live.

We need to revamp the prevention of mother-to-child HIV transmission services as suggested by others (14) by improving on disclosure of HIV status among mothers and giving due attention to HIV discordant couples, those with low CD4 counts, and those with unknown HIV status before pregnancy. Children with advanced HIV disease should be closely monitored and extensively screened for the occurrence of opportunistic infections (15), and focus be given to children with triple infections of HIV, syphilis, and hepatitis B virus (HBV) as the burden of these coinfections is high, particularly in urban Ethiopia (16). HIV serostatus disclosure among children is relatively low in Ethiopia (17,18) and interruption of treatment, though better than in some similar settings, is high compared to others (19). ART and viral suppression rates are low considering the targets to be reached in under three years from today (20). All these require robust planning and innovative interventions.

We need to prevent new HIV infections among children through multiple interventions. Healthcare workers require training on an ongoing basis to provide effective HIV services for children living with HIV. Community engagement and support systems need to be strengthened to provide effective support to the affected children and families to ensure access to HIV services. At the program level, judicious work is required to enlist and nurture collaboration among public, private, and non-governmental organizations to ensure the availability of antiretroviral (ARV) drugs specifically adapted to the needs of children, including child-friendly fixed-dose combinations. A multidisciplinary team approach needs to be strengthened to ensure the delivery of optimal care and treatment. Indeed, much still remains to be done. At best, it we are midway in our uphill battle against the epidemic in general, and among children in particular.

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Original Article

DETERMINANTS OF MECHANICAL BIRTH TRAUMA AMONG LIVE BORN NEONATES ADMITTED AT UNIVERSITY OF GONDAR COMPREHENSIVE SPECIALIZED HOSPITAL NEONATAL INTENSIVE CARE UNIT, NORTHWEST ETHIOPIA: A CASE-CONTROL STUDY

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ABSTRACT

Background*: The occurrence of birth trauma varies according to the fetal factors, labour and delivery processes and maternal factors. However, there is limited data on the possible factors associated with neonatal birth trauma in our setup. This study aimed to identify the associated factors of birth trauma among live-born neonates in the University of Gondar Comprehensive Specialized Hospital (UoGCSH) Neonatal Intensive Care Unit.*

Method*: An unmatched case-control study was conducted among live-born neonates admitted neonatal intensive care unit of UoGCSH over a year from February 1, 2020 to February 1, 2021 G.C. Data was analyzed by SPSS version 20. Descriptive statistics and adjusted Odds Ratio (AOR) with a 95% confidence interval and a p-value of <0.05 was used to identify determinant factors.*

Result*: A total of 300 neonates were included with 1:2 ratio of case and controls. The determinant factors of mechanical birth trauma were head circumference (AOR=1.76, 95% CI: 1.26, 2.46), instrumental delivery (AOR=10.65, 95%CI: 2.83, 40.04), malpresentation (AOR=6.31, 95%CI: 1.01, 40.08) and prolonged labour (AOR=1.45, 95%CI: 2.04, 4.49).*

Conclusion*: Instrumental delivery, malpresentation, >37cm head circumference, and prolonged duration of labour had statistically a significant association with mechanical birth trauma.*

Keywords: - mechanical birth trauma, live born neonate, determinants, Ethiopia

Background

Scholars define birth injury as the impairment of neonatal body function or structure due to adverse influences of the birth process (1-4). Generally, birth-related injuries are classified into birth injuries due to hypoxia or mechanical injuries (5-8). According to few researches and the International Classification of Diseases-10, birth trauma incorporates the mechanical / physical birth injuries (ICD-10) (6, 7).

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Birth injuries occurred due to the mechanical pressure created by the birth canal and traction forces applied by a birth attendant during the labour and delivery processes (4, 9-11). It is usually associated with the size of the foetus, presentation, mode of delivery, duration of labour, maternal chronic diseases, maternal nutritional status, parity, genital anomalies and the skill of the birth attendant (1, 4, 9). Birth injury includes the soft tissue and musculoskeletal injuries (4, 5, 12). In conclusion, birth trauma is related to the foetal presentation, delivery mechanisms and maternal factors (13).

The prevalence of birth trauma can vary depending on the foetal presentation, mode of delivery and birth weight. The prevalence of birth trauma is 0.02% in uncomplicated spontaneous vaginal delivery (SVD) with cephalic presentation and 0.011 % among caesarean section (3). On the other hand, the rate of birth trauma was 30/1000 live birth and 1/1000 live births for vaginal delivery and caesarean delivery in a referral hospital of Iran, respectively (11). In Indonesia (Cipto general hospital), the rate of birth trauma was 29.9/1000 live births (8). In a teaching tertiary hospital of Nigeria, the incidence of birth trauma in vaginal and caesarean delivery was 43/1000 live births and 14/1000 live births for the former and latter (2). Generally, the overall incidence of birth trauma is decreasing due to the improvement of obstetrics care and prenatal diagnoses, due to early recognition and elective C/S (3, 10, 14). In Ethiopia, Jimma specialized hospital mechanical birth trauma was 8.14% live born neonates which is a relatively higher rate of mechanical birth trauma compared to other studies (5). Despite optimal obstetric care globally, birth trauma still affects neonates especially in low-income countries like Ethiopia (3).

There are different types of mechanical birth trauma. Among these, bleeding in the head is the leading one. Bleeding in the head is grouped into intracranial and extra cranial bleeding (haemorrhage) (5). Intracranial bleeding includes subdural, subarachnoid, intraparenchymal, and intraventricular hemorrhage (15, 16). The extracranial bleeding encompasses the subgaleal haemorrhage, cephalohematoma and bleeding into the caput succedaneum (17). Traumatic injury of the scalp causes subgaleal hemorrhage, cephalohematoma, or caput succedaneum. In cases of forceps-assisted deliveries, the prevalence of cephalohematoma reached up to 0.95-2.3%. In extracranial hemorrhage hypovolemic shock, heart failure, acute bilirubin encephalopathy and coagulopathy were the killers (7, 17). Death rate and Complications were more common in neonates with subgaleal haemorrhage (SGH) than neonates with other mechanical birth injuries (17).

Most neonatal brachial plexus palsy occurred in women with normal labour and delivery processes (18). The risk factors associated with brachial plexus injury were maternal diabetes

fetal distress, meconium-stained liquor, vaginal delivery, shoulder dystocia, perineal laceration or episiotomy, high birthweight and depressed one-minute Apgar score (19). Instrumental assisted and emergency caesarean delivery were also associated with facial nerve palsy (19, 20). In addition, facial nerve palsy occurred in Primiparity, birth weight more than 3500gm and prematurity (13). The prevalence of Erb's/brachial palsy was 0.4% in a newborn with a clavicular fracture (21).

Musculoskeletal injury comprised both bony and soft tissue trauma (16, 21). Some studies described the clavicular fracture as the most common musculoskeletal injury type. It accounted for about 2.7-5.7/1000 live births to as high as 6-16.5/1000 live births (16, 21, 22).

The magnitude of birth trauma is lower in developed countries. However, the reverse is true in developing countries where there is poor health care service provision and quality of care. To our knowledge, few studies were done on risk factors of mechanical birth trauma in Ethiopia. Thus, this study aimed to investigate the determinants of mechanical birth trauma among live-born neonates in the university of Gondar Comprehensive Specialized Hospital neonatal intensive care unit.

Methods and materials

Study design and setting

An unmatched case-control study was conducted at the University of Gondar Comprehensive Specialised Hospital (UoGCSH) Neonatal Intensive Care Unit (NICU) from February 1, 2020 to February 1, 2021 G.C.

The UoGCSH neonatal intensive care unit has 40 beds; Fourteen beds for preterm and twenty -six for term neonates. There are six beds reserved for kangaroo mother care services. Two pediatricians are working in the neonatal ICU during working hours. In addition to the pediatricians, there are three residents, six intern doctors and three BSc nurses. The labour ward and neonatal intensive care unit are adjacent to each other.

Study participants

The target population was all live birth neonates admitted to the NICU ward from February 1, 2020, to February 1, 2021. The study population was all live-born neonates whose gestational age was ≥37 completed weeks and admitted to NICU within the study period. Neonates with congenital anomalies, admitted after seven days of postnatal age and referred from other health facilities after seven days of stay at the hospital they have been initially admitted were excluded. Both out born and newborns born in UoGCSH who came after 7 days were excluded because, most signs and symptoms of birth trauma disappeared with in this period. A case was defined as a neonate with physical injury during labour and delivery which was diagnosed by the resident or pediatrician during clinical evaluation. Control was defined as neonates admitted to NICU on the same days as the case and with other diagnosis other than birth trauma. The cases and controls were selected by simple lottery method.

Sample size estimation and sampling

The sample size was calculated by using the 80% power and 95% confidence. The ratio of controls to cases was 2. The proportion of the controls was 8.1% and the proportion of cases exposed was 20%. We calculated the sample size using the above points, and the final sample size became around 300. Therefore, the cases and controls became 100 and 200, respectively. All cases were included in the study and the controls were selected by simple lottery method.

Data collection

A structured English version questionnaire was developed by the investigators. A preliminary review of 15 neonatal charts were done to test the tool before the actual data collection. Training was prepared for two nurses, two interns and one resident. Then, these trained data collectors extracted the maternal and neonatal sociodemographic factors, mode of delivery, duration of labour, birth attendant, presence/ absence of malpresentation, neonatal anthropometries and maternal factors from the neonatal and maternal charts as well as by face-to-face interview of mothers or caregivers from February 1, 2020 to February 1, 2021. The principal investigator supervised the data collection and checked the data completeness daily. In addition, the data was handled in safe places to keep confidentiality.

Statistical analysis

The collected data was entered into Epinfo 4.1 and analysed using SPSS software version 20. Investigator checked errors, outliers, inconsistencies, and missing observations before the data analysis. Frequency tables, range, mean, and standard deviations were used. The association of birth trauma with different variables was analysed using bivariate logistic regression. The adjusted odds ratio (OR) within the 95% confidence interval (CI) and a p-value of <0.05 guided us to know the associations between the independent and outcome variables.

Study variables

Dependent variables: neonatal mechanical birth trauma

Independent variables:

Neonatal variables: gestational age, sex, Birth weight, Length, head circumference, foetal presentation.

Maternal variables: age, address, parity, duration of labour, duration of rupture of membrane, mode of delivery, obstructed labour, ANC follow up, maternal illness and the birth attendant.

Operational definition

Birth trauma- Physical injury like bone fracture and joint dislocation, bruising, nerve palsy, bleeding, happened to the newborn during labour and delivery process.

Macrosomia- A newborn whose birth weight was ≥ 4000gm.

Prolonged labour- Duration of all stages of labour lasting ≥24hours.

Precipitated labour-Labour duration < 3hours

Prolonged PROM- Duration of rupture of membrane stayed >18hr.

Post term baby- Baby delivered after 42 completed weeks of pregnancy

Term baby- Baby delivered within 37 and 42 completed weeks of pregnancy

Antenatal care- Mother who had at least one health institutional visit for the pregnancy

Foetal malpresentation- Any foetal presentation other than vertex.

Referral baby- Baby brought with referral sheet out of UoGCSH.

Results

Socio-demographic characteristics of neonates and mothers

A total of 300 neonates were included in the study; One hundred cases and 200 controls. The sex ratio was 1:3 and 1:1.8 for cases and controls, respectively. The overall sex ratio of the study population was 1:2. The mean age of mothers of the cases was 25.6±4.8SD, and for controls was 25.8±5.1SD. Among the three hundred mothers, 8.7% and 4.7% were younger than 20 and older than 34 years respectively. Most mothers of cases (83%) and controls (70.5%) attended primary education and above. The other 17% of mothers of the cases and 29.5% of controls were not attending formal education.

The mean head circumference of the cases and controls was 36.52±1.6SD and 35.31±1.2SD, respectively. The weight of the cases was 49-34 grams higher than the weight of the control groups. The mean birth weight of cases and control was 3118.67±451.7SD and 3022±499.3SD, respectively. The birth weight laid between 2500 and 4000grams in 90% of the cases and 86.5% of the controls. Among the three hundred neonates, 7.7% and 3% of them had low birth weight and macrosomia respectively (Table 1).

Table 1: Sociodemographic characteristics of neonates and their mothers to NICU in UoGCSH, 2020

Variables		Birth trauma	
		Cases (n=100(%)	Controls (n=200(%))
Age of the mother	Mean maternal age	25.64±4.77SD	25.84±5.11SD
	<20yr	8(8)	19(9.5)
	20-34yr	89(89)	168(84)
	35-49yr	3(3)	13(6.5)
Level of education	Not attending	17(17)	59(29.5)
	Primary	27(27)	29(14.5)
	Secondary	35(35)	91(45.5)
	College	21(21)	21(10.5)
Newborn's gender	Males	76(76)	128(64)
	Females	24(24)	72(36)
Birth weight [gm]	Mean birth weight	3118.67±451.7SD	3022±499.3SD
	<2500	3930	20(10)
	2500-4000	93(93)	173(86.5)
	≥4000	4(4)	5(2.5)
Gestational age (weeks)	Mean GA	39.3±1.45	39.3±1.49
	37-41WKS	92(92)	181(90.5)
	≥42wks	8(8)	19(9.5)

Obstetric and other maternal health related characteristics

Forty-three percent (43%) of cases and 128 (64%) controls were born via SVD. However, about 39% of the cases and 6% of the control were delivered by instrument. But, 18% and 30.5% of mothers of the cases and controls underwent C/S, respectively.

On the other hand, 56% and 64% of the mothers of the cases and control were multiparous, respectively. Ten-point five percent of mothers of the case and four percent of the controls had malpresentation. Five percent of the cases was born from mothers who had obstructed labour. Ninety-one and ninety-three percent of mothers of the case and control had ANC follow-up (Table 2).

Table 2: Obstetric and other maternal health related characteristics of neonates admitted to NICU in UoGCSH, 2020

Variables		Birth trauma	
		Cases (n=100(%))	Controls (n=200(%))
Parity	Primiparity	44(44)	72[36.0]
	Multiparty	56(56)	128(64.0)
Mode of delivery	SVD	43(43)	128(64.0)
	Caesarean section	18(18)	61(30.5)
	Instrumental	39(39)	11(5.5)
Duration of labour	Mean DOL	15.79±8.1SD	12.27±8.8SD
	<24hr.	84(84)	144972)
	≥24hrs.	16(16)	56(28)
Duration of ROM	Mean ROM duration	10.57±40.4SD	5.29±6.8SD
	<18hrs.	87(87)	169(89.5)
	≥18hrs.	13(13)	21(10.5)
Mal-presentation	Yes	11(11)	8(4)
	No	89(89)	192(96)
Obstructed labour	Yes	5(5)	0(0)
	No	95(95)	200(100)
ANC follow up	Yes	91(91)	187(93.5)
	No	9(9)	13(6.5)
Maternal illness	Yes	13(13)	35(17.5)
	No	87(87)	165(82.5)
Birth attendant	Skilled	97(97)	197(98.5)
	Traditional	3(3)	3(1.5)

Types of birth trauma

The identified mechanical birth trauma were scalp, musculoskeletal and peripheral nerve trauma, and bruising, described from the commonest to the least common one. Scalp trauma encompassed 80% of the mechanical trauma in which subgaleal hemorrhage and Cephalohematoma contributed 56% and 24% respectively. Among the 100 cases, nine had musculoskeletal trauma, which accounted 9% of mechanical birth trauma. Among the musculoskeletal trauma four of them had humeral shaft fractures and one femoral shaft fracture, one skull fracture, and another one shoulder dislocation. Five of the neonates with long bone fractures had a breech presentation. There were four newborns with peripheral nerve trauma. Three had facial nerve palsy; one had brachial plexus palsy (Figure 1). Four neonates with Scalp trauma had concomitant facial bruising in one neonate, facial nerve palsy in two neonates and a depressed skull fracture in another neonate. Seventy-nine percent of neonates delivered by forceps had scalp injuries. Among these, 66.5% had subgaleal hemor-

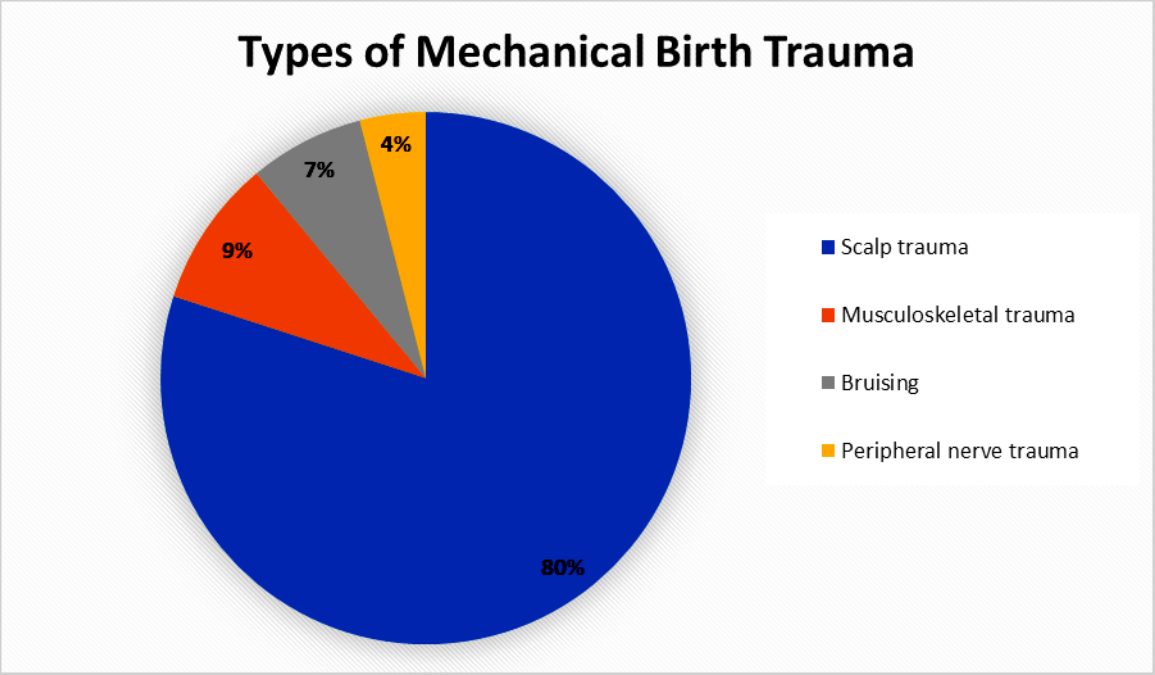

Figure 1: Types of mechanical birth trauma in UoGCSH, 2020

Factors associated with birth trauma

First, the association between the independent and outcome variables were checked by bivariate logistic regression. From bivariate analysis, male gender, malpresentation, head circumference >37 cm, maternal age ≥35 years, gestational hypertension, primiparity, labour ≥24 hours, ANC follow-up and forceps delivery were candidate variables. Then, the candidate variables were interred into a multivariable logistic regression to determine the determinant factors of mechanical birth trauma.

Accordingly, the head circumference >37cm, malpresentation, instrumental delivery and prolonged labour had a significant association with mechanical birth trauma. Instrumental deliveries were around 11 times more likely to have mechanical birth trauma compared to SVD and C/S deliveries (AOR=10.65, 95%CI: 2.83-40.04). The odds of having birth trauma in neonates born from a mother with malpresentation were about six times higher likelihood to have mechanical birth trauma than those infants born without malpresentation (AOR=6.31, 95%CI: 1.20, 40.08).

In neonates delivered after prolonged labour, the occurrence of birth trauma increased by 1.45 times compared to those born within no prolonged labour duration (AOR= 1.45, 95% CI, 2.04-4.49 (Table 3).

Table 3: Factors associated with birth trauma among neonates admitted to NICU in UoGCSH, 2020

Variables		Birth trauma		COR (95% CI)	AOR (95% CI)
		Cases (n=100)	Controls (n=200)		
Gestational age	37-41wk	92(92)	181(90.5)	1	1.00
	≥42wk	8(8)	19(9.5)	1.3(0.43,5.0)	1.24(0.31, 4.92)
Head Circumference (cm)	≤37	80(80)	195(97.5)	1	1
	>37	20(20)	5(2.5)	14.19(3.19,63.14)	1.76(1.26,2.46) *
Age of the mother	< 20 years	8(8)	19(9.5)	1	1
	≥20 years	92(92)	181(90.5)	1.56(0.45,7.35)	1.49(0.34,6.56)
Parity	Primiparity	44(44)	72(36)	1	1
	Multiparty	56(56)	128(64)	0.65(0.35,1.43)	0.52(0.20, 1.36)
Level of education	Not attended	17(17)	59(29.5)	0.32(0.13,1.24)	0.25(0.06, 1.04)
	Primary	27(27)	29(14.5)	0.95(0.37,4.24)	1.05(0.27, 4.14)
	Secondary	35(35)	91(45.5)	0.25(0.08(1.20)	0.30(0.09, 1.03)
	College	21(21)	21(10.5)	1	1
Mode of delivery	SVD	43(43)	128(64)	1	1
	C/S	18(18)	61(30.5)	0.74(0.32-1.68)	0.62(0.23, 1.71)
	Instrumental	39(39)	11((5.5)	10.24(3.29,38.8)	10.65(2.83,40.0*
Duration of labour	<24hrs.	84(84)	144(72)	1	1
	≥24hrs.	16(16)	56(28)	1.41(1.21,1.80)	1.45(2.04,4.49)*
Duration of ROM	<18hrs.	87(87)	179(89.5)	2.34(0.54,5.34)	1.62(0.40, 6.56)
	≥18hrs.	13(13)	21(10.5)	1	1
Malpresentation	Yes	11(11)	8(4)	2.87(0.73-11.26)	6.31(1.20,40.08*
	No	89(89)	192(96)	1	1
ANC follow up	Yes	91(91)	187(93.5)	0.63(0.31,3.25)	0.55(0.20, 2.55)
	No	9(9)	13(6.5)	1	1
Maternal illness	Yes	13(13)	35(17.5)	2.12(0.38,4.38)	1.13(0.29, 4.38)
	No	87(87)	165(82.5)	1	1

Discussion

This study identified instrumental delivery, malpresentation, head circumference and prolonged labour as determinant factors of neonatal mechanical birth trauma. These factors were also identified as risk factor of birth trauma in different studies of many countries. In USA, Huge et al., birth weight, vaginal delivery, primiparity, forceps delivery, vacuum delivery, large for gestational age infant, and male infant sex were risk factors of birth trauma (6). In Indonesian, Cipto general hospital, a study revealed forceps extraction, vacuum ex-

As result of a set up and level of obstetrics care difference, prolonged labour and malpresentation were not risk factors in USA and Indonesian studies. In research done at Jimma University Specialized Hospital, the place of residence, parity, fetal presentation, fetal position and distress, vaginal delivery, and need for resuscitation were factors associated with birth trauma (5). Research done in Addis Ababa, Tikur Anbessa Specialized Hospital (TASH), also showed primiparity, vacuum delivery, forceps delivery and birth weight of ≥3.5 kilograms had strongly associated with birth trauma (23). So, the mode of delivery and presence of malpresentation was in line with the results of these studies. However, head circumference and duration of labour were not associated with birth trauma in the above researches.

One of the risk factors that had a significant association with neonatal birth trauma was the mode of delivery. In this study, the mode of delivery included spontaneous vertex delivery, instrumental assisted delivery and cesarean section delivery. Spontaneous vertex delivery was taken if the neonate was born without instrumental applications. Among these modes of delivery, instrumental assisted delivery had a significant association with birth trauma compared to others.

Contrary to this study, studies done in Saudi Arabia, India, and Iran showed that SVD was the main root of delivery for neonates who had birth trauma (3, 12). But the Indonesian Cipto general hospital study contradicted the Iranian, Saudi Arabian, and Indian studies; they showed that most neonates were born by C/S. In this study, instrumental delivery had a significant association with birth trauma (8). Descriptive study in one of the hospitals in Cameroon done for 11 years showed that 97.3% of neonates with birth trauma were born via SVD. A cross-sectional study in Jimma USH also showed SVD had a statistically significant association with birth trauma. This difference was due to the incorporation of instrumental assisted delivery into the SVD which made SVD riskier than C/S for mechanical birth trauma. In addition, C/S was done after a trial of instrumental application (i.e., forceps and vacuum trial failure).

Head circumference >37cm had also statistically significant association with birth trauma. A 1cm increase in the head circumference resulted in a 1.8 times higher likelihood of birth trauma (AOR=1.76, 95% CI: 1.26-2.46). The increment in the head circumference was due to extracranial or intracranial bleeding. Sometimes head descent could not progress and forceps could be applied. As a result of the forceps application, there could be soft tissue injury like caput and bleeding into the caput that resulted in increased head circumference (1). Although there was significant set up difference, the retrospective case-control study in Israel supported head circumference as the independent risk factor of birth trauma. The research done at Tikur Abessa Tertiary Hospital (TASH) on extracranial bleeding in neonates

showed that subgaleal hemorrhage had a head circumference of above the 90th percentile in 87.9% (17). This result was consistent with ray and Masoumeh et al.; which identified large head circumference as a factor associated with birth trauma (3, 14).Malpresentation of the fetus was one of the determinant factors of birth trauma in this research. In most of the research on birth trauma, malpresentation was a risk factor for mechanical birth trauma. A prospective study in India showed malpresentation and obstructed labour as risk factors for birth trauma. In the same research, increased maternal age, shorter height, higher birth weight, instrumental delivery, prolonged labour and delivery during risk hours were the identified risk factors (14). The fetal presentation had a significant association with birth trauma, which is supported by Workneh et al. The reason for malpresentation as one risk for birth trauma could be due to the association of obstructed labour and prolonged duration of labour, which caused the newborn skull to stay long in contact with the maternal pelvis.

Prolonged labour had a significant association with mechanical birth trauma. The retrospective research in India on predictors of birth trauma showed that prolonged and obstructed labour were an independent predictor of birth trauma. The neonatal and maternal morbidities were more in the protracted second stage of labour. These could be due to prolonged contact of scalp tissue with sacral prominence, obstructed labour and as a result intervention.

The most common type of birth trauma identified was scalp injury, which accounted for about 84% of the total mechanical birth trauma. Although the percentage was lower in other research, the most common type of birth trauma was the injury to the scalp (5, 10, 12, 23). Among the scalp injuries, subgaleal hemorrhage was the leading scalp injury type, which comprised 56% of the injuries (23, 24). In contrast, a Georgetown University Medical Centre study showed that Cephalohematoma was the leading scalp injury type, 56.6%, (6). Cephalohematoma was also the most common scalp injury in India (38.7%) and Iranian (57.2%) (3, 4). The Jimma university hospital and TASH studies showed scalp injury was the commonest injury type. Among the scalp injury, subgaleal hemorrhage was the leading type identified in 20% and 61% for the former and the later studies, respectively (5, 23).

Limitations

The limitation of this study was the absence of trans-fontanel ultrasonography. It was not available to all neonates with birth trauma, especially newborns with scalp injuries which can contribute to missing intracranial bleeding in this study.

Conclusion

Instrumental delivery, malpresentation, >37cm head circumference, prolonged labour had statistically significant association with birth trauma. Birth trauma is associated with birth weight, prolonged duration of labour, malpresentation and instrument delivery.

Instruments are widely used for shortening the duration of labour with risk of birth trauma. Head circumference was found to be determinant factor of neonatal birth trauma.

Declarations

Ethical approval

All methods were performed following the relevant guidelines and regulations. Ethical clearance was obtained from institutional review board of Gondar University. It was funded by the University of Gondar for the master's program.

Consent

Written consent was given to parents or care giver of the neonates. Then, the data were filled in to the questionnaire by the data collectors.

Data availability

Underlying data supporting the result of the study can be made available on reasonable request.

Authors' contribution

All BAM, AS and BT conceptualized the idea. BAM wrote the concept, organized the data collection. All authors analyzed, interpreted, and drafted the manuscript, and had read and agreed to the final manuscript. All authors had read and approved the manuscript and that there are no other persons who satisfied the criteria for authorship. We further confirm that the order of authors listed in the manuscript has been approved by all of us. There had been no significant financial support for this work that could have influenced its outcome.

Conflict of interest

All authors declared that there was no conflict of interest.

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ORIGINAL ARTICLE

BARRIERS TO OPTIMAL USE OF CONTINUOUS POSITIVE AIRWAY PRESSURE MACHINES IN PRETERM BABIES WITH RESPIRATORY DISTRESS SYNDROME AT A TERTIARY REFERRAL HOSPITAL IN ADDIS ABABA, ETHIOPIA

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ABSTRACT

Background: *Neonatal mortality is a significant contributor to under-five mortality in low-income countries like Ethiopia, carrying neonatal mortality of 30 per 1000 live births. Preterm newborns with respiratory distress can be effectively managed with a Continuous Positive Airway pressure machine. It is recommended as an essential lifesaving intervention by the World Health Organization. The study aimed to assess barriers to the optimal use of continuous positive airway pressure machines in preterm babies by Pediatrics residents at a tertiary referral hospital.*

Methods: *A hospital-based cross-sectional study was carried out among pediatric residents at Tikur Anbessa Specialized Hospital from September to October 2021. The data were collected through a self-administered structured questionnaire and analyzed using SPSS version 25. A P-value <0.05 was considered statistically significant.*

Results: *One hundred twelve pediatrics residents were included; 41(36.6%) were females and 89 (79.5 %) were aged between 25-30 years and 106 (94.6%) had NICU experience of less than one year. Forty-one (36.6%) had a moderate level of practicing continuous positive airway pressure safety checklists. There was a statistically significant difference in the practice of CPAP safety checklist usage with the year of residency (P= 0.001). A majority, 90 (80.4%), of `pediatrics residents used locally-made improvised water bottle systems as bubble continuous positive airway pressure machines. The perceived barriers to continuous positive airway pressure machine use included lack of commercial bubble machine, 77 (85.5%), unavailability of oxygen, and lack of appropriately sized nasal prongs.*

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Conclusion: *Lack of commercial continuous positive airway pressure machines and essential equipment were the reported barriers. Tackling the perceived barriers would contribute to the national effort to decrease neonatal mortality and achieve Sustained Development-3.*

Keywords: Continuous positive airway pressure, Newborn, barriers, respiratory distress syndrome, Addis Ababa.

Background

Neonatal mortality rate (NMR), the death of the newborn during the first 28 days of life, is a major world-wide problem. Approximately 6,700 newborns die every day globally (1,2). It contributes to 46 % of under-five mortality globally, mainly in developing world (3,4). Globally, the rate of newborn mortality is declining slowly with significant variation among countries (4-6). With this slow pace, the developing countries will face difficulty to attain the third Sustainable Development Goal (SDG-3). Though SDG-3 aims to decrease the newborn mortality rates to fewer than 12 per 1000 by the year 2030, studies recently showed only a few sub-Saharan African countries are predicted to achieve the SDG-3 goal (6).

In Ethiopia, child death had declined by two-thirds between 1990 and 2025. Though under-five and infant mortality has reduced significantly, neonatal mortality (NMR) remained high with a modest reduction from 39 to 33 newborn deaths per 1000 live births (5,7,8). Ethiopia has set a target of NMR of 21/1,000 live births for 2024/25 (7-9). Preterm complications are the major contributor to NMR. and a pre-term birth rate of 12.3 % or more was estimated in Sub-Saharan Africa. Identification and tackling preterm complications are suggested to decrease the NMR in these settings (1,2,6,10).

According to Ethiopian Demographic and Health Survey (EDHS) the NMR has remained stable and even increased according to recent reports (7,9,8). Prematurity, perinatal asphyxia and neonatal sepsis are the major cause of neonatal mortality in Ethiopia (11-13). An institution-based retrospective follow-up study conducted among 571 newborns at Tikur Anbessa Specialized hospital (TASH) showed that the proportion of neonates with respiratory distress was 42.9% (14). Hence, identifying barriers and leading causes of newborn death are very crucial to select appropriate interventions and strategies to decrease mortality and to achieve the third Sustainable Development Goal (15-17).

Preterm and term newborns with respiratory distress can be easily treated with non-invasive or invasive respiratory support, such as intranasal oxygen, continuous positive airway pressure (CPAP) machine, endotracheal intubation and surfactant replacement therapy. World Health Organization (WHO)strongly

recommended CPAP for the treatment of respiratory distress syndrome in newborns (18,19). Though continuous positive airway pressure is reported to be effective, it needs continuous monitoring and timely equipment functional assessment. The machine has to be checked for the continuous supplies of the electricity and medically important gases. And there is a need of timely monitoring of newborns on CPAP machine to avoid acute life-threatening and long-term complications. As a result, WHO recommends considering the different factors and contexts before introducing and scaling-up the usage of CPAP in low- and middle-income countries (18-20).

There are studies which documented health professionals' poor knowledge on CPAP was as a barrier for CPAP use (15,21). A systematic review on barriers and facilitators to implementing bubble CPAP to improve neonatal health in sub-Saharan Africa- identified shortage of neonatal staff, high turnover of trained staff, low staff motivation and morale to use bubble CPAP as common barriers for effective bubble CPAP usage. The study highlighted that addressing the barriers and improvement in neonatal intensive care unit (NICU) is needed to reduce neonatal mortality in sub-Saharan Africa. Other studies also pointed out improved utilization of bubble CPAP machine in resource-constrained health facilities (13,16, 17, 22-26).

As to our search, there are no studies that assessed bubble CPAP use and its barriers among physicians who primarily manage such respiratory distress cases in the newborn. Hence, our study aimed at identifying perceiver barriers and self-reported practices of bubble CPAP among Pediatrics residents, front-line health professionals managing respiratory distress of the newborn at tertiary referral hospital.

Method

A hospital-based descriptive cross-sectional study was carried out among pediatric residents who gave consent to participate at Tikur Anbessa Specialized Hospital from September 2021 to October 2021. Data was collected through a self-administered structured questionnaire. The questionnaire had four sections: sociodemographic, three sections of knowledge assessment about CPAP, perceived barriers and self-reported practices. The first sub-part of knowledge section had general information and uses of CPAP, the second sub part was about contraindications and complications of CPAP device use and the third was about the fundamentals in the use of CPAP device. The respondents' overall knowledge was assessed using Bloom's cutoff point method, and classified into high level of knowledge if the score was between 80 and 100%, moderate level of knowledge if the score was between 60% and 79% and poor knowledge if the score was <60%.

The other part of the questionnaire was about perceived barriers to the optimal CPAP usage in NICU and the fourth part of the questionnaire were about the self-reported practice of CPAP safety checklists in NICU. The practice of CPAP safety checklists was computed using

cutoff method we used for knowledge assessment was also used to categorized the overall respondents' level of practice scores into good practice, moderate practice and poor practice.

Data collection and Data Analysis

Data were collected by the principal investigator and trained General Practitioners using structured self-administered questionnaires. Data were analyzed using a statistical package for social sciences (SPSS) version 25. P-value <0.05 was considered to be statistically significant.

Results

Socio-demographic characteristics of Pediatrics residents

Of one hundred twelve Pediatrics residents recruited 41(36.6%) were females and 71 (63.4%) were males. Eighty-nine (79.5 %) were aged between 25-30 years with a mean age of 29 years and an interquartile range of 25 –42 years. Among the participants, 51(45.5%) were in their first-year and 25 (22.3%) were in their third-year pediatrics residency. One hundred six (94.6%) of the respondents had less than one year of working experience in neonatal intensive care unit before pediatrics residence [Table 1].

Table 1: Socio-demographic characteristics of pediatrics residents, Tikur Anbessa Hospital, Addis Ababa, Ethiopia

Variable	Category	Frequency (n=112)	Percentage (%)
Sex	Male	71	63.4
	Female	41	36.6
Age	25- 30 years	89	79.5
	31- 35 years	18	16.1
	Above 35 years	5	5
Marital Status	Single	71	63.4
	Married	40	35.7
	Divorced	1	0.9
Years of residency	1st year	51	45.5
	2nd year	36	32.2
	3rd year	25	22.3
Year of Experience in NICU	≤ 1 year	106	94.6
	1 – 3 years	2	1.8
	≥ 3 Years	4	3.6

Residents' knowledge on CPAP machine

Pediatrics resident's knowledge on CPAP machine was assessed with questionnaires about the general information and uses of CPAP, Contraindications and complications to CPAP device usage, and fundamentals in the use of CPAP machine in newborn (Table 2, Table 3 and table 4).

The study showed that 58.1% (65) of pediatrics residents had moderate knowledge about CPAP machine usage, and eight residents had poor knowledge [Figure 1]. As the year of residency increased the knowledge level also increased (P = 0.011, 95% CI: 0.77–1.23). Age and year of experience in NICU before residence had no significant association with knowledge score with P-value of 0.439, 0.807 and 0.671 respectively.

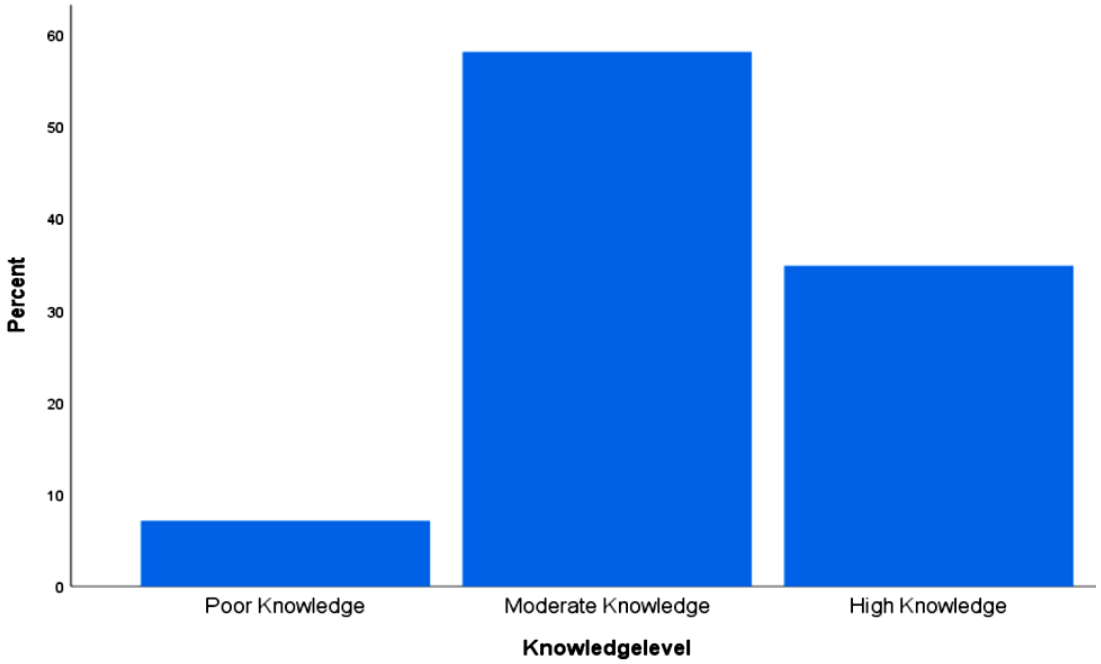

Figure 1- Knowledge level in pediatrics residents at Tikur Anbessa Hospital, September 2021

Table 2: General information and uses of CPAP for newborns among pediatrics residents at Tikur Anbessa Hospital, September 2021

General information and uses of CPAP for newborns	Frequency (n=112)		
	Yes	No	No idea
Maintenance of an increased trans pulmonary pressure during the inspiratory & expiratory phase of respiration.	97 (86.6%)	8 (7.1%)	7 (6.3%)
It is used for patients with respiratory distress syndrome.	112(100%)		
CPAP machine is used for treat Apnea of premature babies.	100(89.3%)	12(10.7%)	
It can be used in case of premature baby with respiratory dysfunction and bradycardia movement	93(83%)	15(13.4%)	4(3.6%)
If the child has bleeding in the upper gastrointestinal tract CPAP can used.	26(23.2%)	61(54.5%)	25 22.3%
It works to increase the effort during the process of breathing	66(58.9%)	44(39.3%)	2(1.8%)
It Conserves surfactant	72(64.3%)	36(32.1%)	4(3.6%)
It Increase the lung compliance	102(91.1%)	9(8%)	1(0.8%)
Early initiation of CPAP has comparable efficacy with exogenous Surfactant therapy in neonate with RDS	105(93.8%)	2(1.7%)	5(4.5%)
The machine is not effective in the case of meconium aspiration.	45(40.2%)	63(56.3%)	4(3.5%)
Feeding shouldn't be initiated while newborn is on CPAP	20(17.9%)	90(80.4%)	2(1.7%)
Nasogastric tube should be inserted while the newborn is on CPAP	96(85.7%)	16(14.3%)	

Table 3: Contraindications and complications to CPAP device usage among pediatrics at Tikur Anbessa Hospital, September 2021

Contraindications and complications to CPAP device usage	Frequency (n=112)		
	Yes	No	No idea
There is no mind to use the machine despite of the certain birth defects in the respiratory tract of a child its present, such as cleft lips or cleft palate.	33(29.5%)	64(57.1%)	15(13.4%)
It can be used in case of severe cardiovascular instability, such as low blood pressure.	41(36.6%)	61(54.5%)	10(8.9%)
If the child is unconscious and does not respond to stimuli cannot use the CPAP machine in this condition	60(53.6%)	49(43.8%)	3(2.6%)
If the child has surgery in the stomach, it does not affect the use of CPAP machine.	31(27.7%)	70(62.5%)	11(9.8%)
CPAP cannot be used together with the Nebulizer.	22(19.6%)	68(60.8%)	22(19.6%)
It contraindicates the use of machine in the case of congenital pneumonia.	13(11.6%)	86(76.8%)	13(11.6%)
Abdominal distention is one of the most complications that can be happen.	105(93.8%)	7(6.2%)	

Table 4: Fundamentals in the use of CPAP machine in newborn among pediatrics residents at Tikur Anbessa Hospital, September 2021

Fundamentals in the use of CPAP machine	Frequency (n=112)		
	Yes	No	No idea
Pressure for treatment of RDS should be start at 4 Cm H2O.	35(31.3%)	75(66.90%)	2(1.8%)
Pressure for treatment of Apnea of Prematurity should be start at 5 Cm H2O.	93(83.0%)	16(14.3%)	3(2.7%)
The sign for CPAP failure in the treatment of RDS is worsening respiratory distress or hypoxemia.	109(97.3%)	3(2.7%)	
Recurrent episodes of apnea are not a sign for CPAP failure in the treatment of Apnea of prematurity.	29(25.9%)	76(67.9%)	7(6.2%)
The appropriate position while using the CPAP should be lifting the head and put a pillow under it.	61(54.5%)	49(43.8%)	2(1.7%)
There is no need to match the size of the probe with a premature baby's nose.	111(99.1%)	1(0.9%)	

Barriers and practice of the usage of CPAP machine in NICU

Fifty seven percent (64/112) of the participant residents has had any formal teaching, learning or training session on CPAP in their newborn care practice. Only 15.2 % (17/64) thought that teaching or training session on CPAP was adequate for treating newborns with respiratory distress syndrome (RDS) in their newborn practice. And, 80.4 % of residents used improvised water bottle system (locally made), 19.6% use commercial CPAP machine and the use of mechanical ventilation in neonatal intensive care unit is nil.

The main reason for using locally made improvised water bottle system was lack of Commercial bubble CPAP machine in NICU, accounts for 88.4%. Unavailability of CPAP machine, Unavailability of oxygen and unavailability of nasal prongs were the main perceived barriers affecting the use of CPAP in NICU. About 61.6% (n=69) of residents used appropriately sized nasal prong for preterm infants. Among the participants, 95.5% (107) of participants thought that there was a shortage of commercial bubble CPAP machine in NICU [Table 5].

Table 5: Barriers affecting CPAP usage in neonatal intensive care unit among pediatrics residents at Tikur Anbessa Hospital, Addis Ababa, September 2021

Barriers in CPAP usage	Residents response	Frequency
Used CPAP Mode	Improvised water bottle system (locally made)	90 (80.4%
	Commercial CPAP machine	22 (19.6%)
	Mechanical Ventilation CPAP mode	0 (0%)
Reasons to use Improvised water bottle system in NICU (n=90)	Lack of Commercial bubble CPAP machine	77 (85%)
	Lack of Commercial CPAP and easy to prepare	11 (12%)
	Easy to prepare	2 (2%)
	Others	1 (1%)
Factors affecting the use of locally made improvised water bottle CPAP (n= 90)	Unavailability of CPAP Machine	32 (34%)
	Unavailability of Oxygen	4 (4%)
	Shortage of staff and work load	2 (2%)
	Unavailability of Oxygen, CPAP, and nasal prong	23 (26%)
	Unavailability of Oxygen + Machine	17 (19%)
	Combination of all factors	12 (13%)
Usage appropriate size nasal prong for preterm	Yes	69 (61.6%)
	No	43 (38.4%
Reasons for not using appropriate size Nasal prong (n=43)	Unavailability of appropriate size	37 (86%)
	Unavailability of appropriate size and Searching	4 (9.3%)
	Searching is time consuming	2 (4.7%)
Shortage of CPAP machine in NICU	Yes	107 (95.5%)
	No	5 (4.5%)

The practice of self-reported CPAP safety checklist

The study showed that 58.9% (66) of the residents had moderate level of practice and 4.5 % had poor practice about addressing CPAP safety check lists. The resident's response about the Practice of CPAP Safety Checklists in newborns is described in table below [Table 6].

There was significant difference in the practice of CPAP safety check lists between residents with different year of residency (P = 0.001). Ordinal Regression was done to assess the significance estimate differences in the practice of CPAP by year of residency and knowledge level. The practice of addressing CPAP safety checklists is three times more likely to practice in the first-year resident's than third-year residents. The mean CPAP safety checklist score among pediatrics residents is shown in figure below [Figure 2].

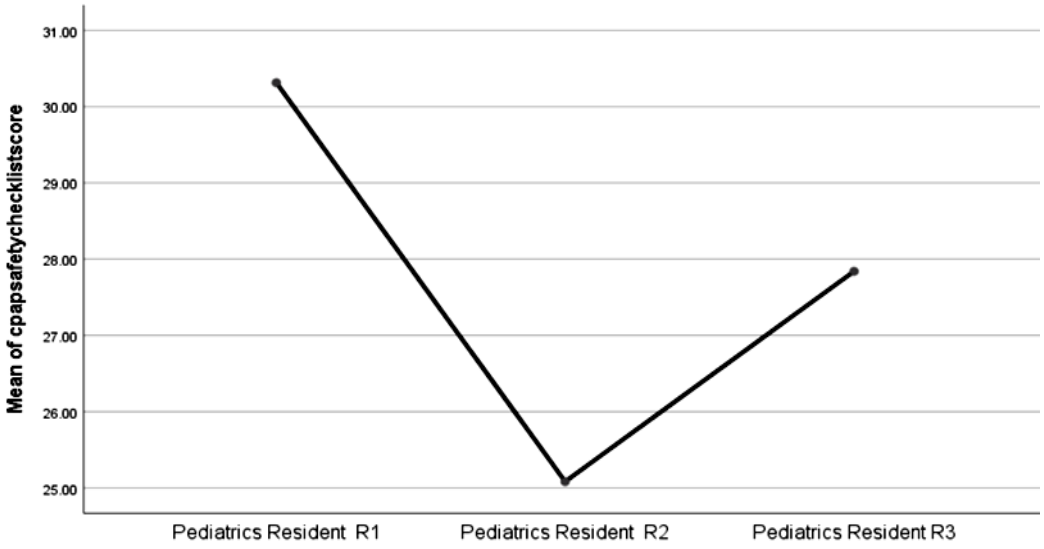

Figure 2: CPAP safety checklist score among pediatrics residents in Tikur Anbessa Hospital, September 2021

Table 6: Practice of CPAP Safety Checklists in newborns among Resident's at Tikur Anbessa Hospital, 2021

CPAP safety check lists	Frequency of use of CPAP safety Check Lists (n=112)				
	Never	Rarely	Sometimes	Usually	Always
Checking oxygen and air flow rate is set correctly.	4(3.5%		15(13.4%)	48(42.9%	45(40.2%)
Assessing respiratory rate, breathing pattern, and saturation hourly.	6(5.4%)	11(9.8%)	36(32.1%)	40(35.7%)	19(17.0%)
Verifying appropriate nasal prong size and placement.	4(3.5%)	10(8.9%)	30(26.8%)	33(29.5%)	35(31.3%)
Assessing nares blockade and consider suctioning.	3(2.7%)	1(0.9%)	15(13.4%)	54(48.2%)	39(34.8%)
Checking for water in CPAP tubing.	3(2.7%)		17(15.2%)	52(46.4%)	40(35.7%)
Check for CPAP bubbling in the chamber.		3(2.7%)	11(9.8%)	36(32.1%)	62(55.4%)
Check auto corrugated CPAP tubing is connected and fixed in place.	3(2.7%)	4(3.5%)	22(19.7%)	38(33.9%)	45(40.2%)

Discussion

This study is the first of its kind to report bubble CPAP use and its barriers among pediatric residents, front-line health professionals in the care of preterm and term newborns with respiratory distress syndrome. Majority had moderate knowledge and self-reported practice. Year of residency was significantly associated with

self-reported practice. The reported perceived barriers for CPAP use in neonatal intensive care unit (NICU) included lack of Commercial bubble CPAP machine, 88.4%; unavailability of oxygen (lack of oxygen delivery connected systems) and lack of appropriately sized nasal prongs.

Formal teaching or training session on CPAP in the new born practice was not adequate as only 57.1% of respondents had any form of formal teaching, learning or training session on CPAP in their Newborn care practice. And among those only 15.2 % (17/64) thought that the teaching or training session on CPAP is adequate for treating newborns with respiratory distress syndrome (RDS) in their practice. This is an important gap as lack of training and teaching of resident's have been identified as a factor that affects the effective implementation of CPAP therapy practice adversely. Our study showed the practice of addressing CPAP safety checklists were three times more likely in the first-year pediatrics residents than third year residents. This might be due to the fact that first year residents are the front-liner physicians dealing with critical newborns who need CPAP per the teaching curriculum designed in our setup.

The study showed that 34.8% Pediatrics and Child Health Residents achieved high Level of knowledge, 58.1% of the residents have moderate knowledge and 7.1 % have Poor Knowledge about the CPAP in their NICU practice. A research done at Tanzania in assessing knowledge about CPAP usage among nurses showed less than half of the participant nurses had moderate knowledge about CPAP machine usage and CPAP device utilization (21). In other study, by Aziz, 2017 about 'assessment of nurses' knowledge toward CPAP Machine in newborn unit' at Al-Diwanyia City Hospitals' showed that Nurses have poor Knowledge towards the CPAP machine in Iraq (22).

Result from our study showed that the respondents had slightly higher level of knowledge of CPAP therapy in NICU when compared to Zephania Abraham 's study in Tanzania where under half of the nurses had moderate knowledge of CPAP device and Aziz's study in Iraq in 2017 which showed that Nurses have Poor Knowledge towards the CPAP machine in NICU (23).

The perceived barriers towards the use of CPAP in NICU showed that 80.4% of Participants used locally made improvised water bottle system. The main factors for using improvised water bottle system is lack of Commercial bubble CPAP machine in NICU which accounts for 88.4%. Availability of CPAP machine, availability of oxygen and availability of nasal prongs are the other combined perceived barrier's affecting the use of CPAP in NICU.

These barriers are also described by other researchers on a systematic review on 'Barriers and facilitators to implementing bubble CPAP to improve neonatal health in sub-Saharan Africa', showed that reliable availability of

equipment, difficulties engaging and informing caregivers and staffing shortages were frequently mentioned barriers to the implementation of bubble CPAP in Sub-Saharan Africa [13,22]. Bubble continuous positive airway pressure (CPAP) have a key role in improving the quality of respiratory support in newborns with respiratory distress in low- and middle-income countries.

Conclusion

Most of the pediatrics residents achieved moderate knowledge about the CPAP usage in NICU. The self-reported practices of addressing CPAP safety check lists in this study were optimal. Most of residents used improvised water bottle system (locally made of water bottle) as standard bubble CPAP machine. The most common reported barriers to the usage of CPAP at NICU were unavailability of commercial bubble CPAP machine, unavailability of oxygen, unavailability of nasal prong and shortage of staff. Only 15.2 % resident's thought that teaching or training session on CPAP was adequate for treating newborns with RDS.

The current findings suggest that there is significant room for improving CPAP usage and practice in NICU in Ethiopia to reduce the neonatal mortality by optimizing teaching and training session on CPAP usage, by tackling perceived barriers that hamper the practice of using CPAP and emphasis should be given to develop the pediatrics residents' skills. Regular training on CPAP machine usage should be provided to Pediatric residents since they are the front-line physician in the management of newborns with RDS requiring CPAP. And neonatal intensive care units should be equipped with standard bubble CPAP machine and mechanical ventilation.

Strength and Limitations of the study

The study was done in only one tertiary hospital relying on self-report and the results may not be reflective of all physicians in Ethiopia. However, the results can be assumed to be the true reflection of the current practice of CPAP in NICU given the fact that the survey was carried out at the nation's biggest teaching tertiary hospital where both surgical and medical service are given for newborns. The study was done on pediatrics residents, medical doctors who are on pediatrics specialty training, providing the key management of newborns who require CPAP. So far, this is the first research done on the front-line physicians working in the tertiary hospitals. Finally, future research should entail on comprehensive evaluation of clinical practice through mixed approach involving direct observation, interviews, and/or prospective audit.

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Declarations

Ethical Approval

Ethical approval was obtained from the Research and Publication Committee of Pediatrics and Child Health Department, School of Medicine, College of Health Sciences, Addis Ababa University. The objectives of study were explained to the participants and a written consent was obtained from each respondent prior to data collection. The participation was entirely voluntary and confidentiality of the collected data was maintained.

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Contributions of authors

GA: inception of idea, data collection, write up HT: data analysis and writeup, AD: review of the manuscript. All the authors reviewed the manuscript and approved for publication.

Conflict of interest: we declare there are no conflict of interest.

Availability of data: Data is available on request on the corresponding author.

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ORIGINAL ARTICLE

ASSESSMENT OF PEDIATRIC RESIDENTS' KNOWLEDGE, ATTITUDE, AND PRACTICE REGARDING OXYGEN THERAPY AND ITS COMPLICATIONS AT TIKUR ANBESSA SPECIALIZED HOSPITAL AND ST. PAUL HOSPITAL MILLENNIUM MEDICAL COLLEGE, ETHIOPIA

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ABSTRACT

Background: *: Oxygen therapy is beneficial, but too much of it or any oxygen therapy errors could be dangerous. Proper knowledge, appropriate practice, and favorable attitudes are important aspects of treatment. Hence, this study aimed to assess the knowledge, attitude, and practice of pediatric residents about oxygen therapy, its complications, and associated factors.*

Methodology: *A cross-sectional study was conducted among pediatric residents at Tikur Anbessa Specialized Hospital and St. Paul Hospital, Millennium Medical College in Addis Ababa, Ethiopia, from June to August 2021. using a self-administered questionnaire. Level of knowledge, attitude, and practice was grouped by Bloom's original cut-off points. A multinomial logistic regression model was fitted to identify significant predictor variables at a 5% level of significance.*

Results*: Of 141 pediatric residents who responded, this study found 17.7%, 40.4%, and 19.1% prevalence of good knowledge, attitude, and practice, respectively. On the chi-square test, the total duration of service as a general practitioner and the year of residency were significantly associated with knowledge and attitude (P values = 0.027 and 0.037, respectively). Residents' knowledge level and year of residency were found to be independently associated with oxygen administration practice. The odds of residents with good knowledge having good practice than poor practice is 8 times (adjusted odds ratio: 7.90, 95% CI 1.15-45.25, P-value =0.035) higher than residents with poor knowledge levels and year of residency was also a significant predictor of practice level (adjusted odds ratio: 0.24, 95% CI 0.06-0.94, P-value =0.042).*

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Conclusions: - *The majority of participants had a positive attitude and had moderate to inadequate knowledge of oxygen administration. Their practice, on the other hand, was generally poor. Regular education and training in oxygen administration can help them improve their knowledge.*

Keywords: - knowledge, attitude, practice, oxygen administration, pediatric residents

Background

Almost all living things on the planet require oxygen to survive. Oxygen is used to treat a wide range of pathophysiological conditions, including pneumonia, heart failure, and hemorrhagic shock (1). It is also an important part of resuscitation, acute medical care, basic life support, anesthesia, and postoperative care. While oxygen therapy is beneficial, too much of it, as well as any errors in oxygen therapy, can be dangerous, worsening a patient's condition and even putting their life at risk (2).

The provision of oxygen to critically sick patients is one of the most crucial components of patient care. As a result, needed knowledge, appropriate practice, and favorable attitudes about oxygen delivery are important aspects of treatment. This allows them to analyze patients' health and provide tailored therapy to improve the patient's quality of life (3). The amount and type of oxygen administration that are appropriate for a patient are determined by their underlying medical condition and whether they have an acute or chronic disease. The optimal oxygen delivery equipment and oxygen flow rate are determined by a variety of parameters, including the patient's age, treatment objectives, and tolerance (4).

Although oxygen therapy is the most common therapy used for infants, inappropriate control of administered oxygen could lead to irrevocable damage to many newborns, particularly preterm infants. The commonest and most extensively studied complication is retinopathy of prematurity, which can lead to permanent damage to the retina and blindness. Supplemental oxygen helps to avoid hypoxemia, but if it is given improperly, the patient risks hypoxemia, respiratory failure, and even death (5 -7).

Oxygen therapy complications necessitate good coordination, adequate documentation, and the handing over of oxygen therapy-specific concerns (8). Oxygen should be treated as a medicine regardless of the situation in which it is administered. Its effectiveness in treating hypoxemia is frequently underestimated, and if used incorrectly, it can be fatal (9). This therapy must be administered in a manner that is suitable, safe, and comfortable for the patient. This is contingent on a thorough understanding of why oxygen is given, how it is given, and the nursing requirements of the patient receiving it (9, 10).

It hasn't been studied in terms of oxygen treatment or pediatric residents' knowledge and practice of oxygen delivery. However, in previous research of nurses working in emergency departments in the two regions

of Ethiopia including Addis Ababa, ranging from 36.2%–to 61% and 33%–to 47% of nurses, respectively, had good knowledge and practice (11-13). According to a survey of Nigerian doctors and nurses, just 60% of doctors and 30% of nurses had a high level of knowledge, while half of both categories had low practice levels (14). Several studies have found that work overload, a lack of training and guidelines, work experience, and knowledge to determine practice are the main determinants of knowledge and attitude toward oxygen therapy (12-15).

Based on theoretical gaps and the fact that, to our knowledge, no research on oxygen therapy or associated knowledge and practice of pediatric residents for oxygen delivery in pediatric patients exists in our country, hence this study aimed to assess the knowledge, attitude, and practice of pediatric residents about oxygen therapy and its complications and associated factors in the pediatrics department of Tikur Anbessa Specialized Hospital (TASH) and St. Paul Hospital, Millennium Medical College (SPHMMC).

Method

Study design and setting

We conducted a cross-sectional study with 141 pediatric residents at TASH and SPMMC in Addis Ababa, Ethiopia, from June to August 2021, G.C. All pediatric residents working in hospitals were considered a source population. A simple random sampling method was used to select the study population from both institutions. A self-administered questionnaire was designed.

Sample size calculation

The total sample was determined using the single population formula with the following assumptions: 80 % power, 95 % confidence interval, margin of error = 5%, P = 50% since no other previous study was conducted with pediatric residents.

The following formula was used to calculate the sample size: -

$$= \frac{(Z\alpha/2)^2 \times P\,(1-P)}{d^2} \quad \frac{(1.96)^2 \times 0.5\,(1-0.5)}{0.05^2} \quad = \underline{\mathbf{384}}$$

Therefore, the total population in this study is less than 10,000, so using the reduction formula:

$$\mathbf{n} = \frac{\mathbf{no}}{\mathbf{1+\,no/N}} \quad \frac{\mathbf{384}}{\mathbf{1+\,384/192}} \quad = \underline{\mathbf{128}}$$

N is the total number of pediatric residents. TASH and SPHMMC have a total of 191 pediatric residents. The study's minimum sample size was calculated to be 128 individuals. After that, a 10% non-response rate was added to get a total sample size of 141.

Sampling technique and procedures

To select study participants from the two hospitals, simple random sampling was used. The total number of pediatric residents participating in the study was proportionally allocated based on the number of health professionals in each hospital and year of residency.

Data collection tool and measurements

A structured, self-administered questionnaire was prepared. The questionnaire included 19 questions on oxygen administration and complications that assessed knowledge, attitude, and practice level, as well as prior oxygen therapy training, availability of oxygen therapy guidelines in their facility, and sociodemographic characteristics (age, sex, place of work, year of residency, and service year as a general practitioner).

Bloom's cutoff point method was used to categorize the respondents' overall knowledge, attitude, and practice, which was then divided into three categories: good, moderate and poor. The key topics included in the assessment of pediatric residents' knowledge of oxygen therapy were indications and contraindications, normal oxygen saturation in newborns and young children, and fundamental physiology of the respiratory system. Three data collectors were assigned, and they were given training about the study. Before the actual data collection, a pre-test was undertaken to ensure that the structured questionnaire was valid. Before filling out the questionnaire, each resident received a brief explanation, and data collection included a detailed check of each completed questionnaire.

Operational definitions: -

Knowledge, attitude and practice score

Good: - if the score was between 80 and 100%.

Moderate: - if the score was between 60 and 79%,

Poor: - if the score was less than 60%.

Normal oxygen saturation (SpO2): - 90% and above.

Physiology of the lung: - those who said ventilation in response to a question, movement of air into and out of the lung is.

Respiratory system Physiology: - For those who said expiration in response to a question, the passive process in respiratory physiology is.

Data management and analysis

IBM SPSS version 25 was used to enter, clean, and analyze the collected data. In tables and graphs, descriptive statistics for categorical data were given using frequency and percentage. A Chi-square or Fisher exact test was used to make a comparison between groups, as appropriate. Then, to identify predictor variables, a multinomial logistic regression model was fitted and checked for model fitting information. An Adjusted Odds Ratio (AOR) with a 95% confidence interval and a P-value of 0.05 was used as statistically significant.

Result

Sociodemographic characteristics and Factors on oxygen therapy

The study included 141 pediatric residents. Of those, 85 (60.3%) were male, and more than three-quarters (77.3%) were aged 30 or below. Of those, 82 (58.2%) were from Tikur Anbessa hospital, and the remaining 59 (41.8%) were from St. Paul hospital. The majority of the residents, 112 (78.7%), were in their first or second year. Around 80% worked

as general practitioners (GP) for 1-3 years. Regarding attendance at training courses, around 78% of the respondents have never attended any short or long-course training about oxygen administration, and only 14.9% of the respondents are aware that there is a guideline in the facility where they are working. Around 70% of residents reported that there is a shortage of oxygen supplies and 85% of participants agreed on the effect of workload on oxygen therapy (Table 1).

Table 1: Socio-demographic and clinical experience characteristics and Participants' responses to the practice of oxygen administration among residents at TASH and SPHMMC.

Variables and category		**n (%)**
Age	≤30	109 (77.3)
	31-35	32 (22.7)
Sex	Male	85 (60.3)
	female	56 (39.7)
Hospital currently working	Tikur Anbessa	82 (58.2)
	St. Paul	59 (41.8)
Year of residency	First-year	56 (39.7)
	Second-year	55 (39.0)
	Third-year	30 (21.3)
The total duration of service as a general practitioner	1-3 years	112 (79.4)
	4-6 years	29 (20.6)
Have you trained in oxygen therapy/ administration?	Yes	32 (22.7)
	No	109 (77.3)
Is there a guideline for oxygen therapy in the current working emergency room?	Yes	21 (14.9)
	No	63 (44.7)
	I don't know	57 (40.4)
Using too little oxygen in the emergency room may contribute to carbon dioxide retention?	Yes	62 (44)
	No	79 (56)
Is there an adequate supply of oxygen and delivery systems in emergency room?	Yes	43 (30.5)
	No	98 (69.5)
Do you think workload/ burden affects oxygen therapy in emergency room?	Yes	120 (85)
	No	21 (15)

Knowledge of pediatric residents on oxygen administration and complications

Only 64.6% correctly identify oxygen indications; 49.6% correctly identify the normal range of oxygen saturation in infants and young children, and 93.6% correctly identify respiratory system physiology. (Table 2)

Attitude of pediatric residents on oxygen administration and its complications

Seventy four percent correctly answered the question about whether oxygen is a type of medicine that should be administered by a medical officer. Only 50.4% managed to provide a good answer about how people with

severe lung disease are managed. Only 12.8% managed to provide a good answer in comparing continuous oxygen administration and intermittent oxygen therapy. When delivering oxygen treatment to adult critically sick patients, 70.2% of those polled were able to correctly identify whether or not oral and nose hygiene, as well as normal saline drops, should be performed. (Table 2)

Table 2: Response on the level of knowledge, attitude and practice among residents at TASH and SPHMMC.

Knowledge questions	**Responses**	**n (%)**
Indication of Oxygen administration	Correct	91 (64.6)
	Incorrect	50 (35.4)
Proper use of oxygen	Correct	114 (80.9)
	Incorrect	27 (19.1)
The normal oxygen saturation at rest for infant	correct	70 (49.6)
	Incorrect	71 (50.4)
Contraindication to oxygen administration	Correct	24 (17)
	Incorrect	117 (83)
Physiology of lung	Correct	132 (93.6)
	Incorrect	9 (6.4)
Respiratory system physiology	Correct	94 (66.7)
	Incorrect	47 (33.3)
Sign of oxygen toxicity	Correct	107 (75.9)
	Incorrect	34 (24.1)
Overall knowledge score	Good knowledge	25 (17.7)
	Moderate knowledge	97 (68.8)
	Poor knowledge	19 (13.5)
Attitude question	**Responses**	**n (%)**
Oxygen is a drug that should be given only when ordered by a medical officer or a registered nurse-initiated order in an emergency	Strongly agree	104 (73.8)
	Agree	27 (19.1)
	Neutral	2 (1.4)
	Disagree	4 (2.8)
	Strongly disagree	3 (2.1)
Oral and nasal hygiene and normal saline drops as necessary should be done when giving oxygen to children	Strongly agree	99 (70.2)
	Agree	39 (27.7)
	Neutral	3 (2.1)
	Disagree	0 (0.0)
	Strongly disagree	0 (0.0)
Continuous oxygen administration is more beneficial than intermittent oxygen therapy	Strongly agree	18 (12.8)
	Agree	42 (29.8)
	Neutral	40 (28.4)
	Disagree	38 (27)
	Strongly disagree	1 (0.7)

Humidification is the best practice to prevent dryness of the mucus membrane of upper respiratory tract causing soreness	Strongly agree	88 (62.4)
	Agree	49 (34.8)
	Neutral	4 (2.8)
	Disagree	0 (0.0)
	Strongly disagree	0 (0.0)
Persons with severe lung disease need to be maintained at the prescribed oxygen saturation range	Strongly agree	71 (50.4)
	Agree	57 (40.4)
	Neutral	6 (4.3)
	Disagree	3 (2.1)
	Strongly disagree	4 (2.8)
Since oxygen is a drug, its administration to the patient is not safe, and also, it's very dangerous	Strongly agree	23 (16.3)
	Agree	40 (28.4)
	Neutral	28 (19.9)
	Disagree	32 (22.7)
	Strongly disagree	18 (12.8)
A child on oxygen therapy indicates that the patient is critically ill	Strongly agree	7 (5)
	Agree	55 (39)
	Neutral	31 (22)
	Disagree	39 (27.7)
	Strongly disagree	8 (5.7)
Overall attitude score	Good attitude	57 (40.4)
	Moderate attitude	82 (58.2)
	Poor Attitude	2 (1.4)
Questions on oxygen practice	**Responses**	**n (%)**
Use of pulse oximetry for monitoring	Correct	32 (22.7)
	Incorrect	109 (77.3)
Factors obstructing oxygen delivery tube	Correct	62 (44)
	Incorrect	79 (56)
Methods of optimizing fast delivery of oxygen	correct	98 (69.5)
	Incorrect	43 (30.5)
Proper use of Nasal cannula	Correct	107 (75.9)
	Incorrect	34 (24.1)
Patient discomfort while using oxygen delivery devices	Correct	22 (15.6)
	Incorrect	119 (84.4)
Overall practice score	Good practice	27 (19.1)
	Moderate practice	49 (34.8)
	Poor practice	65 (46.1)

Practice of pediatric residents on oxygen administration and its complications

Table 2 shows that only 32 (22.7%) have best practice pulse oximetry. Also, 62 (44%) of respondents demonstrated good practice on the effects of a collection of water in a tube and the best practice that helps oxygen travel easily; 98 (69.5%) managed to prove their aptitude for good practice thereto. The respondents who are aware of providing appropriate oxygen concentration using a nasal cannula turn around 107 (75.9%), and to the question

related to providing appropriate oxygen concentration using a facial mask, only 22 (15.6%) have information on the difficulty of tolerating and constantly struggling to remove the oxygen when using a face mask for oxygen therapy. (Table 2)

Blooms cut off points

According to the results in the figure below, the majority of residents 116 (82.3 %) had poor or moderate knowledge about oxygen administration, while the rest 25 (17.7%) had a high level of knowledge. More than half of the residents, 82 (58.4%) and 57 (40.0%), respectively, had a moderate or good attitude on oxygen administration and related complications, while just two (1.4%) had a poor attitude. Only 27 individuals (19.1%) had a good level of practice in oxygen administration, while the remaining 49 (34.8%) and 65 (46.1%) had moderate and poor levels of practice, respectively (Figure 1).

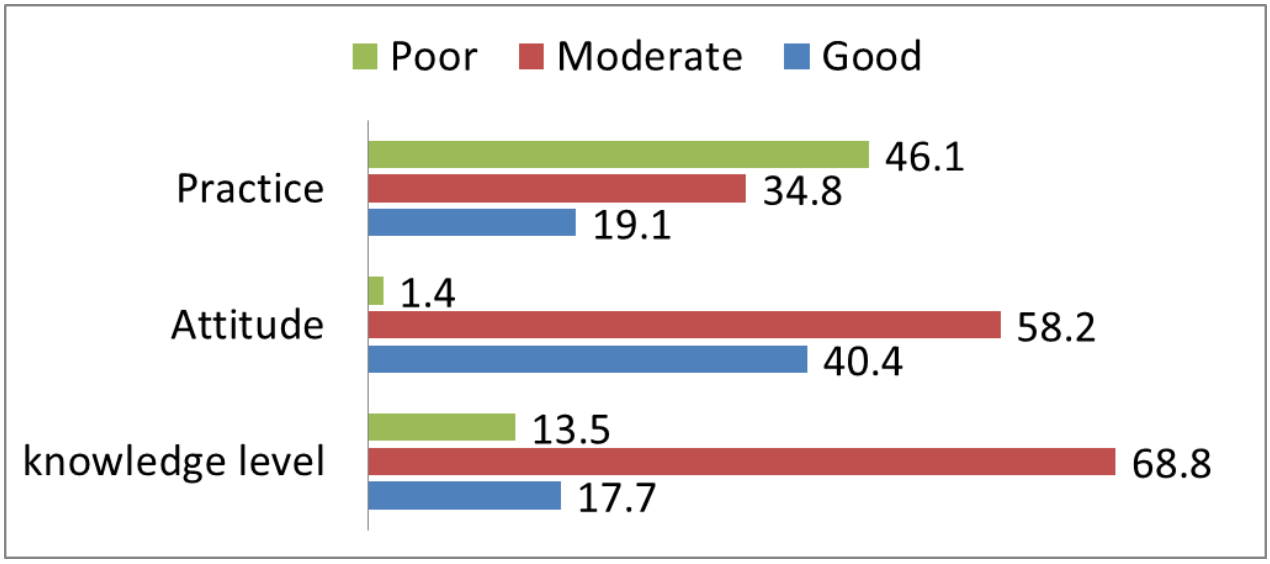

Figure 1: Participants' knowledge, attitude, and practice level (n = 141)

The chi-square test table depicts the association between participant characteristics and oxygen administration knowledge, complications, and practices. The entire period of service as a GP was significantly associated with the residents' knowledge of oxygen administration and complications (P-value = 0.027). The year of residency had also a significant impact on the residents' oxygen administration practice (P-value = 0.037) (Table 3).

Table 3: Chi-square comparison of characteristics of knowledge and practice levels.

Variables		**Knowledge level**			**X^2**	**P-value**
		Good	Moderate	Poor		
Age	≤30	16 (14.7%)	80 (73.4%)	13 (11.9%)	4.85	0.073
	31-35	9 (28.1%)	17 (53.1%)	6 (18.8%)		
Hospital currently working	TASH	10 (12.2%)	62 (75.6%)	10 (12.2%)	4.94	0.084
	SPMMC	15 (25.4%)	35 (59.3%)	9 (15.3%)		
Year of residency	First-year	8 (14.3%)	39 (69.6%)	9 (16.1%)	1.19	0.863
	Second-year	11 (20.0%)	38 (69.1%)	6 (10.9%)		
	Third-year	6 (20.0%)	20 (66.7%)	4 (13.3%)		
The total duration of service as a GP	1-3 years	16 (11.3%)	83 (74.1%)	13 (11.6%)	7.28	0.027*
	4-6 years	9 (31.0%)	14 (48.3%)	6 (20.7%)		
Training in oxygen therapy	Yes	5 (15.6%)	24 (75.0%)	3 (9.4%)	0.85	0.747
	No	20 (18.3%)	73 (67.0%)	16 (14.7%)		
Variables		Practice level			X^2	P-value
		Good	Moderate	Poor		
Age	≤30	21 (19.3%)	35 (32.1%)	53 (48.6%)	1.63	0.442
	31-35	6 (18.8%)	14 (43.8%)	12 (37.5%)		
Hospital currently working	TASH	12 (14.6%)	30 (36.6%)	40 (48.8%)	2.58	0.275
	SPMMC	15 (25.4%)	19 (32.2%)	25 (42.4%)		
Year of residency	First-year	11 (19.6%)	17 (30.4%)	28 (50.0%)	10.18	0.037*
	Second-year	6 (10.9%)	26 (47.3%)	23 (41.8%)		
	Third-year	10 (33.3%)	6 (20.0%)	14 (46.7%)		
The total duration of service as a GP	1-3 years	25 (22.3%)	35 (31.3%)	52 (46.4%)	4.76	0.091
	4-6 years	2 (6.9%)	14 (48.3%)	13 (44.8%)		
Training in oxygen therapy	Yes	5 (15.6%)	12 (37.5%)	15 (46.9%)	0.36	0.863
	No	22 (20.2%)	37 (33.9%)	50 (45.9%)		
Knowledge level	Good	9 (36.0%)	6 (24.0%)	10 (40.0%)	6.79	0.197
	Moderate	16 (16.5%)	37 (38.1%)	44 (45.4%)		
	Poor	2 (10.5%)	6 (31.6%)	11 (57.9%)		

In a multinomial logistic regression model, variables having a P-value < 0.3 in bivariate analysis were included. There was no significant factor detected in multinomial logistic regression to determine knowledge level. Residents' knowledge level, on the other hand, was found to be a significant determinant of oxygen administration practice. The odds of residents with a good knowledge level having a good practice than poor practice is 8 times

Table 4: Multinomial regression table showing factors associated with Knowledge level.

Knowledge	Variables		COR (95% CI)	AOR (95% CI)	P-value
Good	Age	≤30	0.82 (0.23-2.91)	0.86 (0.20-3.68)	0.847
		31-35	1	1	
	Hospital currently working	TASH	0.60 (0.18-2.00)	0.60 (0.17-2.10)	0.431
		SPMMC	1	1	
	Year of residency	First-year	0.59 (0.12-2.88)	0.65 (0.12-3.42)	0.614
		Second-year	1.22 (0.24-6.11)	1.28 (0.23-6.85)	0.773
		Third-year	1	1	
	The total duration of service as a GP	1-3 years	0.82 (0.23-2.91)	0.97 (0.23-4.09)	0.968
		4-6 years	1	1	
	Training in oxygen therapy	Yes	1.33 (0.27-6.44)	1.21 (0.23-6.41)	0.81
		No	1	1	
Moderate	Age	≤30	2.17 (0.72-6.52)	1.87 (0.53-6.59)	0.330
		31-35	1	1	
	Hospital currently working	TASH	1.59 (0.59-4.29)	2.07 (0.75-5.93)	0.174
		SPMMC	1	1	
	Year of residency	First-year	0.86 (0.23-3.16)	0.89 (0.23-3.62)	0.879
		Second-year	1.26 (0.32-5.01)	1.97 (0.44-8.75)	0.368
		Third-year	1	1	
	The total duration of service as a GP	1-3 years	2.73 (0.82-8.39)	3.02 (0.83-0.96)	0.092
		4-6 years	1	1	
	Training in oxygen therapy	Yes	1.75 (0.47-6.54)	1.98 (0.48-8.17)	0.343
		No	1	1	

The reference category is poor knowledge.

Table 5: Multinomial regression table showing factors associated with practice level.

Practice	Variables		COR (95% CI)	AOR (95% CI)	P-value
Good	Age	≤30	0.79 (0.26-2.38)	0.59 (0.15-2.24)	0.443
		31-35	1	1	
	Hospital currently working	TASH	0.50 (0.20-1.24)	0.46 (0.17-1.27)	0.138
		SPMMC	1	1	
	Year of residency	First-year	0.55 (0.18-1.60)	0.40 (0.12-1.36)	0.146
		Second-year	0.36 (0.10-1.22)	0.24 (0.06-0.94)	0.042*
		Third-year	1	1	
	The total duration of service as a GP	1-3 years	3.12 (0.65-14.92)	7.46 (0.97-39.36)	0.051
		4-6 years	1	1	
	Training in oxygen therapy	Yes	0.75 (0.24-2.34)	0.41(0.11-1.53)	0.187
		No	1		
	Knowledge level	Good	4.95 (0.85-28.63)	7.90 (1.15-45.25)	0.035*
		Moderate	2.00 (0.39-10.02)	2.40 (0.44-13.81)	0.303
		Poor	1	1	
Moderate	Age	≤30	0.56 (0.23-1.36)	0.57 (0.21-1.55)	0.278
		31-35	1	1	
	Hospital currently working	TASH	0.98 (0.46-2.11)	0.93 (0.41-2.09)	0.871
		SPMMC	1	1	
	Year of residency	First-year	1.14 (0.45-4.38)	1.67 (0.50-5.54)	0.399
		Second-year	2.63 (0.87-7.99)	2.67 (0.82-8.66)	0.101
		Third-year	1	1	
	The total duration of service as a GP	1-3 years	0.62 (0.26-1.48)	0.74 (0.27-2.03)	0.564
		4-6 years	1	1	
	Training in oxygen therapy	Yes	1.08 (0.45-2.58)	1.28 (0.49-3.36)	0.610
		No	1	1	
	Knowledge level	Good	1.10 (0.26-4.54)	0.95 (0.22-4.10)	0.951
		Moderate	1.54 (0.52-4.57)	1.68 (0.53-5.36)	0.376
		Poor	1	1	

The reference category is poor practice.

Discussion

A total of 141 pediatric residents took part in the study, with 82 from TASH and 59 from SPHMMC. About 17.7% have a good level of knowledge, while 19.1% have a good practical level of oxygen therapy and its complications. Residents' knowledge level and year of residency were found to be independently associated with oxygen administration practice level (P = 0.035 and 0.042).

Knowledge of pediatric residents on oxygen administration

Physicians and nurses should be aware of oxygen treatment indications and normal oxygen saturation at various ages, as well as normal breathing rates, according to world health organization, Western Australian Hospitals, British Thoracic Society, and Allied Health provincial multi-disciplinary group standards (5, 16).

To the best of our knowledge, this was the country's first study of its kind on pediatric residents. As evidenced by the various analyses conducted, the majority of pediatric residents had poor to moderate knowledge of oxygen administration. The level of education and lack of fundamental practical knowledge that may be acquired by various training, workshops, and exposures to scientific papers are likely to contribute significantly to the observed weakness. The number of participants scoring at the low level of knowledge was 13.5%, with just 25 individuals scoring at the high level of knowledge, representing 17.7% of the total, with a standard deviation of 2.3.

In this study, 17.7% of residents had good knowledge of oxygen therapy and its complications. This conclusion contradicts from a result obtained from a study in southwest Nigeria on doctors and nurses, which revealed that 49.5% had good knowledge. Also differ from a study in Rwanda that found just 3.1% of intensive care unit (ICU) health care staff had good knowledge. This disparity might be due to the different types of professionals investigated. The Rwanda study looked at midwives and nurses. (14, 17).

The findings of our study revealed a lack of knowledge about oxygen therapy, such as knowledge of normal oxygen saturation. Approximately half of the respondents (49.6%) provided the correct answer. A. F. Aloushan et al. show 72.7% are aware of normal oxygen saturation (15). The reported low levels could be attributed to a lack of training, as reported by the majority (78%) of respondents who had not completed a training course. This implies the responsibility of hospital management for not providing the staff skills development program, while updating the knowledge of the pediatric residents is a paramount factor in professional performance.

Attitude of pediatric residents on oxygen administration

The poor attitude or negative attitude score for oxygen therapy was determined to be quite low in our study which is 1.4%, and 40.0 % have a positive attitude. This is low compared

with a local study involving physicians from South Gonder hospitals found that 54.6% had a favorable attitude (18). Even though the majority of residents are positive about oxygen therapy, considerably greater understanding and relevant updates are critical to professional performance success.

Oxygen is recognized as a drug by 73 % of residents, implying that right indication and dose with order are required for its administration, resulting in better patient care, minimal complications, and less unnecessary usage. A study in Rwanda also found that 54% of people think that oxygen should be used as a drug (17).

Practice of pediatric residents on oxygen administration

According to our findings, 27 respondents (19.1%) have good oxygen utilization practice, whereas 46.1% had poor practice. This is analogous to Adeniyi et al.'s report, which found that 48.2% of doctors had poor practice. On the contrary, research done in the Gonder and Harari regions, Ethiopia (47.0%) and Kigali, Rwanda (46.2%) had very high practice levels compared to the current study (19.1%) (11, 17, 19). To save the lives of many emergency patients, a standard guideline for oxygen delivery and monitoring state that physicians and nurses should be trained in the best practices for pulse oximetry, humidification attachment, and the use of various oxygen devices (9, 14).

In the chi-square test, our study revealed that duration of service was significantly associated with residents' knowledge regarding oxygen administration and complications. This is in line with a study reported by Demilew BC et al (18). Residents' knowledge level was a significant determinant of oxygen administration practice in multivariate analysis. Residents with good knowledge levels have 8 times more likelihood of having good practice than those with poor knowledge levels. This finding is comparable to that of Zeleke et al. and Getahun et al., who reported that good practice of oxygen therapy is significantly associated with good knowledge in a local study of nurses working in a general hospital (12, 19).

The study's limitation is that the obtained data was self-administered, so there may be an information bias. Despite this limitation, the study's strength is that it was conducted in two of the country's main referral and teaching hospitals, and it could be considered representative of other hospital settings as well. It is also the first of its kind among pediatric residents that we are aware of.

Conclusion

In conclusion, pediatric residents in the capital's two main hospitals had a gap in their knowledge and practice of oxygen therapy. As a result, extensive oxygen therapy education and training programs are required to improve awareness among healthcare professionals.

Recommendation

Residents should be given access to the available oxygen therapy guidelines. Workshops and training for should be held regularly.

Furthermore, regular practical training sessions for health personnel should be planned to keep them up-to-date on the most recent guidelines on oxygen therapy.

Declarations

Ethics approval and consent to participate.

TASH gave their ethical permission after receiving a legal supporting letter from the AAU College of Health Sciences, Department of Pediatrics and Child Health, institutional research and ethics review committee (458/13) on July 13, 2021. After that, each study participant signed a formal informed consent form before the start of data collection.

Consent for publication

Not applicable

Availability of data and materials

All data from this study will be available in this published article.

Competing interests

There were no conflicting interests stated by the authors.

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Addis Ababa University

Authors' contributions

RAK, HG, and KB conception and designed the research. KB performed the research and data collection. KB and EKE analyzed data, and interpretation and wrote the paper.

All authors read and approved the final manuscript

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ORIGINAL ARTICLE

TREATMENT OUTCOME FROM SEVERE ACUTE MALNUTRITION AMONG CHILDREN 6 TO 59 MONTHS ADMITTED TO HAWASSA UNIVERSITY COMPREHENSIVE SPECIALIZED HOSPITAL, SOUTHERN ETHIOPIA

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ABSTRACT

Background: *: Malnutrition continues to be a long-term year-round phenomenon, threatening under 5 children unacceptably the most. It is responsible for 25,000 children's hospitalization per month and nearly 50% of all under-5 mortalities in Ethiopia. The national burden of SAM highlights the importance of addressing predictors of recovery rates.*

Methodology: *An institution-based retrospective cohort study was implemented from a period of august 2020- august 2021. Data were collected using a structured questionnaire and entered and analyzed using SPSS 25. The output of both bivariate and multivariate logistic regression analysis was presented using an odd ratio and 95% CI. A p-value of less than 0.05 was taken as statistically significant.*

Results*: Among the total study cases of 241 children, 192(79.7%) records were recovered, 15 (6.2%) died, and 20(8.3%) were defaulted. The majority of the children, 155(64.3%) had non-edematous malnutrition. The independent predictors of mortality were pneumonia (AOR=6.57), hypovolemic shock (AOR=0.05), presence of both pneumonia and gastroenteritis (AOR=4,463), getting third-line antibiotics (AOR=0.23), fourth-line antibiotics (AOR=0.15) and hospital stay more than 28 days (AOR=0.12).*

Conclusion*: The finding of this study attested that recovery and death rates are within the national standard. As many of the death occurred within the first week of admission, due attention should be given to SAM patients from the first minutes of arrival. Reduction in length of the hospital stays, and early recognition and management of complications have been unveiled to further upgrade the recovery rate.*

Keywords: Outcome, recovery, retrospective cohort study

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Background

Nutrition is a crucial factor for optimum child growth and development, especially throughout the first 1000 days of life, but also beyond. All children, no matter where they live or their circumstances, have the right to survive and thrive. An adequate well-balanced diet is the bedrock of child survival, health, and development. Undernutrition, by the same logic, is a devastating public health problem, particularly affecting under-5 children with major consequences like blunting the intellect, sapping productivity, and perpetuating poverty(1, 2).

Globally, malnutrition affects around 20 million children and contribute for more than 50% of under 5 mortalities signifying 3.5 million children death each year. Developing countries are home to 70 to 80% of undernourished children in the world(3). With an alarming figure of one million under 5 children deaths each year, SAM is among the deadliest forms of malnutrition in developing countries (4, 5). SAM as defined by WHO-UNICEF includes severe wasting and nutritional edema. Severe wasting (marasmus) is defined as weight-for-length (WFL) or weight for height (WFH) below −3 standard deviations (SD or Z-scores) or mid-upper arm circumference (MUAC) <115 mm (6-8).

According to the Global Hunger Index 2020, Chad was the most affected by hunger and malnutrition, with an index of 44.7. Approximately about 239 million of malnourished children live in Sub-Saharan Africa. Diarrhea, malaria, and HIV/AIDS are considered major causes of undernutrition (9). According to 2020 reports, the prevalence of wasting, stunting, and overweight in Ethiopia is 7.2%, 36.8%, and 2.1%. Ethiopia has found it hard to meet all targets for infant and young child nutrition with disappointing progress to increase the figure (10). Severe malnutrition is both a medical and a social disorder. That is the medical problems of the child result, in part, from the social problems of the home in which the child lives (11, 12). The provision of routine antibiotics for children with malnutrition irrespective of place of treatment improves the recovery rate (13, 14).

AIDS and TB are the two well-known infectious comorbidities to bring about secondary malnutrition, particularly in sub-Saharan Africa (15,16). Diarrhea with or without dehydration is credited for 67.3% to 71% of death among under 5 malnourished children, though septicemia, pneumonia, malaria, and hypothermia are also contributing (17-20).

Today, almost a quarter of all children under 5 years of age are stunted and the progress is not only too slow to meet global targets but also deeply unfair. Being underweight is a persisting issue for the poorest countries and can be ten times higher than in wealthier countries (21 -23). In Ethiopia, nearly 4 in 10 (38%) of children under five are stunted. Stunting is more common in Amhara (46%) and less common in Addis Ababa (15%). Overall, 10% of children are wasted, a sign of acute malnutrition.

In addition, 24% of children are underweight. About 472,000 Ethiopian children die each year before their fifth birthday, which places Ethiopia sixth among the countries in the world in terms of the absolute number of child deaths. The national Under-five Mortality Rate is about 49/1000, with variations among the regions from 114 to 233/1000. About 90% of mortality in under-fives is caused by pneumonia, neonatal causes (prematurity, asphyxia, and neonatal sepsis), malaria, diarrhea, and measles. Malnutrition is the fundamental cause of death in about 57% of these deaths, and 11% are associated with HIV infection (24).

A study was done in Southern Nations Nationalities and Peoples Regional (SNNPR) state to unravel 45% stunting, 42% underweight, and 12% wasting (25). comparably in Jimma town the prevalence of stunting, underweight, and wasting were 36%, 36%, and 9% respectively (23). 57% of children aged 6-59 months in Ethiopia are anemic. (20, 23). Young children are most vulnerable to the effects of undernutrition because of their rapid growth and development and smaller bodily reserves. (26). The age of a child, sex, weight of the child at birth, mother's BMI, and region of residence were significant determinants of malnutrition of children under five years in Ethiopia (27).

In Ethiopia there is a scarcity of hospital-based studies done to explicit predictors of recovery from malnutrition among 6 to 59 months children, Hence, this study will identify the gap, will be used to improve the outcome, and becomes a basis for a future large multicenter study. The study was aimed to determine the treatment outcome and predictors of recovery from SAM among children between 6 months to 5 years of age.

Material and methods

Study area and period

The study area was at Hawassa, a capital city of the Sidama region in Ethiopia, on the shores of Lake Hawassa in the great rift valley. It is located 270km south of Addis Ababa with a latitude and longitude of 70 3’ N380 28’E and an elevation of 1708 meters.

The city accompanies Hawassa University which encompasses the agricultural college, main campus, forestry campus, and medicine and health science college. The study was conducted in Hawassa university college of medicine and health sciences inside Hawassa University's comprehensive and specialized hospital pediatrics and child health department. The department has outpatient and inpatient units, one of the inpatient units is a therapeutic feeding unit (TFU) in which children with SAM are treated and stabilized. It has three subunits phase 1, transition, and phase 2 with an average of 15 malnourished children admitted per week. The study was conducted from august 2020 to august 2021.

Study design

The study design was an institution-based retrospective cohort study based on secondary records of children aged 6 to 59 months with SAM admitted at the HUCSH stabilization center during a specified study period.

Population

All children with SAM came to seek medical care at HUCSH during the study period. All children aged 6 to 59 months with SAM were admitted to the HUCSH stabilization center during the study period. Children with malnutrition aged 6 months to 5 years of age were included, but incomplete documentation was an exclusion.

Sample size determination

The double population proportion formula for cohort study was entertained to calculate the sample size using Epi info 7(Fleiss w/CC) by considering the following statistical assumptions: two-sided confidence level (95%), Odds ratio for inpatient complication (AHR=2.2), and power 80%. The AHRS were taken from the study where the maximum recovery rate was reported and the predictor gave the appropriate sample size (28). Accordingly, a total study sample size of 248 was obtained, including compensation of 10% type 1 error, and SAM children's records were recruited.

Sampling technique and procedures

Data was collected from the patient's chart after tracing it from card rooms. Patients with severe acute malnutrition who were discharged during the study period were also the other source of data collection. After counting the study population from the hospital pediatrics department ward and EOPD logbooks, a total of 862 children aged 6 to 60 months with SAM were admitted during the study periods. The sample size was 248, making a constant K value of approximately 3.5. Eligible cases were selected from the existing medical records using a simple random sampling technique. The sample frame was developed for all records of SAM patients aged 6 to 59 months admitted at the HUCSH stabilization center from august 2020 to august 2021 based on their unique SAM identification number. To improve the retrieval rate, incomplete medical records and incorrect data were replaced by the next patient's card. Subsequently, a total of 241 patient cards were correctly retrieved from the hospital card room.

Data collection tool and procedure

Data was collected from the patient's folder who fulfilled the inclusion criteria after ethical clearance from the responsible body was obtained. It was collected by the investigators using standardized survey tools after it was tested by pilot studies. Data were collected by trained personnel. Before the data collection, the collectors were given in-depth training on the objectives of the study, on how to collect the data and fill the questionnaires properly.

Data quality assurance

During the study, the quality and completeness of filled information were checked periodically by the principal investigator, and accordingly, the necessary amendments were made. To help ensure subject privacy and confidentiality, only a unique study identifier appeared on the data collection form for each subject. Any collected subject identifying information corresponding to the unique study

identifier was maintained on a linkage file, stored separately from the data. Data access was limited to study staff.

Data processing and analysis

Data obtained from the study was cleared, entered, and analyzed using SPSS- Version 25 (computer software). Data were summarized using mean and standard deviation for quantitative variables, and percentage for qualitative variables. Data analysis involved calculation for indicators like recovery, death, and defaulter rate. The association between the recovery rate and type of malnutrition, age of a child, presence of diarrhea, pneumonia, shock (septic and hypovolemic), Length of hospital stay, and presence of TB controlling confounding factors for each was analyzed by using bivariate and multivariate logistics regression analysis. A P-value of less than 0.05 was considered statistically significant at a confidence interval of 95%.

Variables

The dependent variables for this study is a treeatment outcome which is classified as good Vs poor) The independent variable included age, type of malnutrition, length of hospital stay, the presence of complications like gastroenteritis, pneumonia, shock, lines of antibiotics received, severe anemia, HIV/AIDS, and Tuberculosis.

Measurements

Outcome comprises good outcome (recovered) and bad outcome (death, defaulter, and non-respondent).

Recovered/cure: a patient who fulfills WHO discharge criteria within 42 days of admission.

Death is a patient who died while he/she was being treated in the program in a facility, and a **defaulter** is a SAM patient that was absent for two consecutive weighing's.

A patient who could not meet the discharge criteria after six weeks of inpatient management is considered a **nonrespondent.**

Result

Demographic characteristics

From a total of 248 randomly selected records of children admitted with a diagnosis of SAM during a study period, 241 patients had complete medical records with a retrieval rate of 97.2%. Both sexes were evenly distributed, with a male-to-female ratio of 1.07. The majority of children 234(95.03%) were newly admitted cases, whereas 7(4.97%) cases had one previous admission with the same diagnosis. More than half of all children 154(63.9%) were aged less than 2 years age and 6 to 18 months represented the highest 129(53.5%). The mean age of study participants was 22.85±7.03months

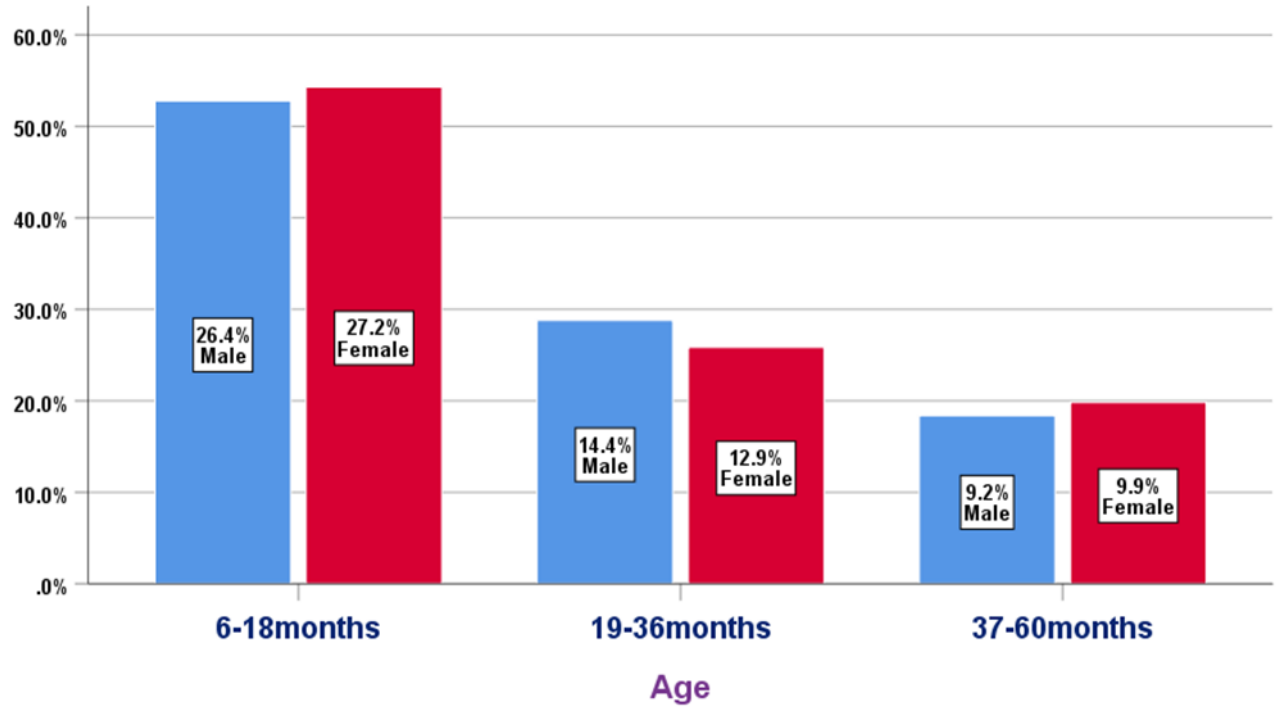

Figure 1: Distribution of age of the children with respect to their gender

Among 241 admitted cases, 126(52.3%) were from the Oromia region, particularly around Shashemene zone were 67(53.17%). Kebele 2 accounted for 30(44.78%), and 103(42.6%) were from the Sidama region. The rest 11 (4.5%) were from the south region. One hundred six (44%) children were completely vaccinated according to the schedule and 60 (24.9%) were vaccinated for their age whereas 27(11.2%) were not vaccinated at all.

Anthropometric information on severely malnourished children

Non-edematous acute malnutrition (severe wasting) was the topmost cause of admission 155(64.3%), followed by edematous acute malnutrition 86(35.7%), with marasmic-kwashiorkor and kwashiorkor representing 50 (20.7%) and 38(14.9%) respectively. The mean age of non-edematous malnutrition (21.75 months) was younger than that of edematous malnutrition (31.95months), 33.33 months for kwashiorkor, and 30.96 months for marasmic-kwashiorkor.

Of all admitted cases, 238(98.8%) were breastfed at least till admission. Of which, 174 (72.2%) children were on exclusive breastfeeding (EBF) for 6 months, 64(26.6%) were not on EBF, and 3(1.2%) did not breastfeed at all because of different reasons like a maternal loss. Two hundred one (83.4%) children were breastfed for less than 2 years with 115 (47.7%) breastfeeding upon admission. The mean age of breastfeeding was 14.3 months. The main source of income for their parents was farming 123(51%), and a majority of the children live with family members of 4 to 8 individuals 132(54.8%).

Table 1: Characteristics of children aged 6 - 59 months admitted with SAM to stabilization center at HUCSH, August 2020 to August 2021

Characteristics(n=241)	Category	Frequency	Percent
Gender	Male	125	51.9
	Female	116	48.1
Age	6 to 18 months	129	53.5
	19 to 36 months	66	27.4
	37 to 60 months	46	19.1
Breastfeeding	Still BF	115	47.7
	Below 2 years	86	35.7
	Above 2years	36	16.2
Region of residence	Oromia	126	52.3
	Sidama	102	42.3
	South	13	5.4
Admission stattus	New	134	95.03
	Readmission	7	4.97
Admission criteria	Marasmic	155	64.3
	Marasmic kwashiorkor	50	20.7
	Kwashiorkor	36	14.9
Vaccination status	Complete	106	44.0
	Vaccinated for age	60	24.9
	Incomplete	48	19.9
	Unvaccinated	27	11.2
Birth order	First	50	20.7
	Second	54	22.4
	Third	61	25.3
	Fourth and above	76	31.5
Admission diagnosis	Non-edematous SAM	155	64.3
	Edematous SAM	86	35.7

Medical comorbidities

Of all admitted patients, 229 (95.0%) had 1 or more malnutrition-related complications during admission. Anemia was the most common complication, accounting for 129(53.5%). of which, 121(50.2%) were moderately anemic and 8(3.3%) were severely anemic, requiring blood transfusion with the mean (±SD) hemoglobin (Hb) level of 8.1 (±1.86) g/dL. Pneumonia was the second most common complication 75 (31.1%), followed by both gastroenteritis and pneumonia 65 (27.0%) and gastroenteritis alone 58(24.1%). Septic and hypovolemic shock were seen in 10(4.1%) and 5 (2.1%) respectively. Septic shock 9(60%) and pneumonia 3(20%) were the 2 most common causes of death in this study.

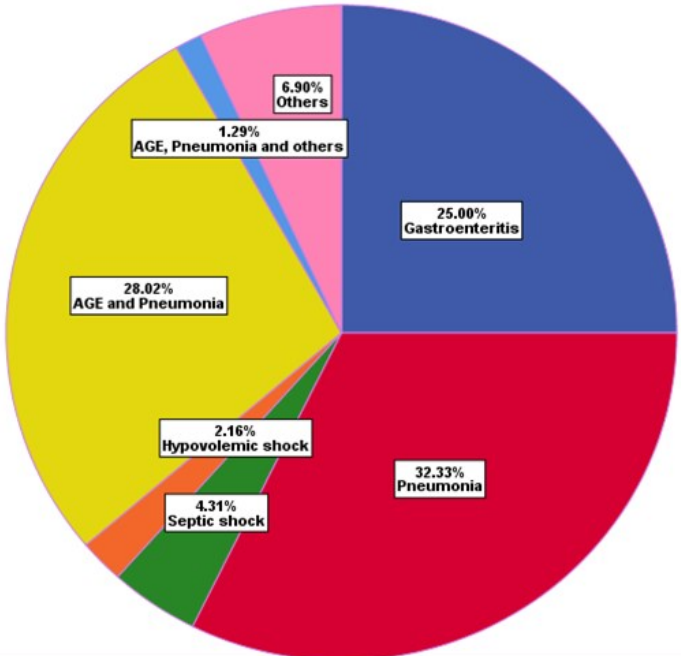

Figure 2: Distribution of complication of SAM patients at admission

None of the study cases had either a positive HIV test or started on ART. Tuberculosis was diagnosed in nearly 1 in 6 patients 39 (16.2%), with disseminated TB responsible for 27 (69.2%), succeeded by pulmonary tuberculosis (PTB) 8 (20.5%) and Extra-pulmonary tuberculosis (EPTB) 4 (10.3%). In the majority of study cases, 228- (94.6%) had received intravenous (IV) antibiotics, with 90 (37.3%) children receiving the second-line antibiotics (Ampicillin and gentamicin) and 99 (41.1%) third-line antibiotics (Ceftriaxone with oral ciprofloxacin) during their hospital stay. The remaining 39 (16.2%) study participants had received fourth-line antibiotics (Vancomycin and ceftazidime) and more potent antibiotics during admission. Those cases who received the third and fourth line of antibiotics had a higher rate to die with a statistically significant P-value of <0.05 (.00).

All 241 study cases were retrospectively followed for a minimum of 2 and a maximum of 55 days during the study period once admitted to the stabilization center of the hospital. The overall proportion of recovery was 192 (79.7%), death 15 (6.2%), and a defaulter rate of 20 (8.3%). According to the national minimum standards for the performance indicators, a recovery rate of >75%, a Death rate of < 10%, and a defaulter rate of <15% are acceptable figures as developed by the SPHERE project. Thus, the outcome figure is consistent with the national standard. The remaining 12 (5.0%) and 2(0.8%) represented the transfer out and the non-respondent rate during the study periods. The overall proportion of death among non-edematous and edematous malnourished patients was (11) 9.24% and (4) 5.55% using total respective admitted cases as denominators.

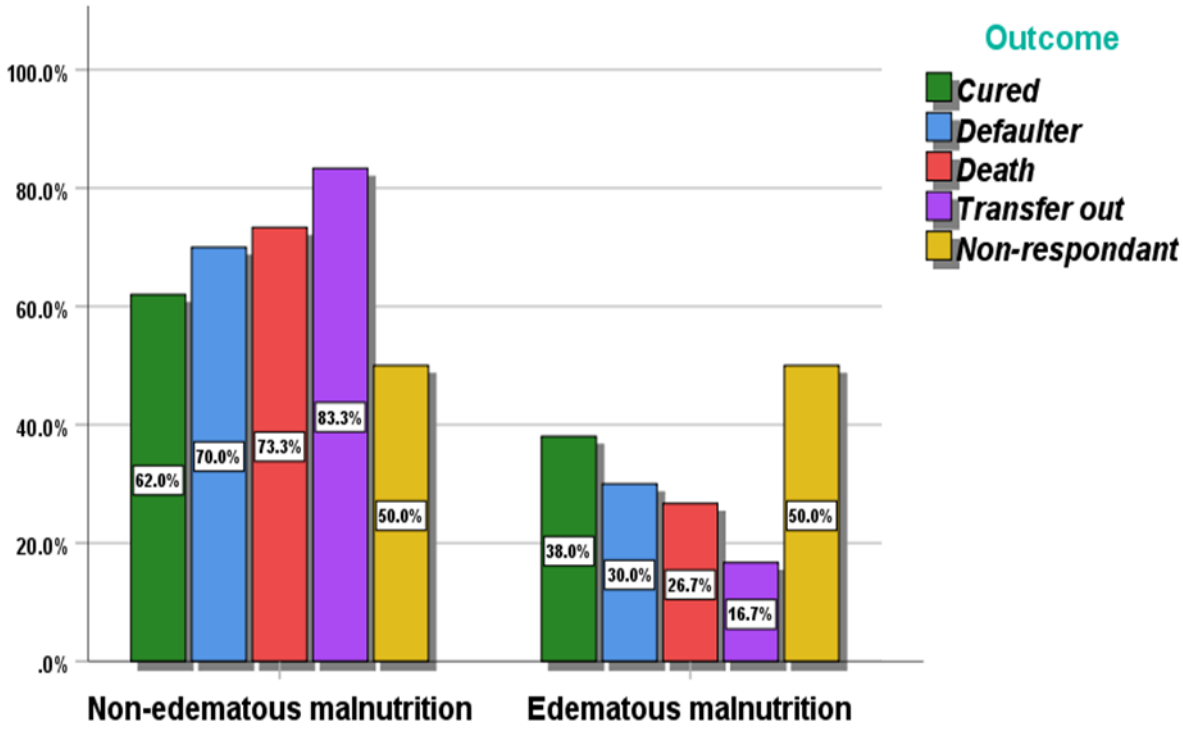

Figure 3: Treatment outcomes of studied cases according to the status of malnutrition

Most of the patients were hospitalized for the first 28 days 232(96.3%), with a mean length of hospital stay 0f 17.8(±4.87) days, which is still an acceptable range according to the SPHERE project. The mean length of hospital stay was higher for patients with marasmic kwashiorkor (25.57days). of the total cured cases 191, 119 (62.3%) were marasmic, 42 (21.9%) marasmic kwashiorkor, and 30 (15.7%) kwashiorkor. This figure might be proportionated with a higher number of admissions of marasmic patients.

Predictors of mortality of children from complicated SAM

On binary logistic regression analysis had been attempted considering a dependent variable(poor outcome) and the following independent variables, Age, gender, vaccination status, hospital stay, breastfeeding, admission criteria, admission diagnosis, presence of complication, types of complications, HCT at admission, place of residency, tuberculosis, and family size. Subsequently, longer hospital stays (p-value=0.003, COR=0.12), line of antibiotics received (p-value=.000, COR=0.146), types of tuberculosis (p-value=0.059, COR=0.09), presence of TB (p-value=0.186, COR=1.69, 95% CI=0.776-3.71), presence of complications (p-value=0.004, COR=8.10), admission diagnosis (non-edematous Vs edematous SAM) (COR=0.14, COR=0.59) was statistically significant, at p-value<0.2.

Moreover, duration of breast feeding (p-value=0.191, COR=0.50), age (p-value=0,106, COR=0.52), vaccination status (p-value=0.25, COR=1.88), gender (p-value=0.16, (male to

female) COR =1.58, 95% CI=0.837-2.99), and source of income (p-value=0.018, COR=2.38) were also demonstrated statistical significance. Whereas being EBF for the first 6 months, region of residency, family size, admission criteria, birth order, and age of the child was not shown statistical significance as their p-value is greater than 0.2.

Table 2: Product of binary logistic regression analysis of severely malnourished children hospitalized at HUCSH, August 2021.

Variables	Category	Recovery status			
		Recovered	Censored	COR	p-value
Gender	Male	104	21	1	1
	Female	88	28	1.58	0.158
Age	6-18months	107	22	1	1
	19-36months	52	14	0.52	0.105
	37-60months	33	13	0.68	0.392
Duration of breastfeeding	Still BF	87	28	1	1
	Below 2 yrs.	70	15	0.50	0.191
	Above 2 years	31	5	0.71	0.531
Source of income	Farming	105	18	1	1
	Laborer	27	9	2.38	0.018*
	Employee	8	2	1.22	0.665
	Pauper	3	0	1.63	0.557
Admission diagnosis	Non-edematous SAM	119	36	1	1
	Edematous SAM	73	13	0.59	0.137
Types of complications	Gastroenteritis	54	4	1	1
	Pneumonia	60	15	8.10	0.004
	Septic shock	1	9	2.40	0.139
	Hypovolemic shock	3	2	0.07	0.021
	AGE and pneumonia	58	7	0.90	0.920
	AGE, pneumonia, and others	2	1	4.97	0.014
	Others	10	6	1.20	0.891
Tuberculosis	Yes	164	38	1	1
	No	28	11	1.70	0.186
Types of TB	PTB	6	2	1	1
	EPTB	1	3	0.86	0.870
	Disseminated TB	21	6	0.10	0.059
Line of antibiotics	First line	8	5	1	1
	Second line	75	15	0.73	0.629
	Third line	88	11	0.23	0.001
	Fourth and higher	21	18	0.15	0.000
Hospital stays	<9 days	73	27	1	1
	9-28 days	115	17	0.29	0.082
	>28 days	4	5	0.12	0.003

Sequentially, multivariate logistic regression analysis was then carried out for those independent variables with a p-value <0.20 obtained from binary logistic regression analysis. Accordingly, the following outcome was entertained. Those children who were hospitalized for more than 28 days were 88.1% less likely to recover than those admitted for <9 days (p-value=0.003, AOR=0.12, 95% CI=0.290-0.490). Similarly, children admitted with a complication of pneumonia alone and pneumonia with AGE had a higher chance of recovery compared to those with gastroenteritis alone (p-value-0.012, 0.024, AOR-6.565, 4.463, 95% CI=1.508-28.90, 1.219-16.34, respectively).

On the contrary, those children complicated with hypovolemic shock were 94.6% less likely to recover and be discharged from the SC than those with gastroenteritis. (p-value=0.014, AOR=0.054, 95% CI=0.005-0.559). Furthermore, children who received third and fourth lines of IV antibiotics during their hospitalization were 76.5% and 84.8% less likely to recover and be discharged than their counterparts. (p-value=0.000, 0.001, AOR=0.24, 0.15, 95% CI=0.101-0.54, 0.06-0.37, respectively).

Table 3: Output of multivariate logistic regression analysis of children admitted with SAM at HUCSH, August 2021.

Variables	**Category**	**Status of recovery**		**p-value**	**AOR**	**95% CI**	
		Recovered	Censored			Lower	Upper
Types of complication	Gastroenteritis	54	4	1	1	1	1
	Pneumonia	60	15	0.012	6.57*	1.51	28.90
	Hypovolemic shock	3	2	0.014	0.05	0.01	0.56
	Pneumonia, AGE, and others together	2	1	0.024	4.46*	1.22	16.34
Lines of antibiotics	First	8	5	1	1	1	1
	Third	88	11	0.001	0.23*	0.10	0.54
	Fourth	21	18	0.000	0.15*	0.06	0.33
Hospital stays	<9 days	73	27	1	1	1	1
	9-28 days	115	17	0.082	0.29	0.72	1.17
	>28 days	4	5	0.003	0.12*	0.29	0.49

***- Significant at p-value 0.005**

Discussion

This study unravels the recovery, death, and default rate of 79.7%), 6.2% and 8.3% among children with SAM admitted to the stabilization center of HUCSH. The two most common complications identified were pneumonia and anemia, followed by acute gastroenteritis. Tuberculosis was identified as one of the complications that guard the recovery. 66.7% of the death occurred within the first week of admission and 78.1% discharged improved within the first four weeks of admission. The majority of the children, 64.3% had non-edematous malnutrition. The mean age of children with SAM was 22.85±7.03 months, which was inconsistent with similar studies conducted in Zambia(12-24months) and Zomba (29-31).

The finding of the study disclosed that the good treatment outcome (recovery) of SAM children admitted at the HUCSH stabilization center was within a range of the national minimum standards for performance indicators of recovery rate greater than 75 % (29, 32). This result is supported by studies done in Bangladesh (cure rate of 88%), the Sidama zone (93.36%), Southern Ethiopia (87%), Woldia (85%), and Jimma (77.8%) (33-37). This recovery rate was better than studies conducted in Africa (cure rate of 73 %), Hindawi (33.6%), Gedeo (76%), and selected hospitals in Ethiopia (55.9%) (38-41). This might be accountable to the difference in settings, case flow, number of trained health professionals, and the severity of complications they had. This study also uncovered that the death rate among study participants was below the national minimum standard of less than 10 % [29]. This finding antagonized studies carried out in other parts of Ethiopia (42, 43) However, most of the deaths occurred within the first week of admission, so this might be related to stabilization center factors such as excess case -load and failure to recognize complications earlier.

This study revealed that children who defaulted (8.3%) were considerably below the national and international minimum standards of cut -off point (< 15%) (44, 45). A similar finding with a defaulter rate of 5.3 to 12.9% was also obtained in different studies conducted in Ethiopia (39, 41-43, 46), but a higher defaulter rate was seen in other studies (38, 47, 48). Although this study showed that anemia and pneumonia were the two common complications encountered, anemia had no statistically significant relationship with the recovery rate of SAM, but a study done in Sekota, northern Ethiopia has shown severe anemia related to a higher mortality rate (AHR=6.71) (49), while those children who had pneumonia at admission had a higher recovery rate (AOR=6.565). This finding is inconsistent with the study done in southwest Ethiopia (50).

Despite the high burden of TB disease in this study (1 in 6), there was no statistically significant relationship between TB and recovery from SAM. This is in favor of a similar study conducted in Zambia Lusaka (30), Woldia (36), and Jimma (37). However, the result of

this study was out of favor with a study done at Jimma University (AHR=0.54) (42), Bahirdar Felege Hiwot Hospital (43), and Sekota Hospital (AHR=2.88) (49), where TB affected the cure rate negatively. The possible argument underlying this result would probably be because the study area was a comprehensive specialized hospital with early recognition and treatment of TB. The average length of stay under the stabilization center was 20.1 days. This is in line with the acceptable minimum international standard according to the SPHERE project (45) and the Ethiopian national guideline for the management of SAM which recommends a mean length of hospital stay less than 4 weeks as benchmarks against which to interpret the quality and effectiveness of functioning under average conditions (44) This result was better than studies done on Yemeni children (48) but in Zomba, Malawi where the median recovery day was 12 days (31).

As inferred from this study children who were remained in the stabilization center for more than 28 days were less likely to recover and discharged (AOR=0.119), which disagreed with a study done in Bahirdar where children who stayed longer had a higher recovery rate (43). This finding might robust the concept that the longer they stayed in the hospital, the more likely they to have or develop serious medical complications, which decreased the recovery rate. In this study, age was not an independent predictor of nutritional recovery rate. This finding was in line with a study done in Kenya and India (51, 52). however, it was the opposite of a study conducted in southern Ethiopia and Hindawi (31, 38). This difference might be due to the reference age range included in the studies. This study also discovered that children who received third (ceftriaxone and PO ciprofloxacin) and Fourth (Vancomycin, ceftazidime, and more potent antibiotics) lines of antibiotics were less likely to be discharged improved. (AOR=0.235, AOR=0.146, respectively). This finding is encouraged by a study conducted in Malawi (51) although the association was done for amoxicillin and cefdinir but against a study done in Althea, Indonesia (53), where the types of antibiotics were not specified. This finding is also antagonized by a study done in the Sekota Wagehmera zone (49) where children not managed by intravenous antibiotics had a higher mortality rate (AHR= 2.73). This difference is explained by the that those children who required more potent antibiotics likely to have severe complications that demand longer hospital stays, which in turn negatively affect the nutritional cure rate.

As this study suggested that the status of malnutrition was not a statistically significant independent variable, this finding was contrary to a study done in southern Ethiopia and Hindawi (29, 38), where edematous malnourished children were associated with a better recovery rate. This might be a higher number of admission due to severe wasting. Furthermore, the vaccination status of studied children was not statically associated with the

recovery rate unlike the study conducted by Viramitha K (53) suggested that complete vaccination history increased the recovery rate. The average weight gain among recovered cases, in this study, was 10.9(±3.4) g/kg/d, which was much lower than the study done in Hindawi (38). This difference might result from the duration of hospital stay and the weight scale used for study participants.

As indicated in this study the presence of complications like pneumonia alone (AOR=6.565) and pneumonia with AGE (AOR=4.463) was statically associated with a higher rate of recovery when compared to those children with gastroenteritis. However, Study done by Karunaratne R (AHR=1.89) (54) showed that the presence of pneumonia is rather associated with a higher rate of mortality. Moreover, a study done in Zomba Malawi revealed that those children who had pneumonia (AOR=0.71) were 29% less likely to recover (31). This might be owing to the difference in independent variables, HIV serostatus, and reference category, because 95.0% of study participants were admitted with 1 or more complications, thus the comparision was brought in amongst malnourished children with gastroenteritis and those with other complications like pneumonia, On contrary, those children complicated with hypovolemic shock had 94.6% less likely to recover and be discharged (AOR=0.054), which agreed with a study done by Karunaratne R. (54) and done in Jimma (AOR=0.18) (50).

The findings of this study might suffer from the fact that the study used secondary data from records. As the outcome was dichotomized into a good and bad outcome, the outcome of the transfer out and defaulter cases was unknown, which might affect the interpretation of the result. Adherence and practice of health professionals according to the standard protocol cannot be identified from records

Conclusion

The study revealed that recovery rate, defaulters' rate, death rate, and length of hospital stay has met the accepted minimum national and international standard for malnourished children which is the cure rate of more than 75 %, defaulter rate of less than 15%, a death rate of less than 10 % and the average length of stay of fewer than 28 days. Reducing the length of hospital stay has improved the nutritional recovery rate significantly. Children who had pneumonia and gastroenteritis were more likely to recover than those who had a hypovolemic shock. Most deaths occurred within the first weeks. Children who required 3rd or 4th line antibiotics had a lesser recovery rate. Therefore, early discharge, early recognition, and treatment of malnutrition-related complications have paramount importance to maximizing recovery rate and minimizing defaulter and death rate.

Declaration

Ethical consideration: Ethical approval was received from Institutional Review Board (IRB). In this study, there was no direct

contact with patients, and secondary data was used anonymously by using identity numbers instead of names to protect patient identity. As this was a retrospective cohort study, there was minimal risk to involve participants physically. All protected health information (PHI) was de-identified before data analysis and publication; subject identities were known only to the study staff. No reference to any individual participant was made in the study reports.

Author contribution:

Competing interest: the author has no conflict of interest.

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ORIGINAL ARTICLE

KNOWLEDGE, ATTITUDE, AND PRACTICE OF PEDIATRIC RESIDENTS TOWARDS ORAL HEALTH OF CHILDREN IN ADDIS ABABA: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: *: The state of good oral health in children is mainly contributed by the knowledge, practice and attitude of front-line health workers like general practitioners, family physicians, postgraduate pediatric residents, and pediatricians. Assessing the knowledge, practice, and attitude of residents would give directions for further quality improvement projects. This study aimed to assess the knowledge, attitude and practice of pediatric residents on oral health in children in 3 public post-graduate teaching institutions in Addis Ababa, Ethiopia.*

Methods: *Hospital-based cross-sectional study was conducted among 169 pediatric residents from 3 public postgraduate teaching institutions of Addis Ababa from June 1-August 30. 2022. The knowledge, Attitude and practice of residents were assessed by a structured questionnaire adapted from an extensive literature survey. Then the data was analyzed using SPSS version 25 software package. Descriptive summary statistics such as frequency and proportion were applied and finally, the results were presented using tables and figures.*

Results*: In this study, 169 residents were involved. Males were 106 (62.7%) and the remaining were females. Only 18 (10.7%) of participating residents had good knowledge but 43 (25.4 %) and 108 (70.2%) had moderate and poor knowledge of oral health in children respectively. Most 164 (97%) had a good attitude towards oral health, but 19 (11.2%), 86 (50.,9%), and 64 (37.9%) had good, moderate, and poor practice respectively.*

Conclusion: *The majority of pediatric residents in Addis Ababa had good attitude toward oral health but moderate practice and poor knowledge about oral health in children. Residents should be trained to improve their knowledge and practice toward oral health.*

Keywords*:* Knowledge, Attitude, Practice, Pediatrics, Oral Health, Ethiopia

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Background

Oral health determines overall health, well-being, and quality of life (1). Dental caries is among the most common chronic diseases affecting children. It is a remarkable public health problem in early childhood, with unfavorable impacts across the lifespan. 60–90% of children are affected, with rates of dental caries higher than childhood asthma globally2. Dental caries is a progressive disease; if managed early can be reversed, but becomes more complex over time if left untreated (3,4). Chronic pain/discomfort related to dental caries affects the children's cognitive development commonly with poor school attendance and lack of concentration (5). Contributing factors for poor oral health in children include age, gender, geographic location, social disadvantage, socioeconomic status, and lifestyle factors (6-10).

It is recommended that dental care should be a priority in all health service programs including dental care starting from 6 months of age, regular exposure to small amounts of fluoride, and promotion of exclusive breastfeeding (11-18).

Parents visit a pediatrician than a dentist in the early lives of their children so pediatricians are considered to be the best for prevention of caries and early referral of children to the dentist when needed (19,20). For pediatricians to be successful in this regard, they should be equipped with up-to-date evidence-based knowledge and practice. On the contrary several studies have shown that the oral health knowledge and practice of pediatricians is unsatisfactory though they are willing to practice oral health care (20-21). A study done in Ethiopia at different levels of health workers showed oral health-related knowledge was low (22).

The study aimed at finding the gap and provide the available information related to knowledge, attitudes, and practices (KAP) of pediatric residents working in the Department of Pediatrics of Addis Ababa University, St. Paul's Millennium Medical College, and Yekatit 12 Hospital Medical College.

There are no studies done regarding KAP on pediatric oral health among pediatric residents in the study area. The results of this study therefore will provide information about KAP among pediatric residents and plan for further educational interventions.

Materials and Methods

Study area

The study was conducted at three government teaching Hospitals, Tikur Anbessa Specialized Hospital, St. Paul's Hospital Millennium Medical College and Yekatit 12 Hospitals where post-graduate education is being conducted.

Tikur Anbessa Specialized Hospital is found in the capital city of Addis Ababa and is the largest referral hospital in the country, and serves approximately 370,000- 400,000 patients a year but the exact number is not known. It is one of the largest teaching hospitals in the country providing eight undergraduate and over 70 post graduate programs.

There are 123 residents attending the postgraduate program in the Department of Pediatrics and Child Health.

St. Paul's Hospital Millennium Medical College, is also located in the capital city of Addis Ababa. The college initiated Ethiopia's first integrated modular and problem–based curriculum for its undergraduate medical education and is currently expanding to postgraduate programs including pediatric residency. There are 72 residents enrolled in the postgraduate program of pediatrics and child health.

Yekatit 12 Hospital Medical College, is also located in Addis Ababa, and was established in 1923 as one of the modern medical service delivery centers in the country but started its postgraduate program recently and currently there are 37 residents enrolled in the postgraduate training of pediatrics and child health.

Study design and period

An institution-based cross-sectional study was conducted from June 1-August 30. 2022. The study participants were all pediatric residents practicing in these 3 teaching hospitals during the study period and who were willing to participate in the study. All residents who were not available at the time of data collection because of various reasons and who were not willing to participate were excluded.

Sample size determination

The required sample size of eligible participants for the study was determined by using a single population proportion formula,5% margin of error and 95% confidence level. Using this formula, the sample size becomes 384. But the total number of pediatric residents in the 3 hospitals was 232, so we took all the residents as study participants.

Data collection methods

The questionnaire was distributed to the study participants by the principal investigator after their morning meetings by the principal investigator and collected on the spot. The data was obtained from residents by using structured questionnaire after getting verbal consent. The questionnaire was adapted from an extensive literature survey. It consisted of five parts. The first part contained basic demographic information. The second part included 7 Yes/ No and 2 multiple choice questions to assess the participants' knowledge. The third part included 8 questions to assess the participants' attitude towards oral health care in children with the answers of Agree, Uncertain and Not agree. The fourth part contains 5 questions with the answers of always/sometimes/ rarely and not at all to assess practice of participants. The fifth part contains two multiple-choice questions to assess the oral health information sources of participants. The questionnaire was in English and it was distributed to residents at the same time and collected on the spot. The face and content validity of the questionnaire was established by experts' approval from previously done studies.

Data processing and analysis

After data collection, it was entered using ODK version 1.25.2, each completed form was checked for completeness and exported to SPSS version 25 for analysis. The result is

presented using descriptive summary statistics such as frequencies, proportions and presented in tables and figures

Study Variables:

Outcome variables: Knowledge, Attitude and practice of residents

Explanatory variables: age, sex, religion, marital status, year of residency, training about oral health care and work experience.

Operational Definition (27)

Scoring criteria

- **Good Knowledge -** Respondents who score above or equal to the mean score (75%) of knowledge related questions.
- **Moderate knowledge-** Respondents who score above or equal to the mean score (50%) but below mean score (75%) of knowledge related questions.
- **Poor knowledge -** Respondents who score below mean score (50%) of knowledge related questions.
- **Good attitude** - Respondents who scored more or equal to mean score (75%) of attitude related questions.
- **Moderate attitude-** Respondents who score above or equal to the mean score (50%) but below mean score (75%) of attitude related questions
- **Poor attitude** - Respondents who scored below mean score (50%) of attitude related questions.
- **Good practice -** Respondents who scored more or equal to mean score (75%) of practice related questions.
- **Moderate practice-** Respondents who score above or equal to the mean score (50%) but below mean score (75%) of practice-related questions
- **Poor practice** - Respondents who scored below the mean score (50%) of practice-related questions.

Ethical consideration

An ethical clearance and official letter were obtained from the Department Research and Publication Committee of Addis Ababa University, Department of Pediatric and Child Health. After getting permission from the hospitals to participate in the study, verbal consent was obtained from each resident. The data collection was anonymous which doesn't include the names of individual participants or any other personal identifiers and confidentiality was maintained at all levels of the study, and the collected information was kept in a secured place.

Results

Out of the total 232 residents, 31 were excluded from the study due to annual and maternity leaves. The remaining 201 residents were given the questionnaire and 169 of them responded with a response rate of 84%. The majority of respondents 74 (43.8 %) were year two, 56 (33.1%) were year one, and 39 (23.1%) were year three residents. Males were 106 (62.7%) the remaining were females. The majority 77.5% were between 25-30 years old. The socio-demographic characteristic of the study participants is shown in (Table 1).

Table 1: Demographic characteristics of 169 participating residents on oral health survey in children, Addis Ababa

Variable		Frequency	Percent
Institution	Black lion	85	50.3
	St Paul	61	36.1
	Yekatit 12	23	13.6
Gender	Male	106	62.7
	Female	63	37.3
Age	below 25 years	1	0.6
	25-30 years	131	77.5
	31-35 years	35	20.7
	above 35 years	2	1.2
Marital status	Single	93	55.0
	Married	73	43.2
	Divorced	3	1.8
Year of residency	first year	56	33.1
	second year	74	43.8
	third year	39	23.1
Training on oral health	Yes	40	23.7
	No	129	76.3
Duration of the training	< 1 hour	6	3.6
	1-2 hours	15	8.9
	2-3 hours	3	1.8
	> 3 hours	16	9.5
	Total	40	23.7
Total		169	100.0

Assessment of knowledge of 169 participating residents towards oral health in children

Knowledge of oral health in children was measured using the cumulative score of 9 questions. Sixty-one-point five percent of the residents feel that topical application of fluoride prevents tooth decay, 46.2% of the residents feel that fluoridated toothpaste is unsuitable for under 3 years of age and 85% of the residents feel that the first dental visit shall be started at 3 years of age. (table 2). The mean ± SD knowledge score of the total residents were 3.95 (±1.91).

Table 2: Knowledge of 169 participating residents on oral health in children, Addis Ababa

Items		Frequency	Percent
Fluoride prevents tooth decay when applied topically	No	33	19.5
	uncertain	32	18.9
	Yes	104	61.5
Fluoridated toothpaste is suitable under 3 years of age	No	78	46.2
	uncertain	56	33.1
	Yes	35	20.7
Are there any differences between breast and bottle feeding regarding their effect on the dentition?	No	4	2.4
	uncertain	16	9.5
	Yes	149	88.2
Prolonged and on-demand breastfeeding leads to dental caries.	No	96	56.8
	uncertain	30	17.8
	Yes	43	25.4
Cavity-causing bacteria can be transmitted from mother to child.	No	39	23.1
	uncertain	50	29.6
	Yes	80	47.3
What is the recommended age for initiating a toothbrush and using fluoridated toothpaste for brushing a child's teeth?	When the first teeth erupt	35	20.7
	After all primary teeth erupt	67	39.6
	When a child can hold a toothbrush	18	10.7
	after 5 years of age	49	29.0
Prenatal bad oral health of a mother can affect negatively the child's oral health.	No	35	20.7
	uncertain	39	23.1
	Yes	95	56.2
What is the recommended age for the first dental visit?	3 years old	85	50.3
	5 years old	24	14.2
	≤1-year-old	60	35.5
Can dental/fissure sealants prevent dental caries?	No	37	21.9
	uncertain	65	38.5
	Yes	67	39.6
Total		169	100

More than two third 108 (70.2%) of residents had poor overall knowledge on oral health in children, whereas 43 (25.4%) and 18 (10.7%) residents had moderate and good knowledge respectively (fig 1).

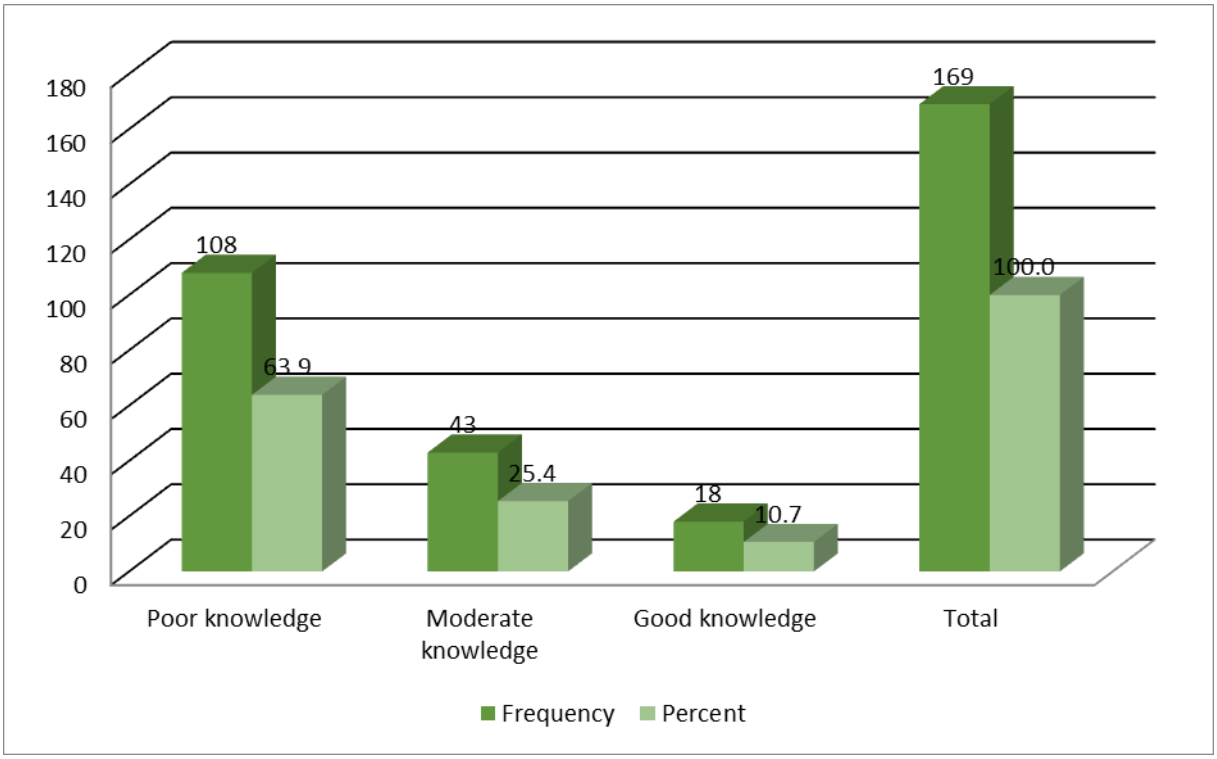

Figure 1*:* Knowledge of 169 participated residents on oral health in children, Addis Ababa

Attitude toward oral health of 169 participating residents on oral health

To assess the attitude of residents toward oral health eight questions were designed with a total score of 16 as demonstrated in table 3. The mean ± SD attitude score of the total residents were 14.3 (±1.4). Most 97% of the residents had good attitude on oral health in children. (fig 3).

Table 3: Attitude of 169 participating residents on oral health in children, Addis Ababa

Variable		Frequency	Percent
Dental caries may be prevented.	Disagree	1	0.6
	Uncertain	3	1.8
	Agree	165	97.6
Gingivitis may be prevented	Disagree	1	0.6
	Uncertain	4	2.4
	Agree	164	97.0
Malocclusion may be prevented	Disagree	13	7.7
	Uncertain	54	32.0
	Agree	102	60.4
Oral hygiene is important in preventing dental caries	Disagree	1	0.6
	Uncertain	5	3.0
	Agree	163	96.4
Routine dental visit is important in preventing oral diseases	Disagree	4	2.4
	Uncertain	10	5.9 %
	Agree	155	91.7
Fluoride supplement is important in preventing dental caries	Disagree	6	3.6
	Uncertain	36	21.3
	Agree	127	75.1
Pediatric residents have an important role in the prevention of oral diseases	Disagree	1	0.6
	Uncertain	8	4.7
	Agree	160	94.7
Pediatric residents should provide an oral cavity health examination	Disagree	2	1.2
	Uncertain	9	5.3
	Agree	158	93.5
Total		169	100

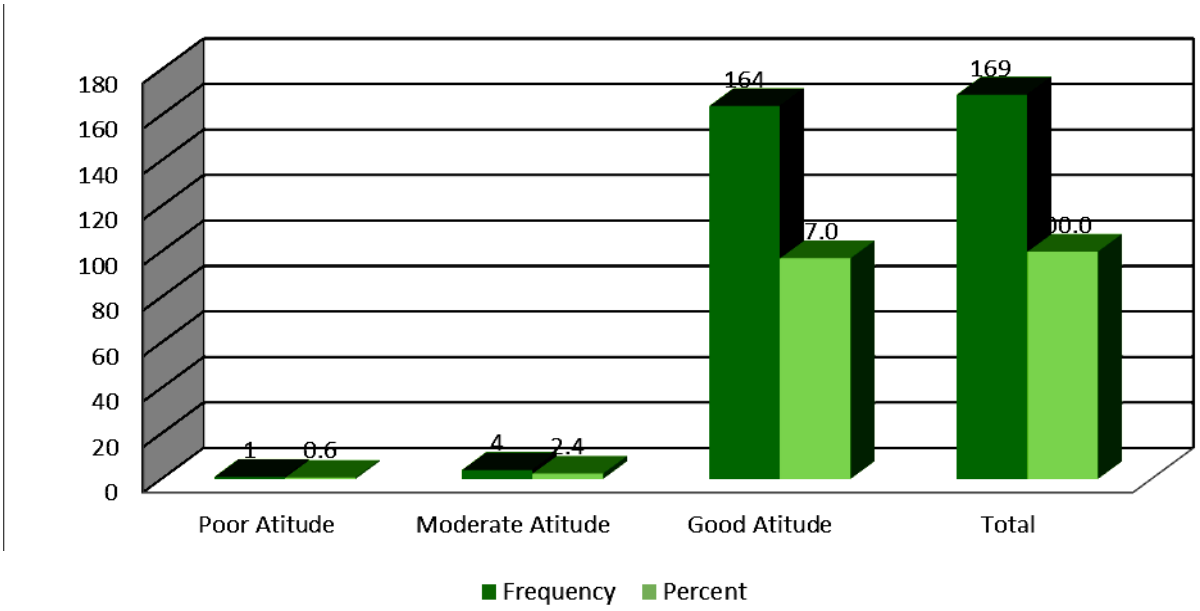

Figure 2: Attitude of 169 participating residents on oral health in children, Addis Ababa

The practice of 169 participating residents toward oral health

Practice on oral health was measured using the cumulative score of 15 questions. Fifty-eight percent of residents sometimes examine children's teeth for cavities, 46.2% of the residents sometimes recommend a dental visit to patients and 48.5% do not provide educational material to patients. (table 4). The mean ± SD Practice score of the total residents were 8.24 ±3.04.

Table 4: Practice of 169 participating residents on oral health in children, Addis Ababa

Variable		Frequency	Percent
Do you examine children's teeth for cavities?	Not at all	6	3.6
	Rarely	35	20.7
	Sometimes	98	58.0
	Always	30	17.8
Do you routinely recommend a dental visit to patients?	Not at all	20	11.8
	Rarely	51	30.2
	Sometimes	78	46.2
	Always	20	11.8
Do you counsel patients and their guardians on regular tooth brushing?	Not at all	6	3.6
	Rarely	36	21.3
	Sometimes	86	50.9
	Always	41	24.3
Do you recommend parents brush their children's teeth?	Not at all	9	5.3
	Rarely	33	19.5
	Sometimes	91	53.8
	Always	36	21.3
Do you provide parents with educational or oral hygiene tools such as books, pamphlets, and toothbrushes?	Not at all	82	48.5
	Rarely	37	21.9
	Sometimes	36	21.3
	Always	14	8.3
Total		169	100 %

Figure 1: Participants' knowledge, attitude, and practice level (n = 141)

Only 11.2% of participating residents had good practice regarding oral health, 50.9% of them had moderate practice but 37.9 % had poor practice (fig 4).

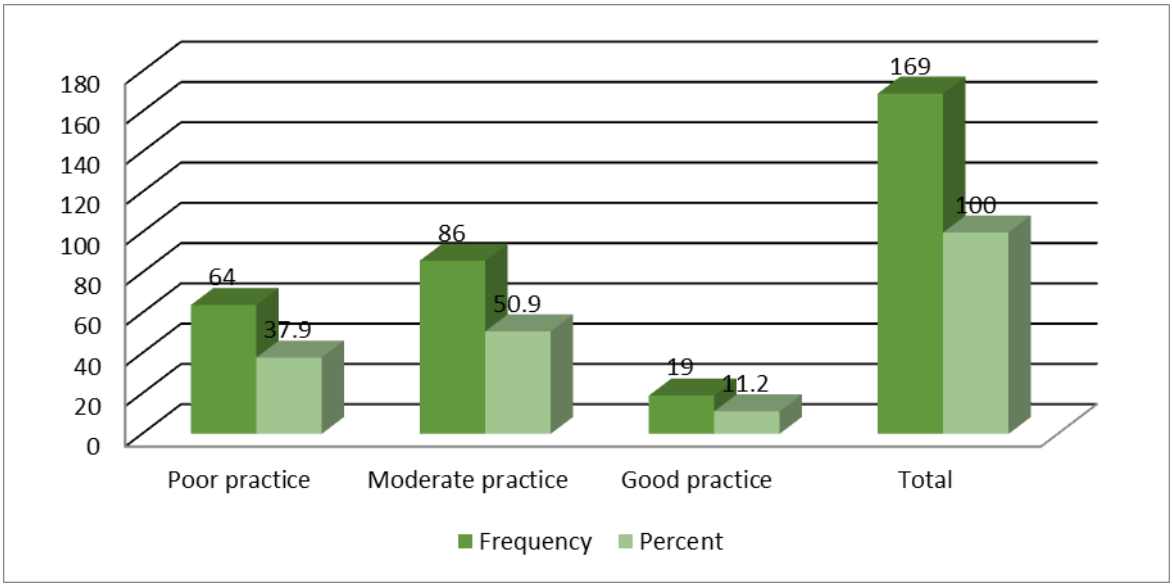

Figure 3: Practice of 169 participating residents on oral health in children, Addis Ababa .

Source of information on oral health

Regarding the source of information about the prevention of oral disease, the most common sources were from undergraduate educational courses that account for more than two third 39.6%, followed by scientific journals and from colleagues, and other sources which accounts for 16.6%, 14.2%, 4.1%, and 7.1% respectively. The rest 18% didn't receive information about prevention of oral disease. Almost all (98.8%) of residents claimed that they need further information about the prevention of oral diseases.

Discussion

Knowledge of 169 participating residents on oral health

This study was conducted with the objective to assess oral health-related knowledge, attitude, and practices among pediatric residents during their residency program. Children visit a pediatrician more often than a dentist but, in this study, only 10.7% of pediatric residents have good knowledge on oral health. The rest 25.2 % and 70.2% of pediatric residents had moderate and poor knowledge on oral health in children respectively. A scoping review of studies done among 19 countries and 42 eligible articles showed that the knowledge of pediatricians on oral health was inadequate (23). In this same studies knowledge on the initial signs of dental caries, etiologic agents of dental caries, recommended dates of initial dental visit, mother to child transmission of cavity causing bacteria and on the use of fluoride supplements to prevent dental caries was poor like our study.

Previous studies have shown that cavity causing bacteria can be transmitted from mother/ care giver to a child (24,25), only less than half of participating residents know about it. Though the first dental examination is recommended at the time of the eruption of the first

tooth and no later than 12 months of age (18); only 20.7% of participating residents mention it correctly. Although the American academy of pediatric dentistry (AAPD) recommends tooth brushing as soon as first tooth erupts (26), only 20.7% of residents mention it correctly. A 2016 systematic review concluded that sealants are effective in preventing and arresting carious lesions of primary and permanent molars in children and adolescents and minimize the progression of carious lesions (18); but only 21.9% participating pediatric residents knew and 38.5% were uncertain about it. Studies done in Saudi Arabia, United Arab Emirates and Balkan countries (27-28, 29) have shown pediatricians knowledge on oral health in children was unsatisfactory.

Practice of 169 participating residents on oral health

Participating residents' practice regarding oral health care is poor; only 11.2% of participating pediatric residents had good practice the remaining 50.9% and 37.9% of residents had moderate and poor practice respectively. A study done in Lagos, Nigeria also showed 71% of pediatricians have poor practice on oral health in children (30). Only 17.7% participating pediatric residents routinely examine children's teeth for cavity. A study done in Lagos, Nigeria showed only 30.8% of pediatricians routinely examine children's teeth for cavity (30), only 11.9% participating residents routinely advice children and their guardians for dental visit, less than a quarter of them council children and their guardians on the importance of regular tooth brushing, 21.3 % routinely recommend parents to brush their children's tooth and only 8.3 % routinely provide parents educational and oral hygiene tools. This is similar with previous results (27,28,30,).

The attitude of 169 participating pediatric residents on oral health

More than 93% of participating residents agree that residents should provide an oral cavity health examination, oral hygiene is important in preventing dental caries and dental caries could be prevented. More than 95 % had a good attitude toward oral health care. Studies done in Saudi Arabia, United Arab Emirates, and Lagos Nigeria have shown good attitude toward oral health in children and pediatricians were of the opinion that they have a role to play in preventing tooth decay in children (30).

There are some limitations in the current study. There could be response bias as in survey studies and other residents out of Addis Ababa were not included so generalization might not be possible.

In conclusion, participating pediatric residents in Addis Ababa have good attitude toward oral health in children but have poor knowledge and practice.

Recommendations

The majority of participating residents have a good attitude toward oral health in children but poor knowledge and practice so we recommend oral health in children should be included in the post graduate curriculum.

Declaration

We declare that there is no conflict of interest.

Authors' contribution:

EA proposal writing, data collection, data analysis

DS proposal reviewing, data analysis, and writeup

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CASE REPORT

SYMMETRIC PERIPHERAL GANGRENE IN A CHILD WITH PLASMODIUM FALCIPARUM MALARIA AND SEPSIS: A CASE REPORT

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ABSTRACT

Symmetric peripheral gangrene is a rare clinical syndrome manifesting with bilateral distal ischemic injury leading to gangrene in the absence of large vessel obstruction or vasculitis. Factors responsible for symmetric peripheral gangrene are many and it usually follows diseases like malaria. We reported a 6 year female child presented with fever, chills and leg swelling and admitted with the diagnosis of severe falciparum malaria, cellulitis and sepsis. On third day, she developed symmetric peripheral gangrene of lower extremities. It needs high index of suspicion to detect symmetric peripheral gangrene early and to offer early prompt treatment of underlying causes.

Keywords: Child, peripheral gangrene, plasmodium falciparum, severe malaria

Background

Symmetric peripheral gangrene (SPG) is a rare but devastating syndrome first described by Hutchinson in 1891(1). SPG is defined as symmetrical distal ischemic damage in two or more sites in the absence of a major vascular occlusive disease. It carries a high mortality rate with a high frequency of limb amputations in the survivors(2–4).

The pathogenesis of symmetrical peripheral gangrene is not well understood; but it has been related to variety of infective and non-infective factors that are complicated by disseminated intravascular coagulopathy (DIC) which is associated in 85% of cases of SPG. As it is described by many case reports; sepsis and rarely, severe plasmodium falciparum (in one case report P. vivax) malaria are the infections associated with symmetrical peripheral gangrene; low output states, vasospastic conditions, myeloproliferative disorders and hyperviscosity syndrome may also contribute(2,4–7).

No specific treatment has been shown to consistently prevent progression or to reverse the gangrene(4) but early aggressive and prompt treatment of underlying etiologies (as in our patient) may limit the severity of SPG and decrease its sequela.

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Case presentation

A 6 year old female child came from Kochore woreda, Gedeo zone, SNNPR, Ethiopia where malarial illness is common, with compliant of high grade fever and chills of 5 days. Two days later, she developed pain and swelling of toes and feet bilaterally. There was no history of bleeding, trauma, exposure to drugs/herbal medicines or cardiac illness. She has no known allergy. She usually wears shoes. She was tachypneic (32BPM), febrile (38.5˚C). Pulse rate was 100bits/minute and BP was 100/70mmHg. RDT for plasmodium falciparum was positive and blood film showed that no hemo-parasite was seen. Complete blood count (CBC) revealed a white blood cell (WBC) of 23 × 10^3 cells/dl with 15.44 × 10^3 cells/dl of neutrophils, platelets of 27 × 10^3/dl and hematocrit of 29.1% and ESR was 22mm/hr.

She was admitted to ward with the diagnosis of malaria with bicytopenia (anemia and thrombocytopenia) + sepsis + cellulitis and treated with IV antimalarials and antibiotics. On next day, lower legs, feet and toes became bluish (figure 1); dorsalis pedis and posterior tibialis were palpable with full volume. On 3rd day, lower 1/3rd of legs, feet and toes became darker with clear boundary (figure 2A and 2B). Doppler study was normal. Coagulation profile and blood culture were not done due to financial constraint. With the consideration of symmetric peripheral gangrene, above managements were continued.

On subsequent days, lower legs, feet and toes became darker and showed gangrenous features bilaterally (figure 2A and 2B). General condition of the child improved, and WBC of 16.52 × 10^3 cell/dl, PLT of 113 × 10^3 /dl and HCT of 25.1%. Orthopedics side evaluated her and planned to see her on follow-up dates. After 3 weeks of stay, she was discharged with appointment; unfortunately her parents failed to bring her on follow date and on phone communication, she was fine and doing well.

Figure 1. Bluish and darkish discoloration of skin seen on 2nd day of presentation.

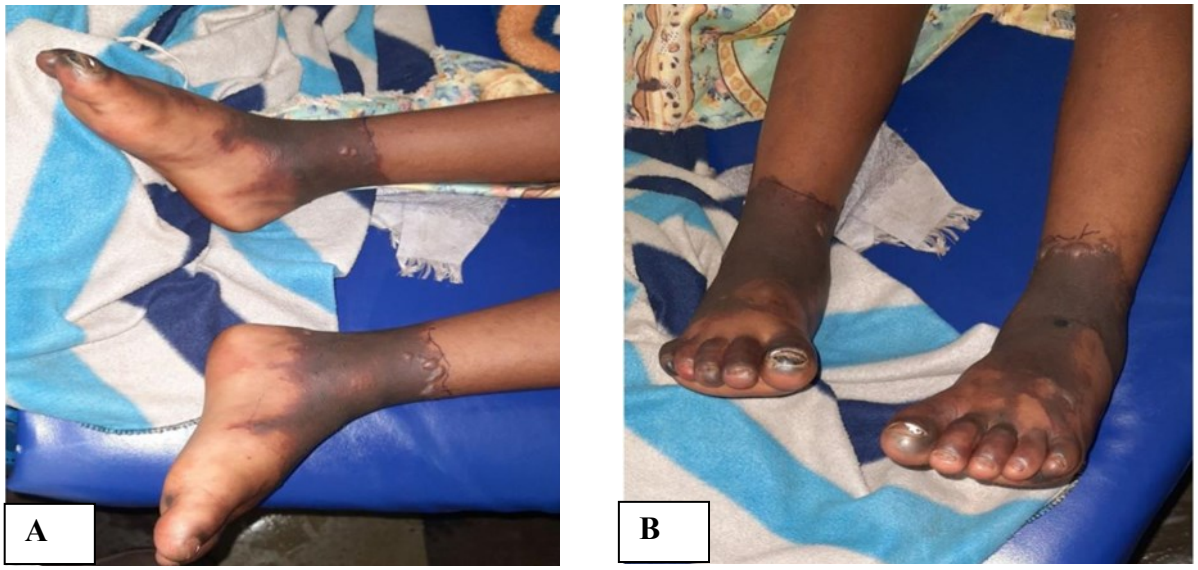

Figure 2. Gangrene of lower legs, feet and toes seen on 4th day of admission (A and B).

Discussion

Symmetrical peripheral gangrene (SPG) is a well- documented and rare clinical condition usually associated with symmetric distal ischemic damage of two or more sites leading to gangrene(1,2,6). Many reported cases resulted in different forms of disabling outcomes, with many requiring differing degrees of amputation. It is usually unexpected and comes up suddenly with significant psychological impact on the family(5,8). Like our patient, many of the cases of SPG reported are due to several different systemic illnesses, including malaria and sepsis.

The incidence of symmetric peripheral gangrene is unknown. Patients of any age group can be affected(6,8). A 1 month old young infant in Nigeria initially admitted with sepsis and he was treated with antibiotics and dopamine, he developed gangrene of distal part of all extremities(9). Another 9 month old infant in Nigeria presented with fever of 2days and admitted and managed for severe malaria and sepsis; he developed peripheral gangrene 24hours after admission (5). Another case of 63 year old woman initially diagnosed with severe malaria and hypotension; on subsequent days she developed symmetric gangrene of the extremities(10).

Cyanosis and pallor of the distal parts of the extremities are typically the first signs of the disease, symmetrically involving the upper and/or lower extremities (like our patient) and gangrene ensues in subsequent days(3).

Unlike our patient, amputation or auto-amputation is a common complication of SPG, seen in 80% of survivors. Generally causes of SPG include heart failure, hypovolemic or septic shock, sickle cell disease, malignancies, drugs (adrenaline, noradrenaline, dopamine) and infections(5). Most of the cases of SPG arising as complications of malaria is due to plasmodium falciparum(3).

No specific treatment consistently halts SPG. Treating the underlying cause and DIC is of very important. Various modalities include aggressive management with antibiotics, antimalarials; if necessary, use of anticoagulants like aspirin, coagulation factors or fluid replacement, plasmapheresis; and IV immunoglobulins with varying success. Amputation is delayed until a clear line of demarcation, followed by rehabilitation with physiotherapy(1).

Conclusions

Symmetrical peripheral gangrene is a rare but highly disabling complication of many common clinical conditions that may result in varying degree of morbidity and permanent limb disability. Early detection, prompt and appropriate treatment of acute infections and underlying problems is mandatory.

Limitations: Screenings tests for cardiovascular, rheumatologic and hematologic diseases were not done due to unavailability of tests in our hospital and/or financial constraints. Final outcome of this patient was not known even though she was discharged with significant improvement.

Abbreviations: Activated Partial Thromboplastin Time (APTT); Complete Blood Count (CBC); Hematocrit (HCT); Platelets (PLT); Prothrombin Time (PT); Symmetric Peripheral Gangrene (SPG); White Blood Cells (WBC)

Declarations

Ethical clearance and consent for participation: Informed written consent was obtained from her parents (both father and mother). The study was conducted in accordance with the Declaration of Helsinki and adhered to Good **Clinical Practice guidelines.** Confidentiality of the information was maintained by excluding names and other personal or social identifications in the case report.

Consent for publication: Written consent for publication was taken from parents.

Availability of data and materials: All materials and data are available from the corresponding author without any restriction.

Competing interest: Authors declare that they have no competing interests.

Funding: None.

Authors' contribution: HM participated in the management of this patient, propose the concept, review case reports, and prepare the case report. MS participated in the management of this patient and collect the case summary. The author(s) read and approved the final case report.

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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.

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- 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

N.B. Articles are acceptable only if NOT previously published or submitted elsewhere in print or electronic format, except in form of abstracts in proceedings of conferences.

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- 2500 words, excluding Abstracts, References, Figures and Tables. The manuscript of the Article, should appear under the following headings:
  - **A) Abstract** (vide infra)
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  - **C) Patients or (Materials) and Methods**: should contain details to enable reproducibility of the study by others. This section must include a clear statement specifying that a free and informed consent of the subjects or their legal guardians was obtained and that the study was approved by relevant institutional and/ or national ethics review board. For manuscripts on clinical trials, a copy of an ethical approval letter from the concerned body should be submitted with the manuscript. Photos of patient s should be disguised or have a written consent.

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.

- **Abstract**: The Abstracts of an Article is prepared on a separate page and contain 250 words; it should be structured under the titles: a) Background; b) Methods; c) Results; d) Conclusions. Briefly summarize the essential features of the article under above headings, respectively. Mention the problem being addressed in the study; how the study was conducted; the results and what the author(s) concluded from the results. Statistical method used may appear under the Methods paragraph of the Abstract, but do not insert abbreviations or References in the Abstract section.
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  - Type the references on a separate sheet, double spaced and keyed to the text.
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The following examples demonstrate the acceptable Reference styles.

Articles:

- Gilbert C, Foster A. Childhood blindness in the context of Vision 2020: the right to sight. Bull World Health Org 2001; 79:227-32
- 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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- Abstracts of up to 200 words; unstructured; (vide supra)
- Statistical statements here are expressed as 5/8 (62.5%)
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