Int. j. adv. multidisc. res. stud. 2024; 4(5):504-509

Received: 10-08-2024
Accepted: 20-09-2024

International Journal of Advanced Multidisciplinary Research and Studies

ISSN: 2583-049X

An Audit of Post-neonatal Infant Morbidity and Mortality from Admissions in an Emergency Unit of a Tertiary Hospital in Sokoto, Northwest Nigeria

[1] Khadijat O Isezuo, [2] Memunat Omar

[1, 2] Department of Paediatrics, Usman Danfodiyo University Teaching Hospital, Sokoto, Nigeria

DOI: https://doi.org/10.62225/2583049X.2024.4.5.3276

Corresponding Author: **Khadijat O Isezuo**

Abstract

Background

The first year of life is a critical period of adaptation for a young infant during which the child becomes exposed to a lot of infectious agents and other environmental problems as its immune systems and other organs are developing. Magnitude of deaths within the first year of life is a significant socioeconomic index of any population. Challenges can also be brought to the forefront which can be tackled by appropriate authorities.

Objectives

To assess the causes of morbidity and mortality amongst infants aged 29 days to 12 months admitted in the emergency Paediatric unit (EPU) of Usmanu Danfodiyo University Teaching Hospital (UDUTH), Sokoto over a 5- year period.

Materials and Methods

The admission records of children aged 29 days to 12 months were retrieved. Information extracted included socio-demographic data, diagnosis and outcome of admission. These were entered into a study proforma and analysed with SPSS version 23.

Results

Total admissions were 1776 in the five-year review. Majority were males accounting for 1030 (58%) with M:F ratio of 1.38:1. 972 (55.4%) were aged 6 to 12 months. Top causes of admissions were diarrhoea disease 328 (18.5%), pneumonia 280 (15.8%), sepsis 211 (11.9%), malaria 202 (11.4%) and malnutrition 154 (8.7%). Mortalities were 223 (12.6%). Highest fatalities out of 223 were from sepsis 47 (21.1%), pneumonia 40 (17.9%), malaria 27 (12.1%), malnutrition 25 (11.2%) and diarrhoea disease 20 (9.0%). Higher proportion of the mortalities were in females 14.5% vs 11.2% ($X^2 = 4.3$; p=0.038). Sepsis mortality was high throughout likewise pneumonia but mortality pattern of other disease conditions varied throughout infancy.

Conclusion

Post-neonatal admissions were mainly due to infections, likewise mortality of which the top causes varied throughout infancy. Females were more proportionately affected by mortality. These insights on the morbidity and mortality patterns calls for more concerted efforts on child survival strategies and targeting this group of infants is imperative.

Keywords: Post-neonatal, Infant, Morbidity, Mortality, Emergency, Sokoto

Introduction

The first year of life is a critical period of adaptation for a young infant during which the child becomes exposed to a lot of infectious agents and other environmental problems as its immune systems and other organs are developing. Infant mortality includes all deaths before the 1st birth day per 1000 live births including the neonatal age (0 – 28 days) [1], while post-neonatal mortality rate is defined as deaths from 29 days till 364 days of life [2]. Some studies in the continent cite post-neonatal causes of morbidity and mortality as any child death outside the neonatal age with upper limits extending up to 15 years which may be confusing when data are needed for policy making. Nevertheless, a deeper analysis of post-neonatal infant morbidity and mortality is warranted as magnitude of deaths within the first year of life is a significant socioeconomic index of any population [2]. Infants are the most vulnerable members of the society and their wellbeing is indicated by their mother's welfare, pre and post-natal care, access to clean water and overall gender equality [3, 4].

Post-neonatal hospitalization has been defined as admission to the hospital on any day between the 29th day of life and the 365th day [2]. This may be in any ward of the hospital be it neonatal, paediatric or surgical wards [5]. However, the emergency paediatric unit is the entry point of most infant emergencies into the hospital except for the neonatal age group. While some surgical conditions (eg anorectal malformations) present directly to the surgical emergency, others may present as medical emergencies to the paediatric emergency (eg intussusception).

The post-neonatal period up to 1 year is the major portion of the infancy period. The infant mortality rate which includes neonatal deaths is one of the most sensitive indicators of population health [2, 6]. Poor social, economic and environmental conditions contribute to high infant mortality. High rates of infant mortality also form a major proportion of child deaths, (up to 5 years) and above [1]. In a multi-centre study by Samantha in South Africa [7], post-neonatal mortality accounted for 48.3% of deaths in age 29 days to 18 years children, while from a recent review in study area [8], it accounted for 32.8% of deaths from 29 days to 15 years children.

The issue of unreliable statistics in the countries where the burden of disease is highest has also been brought to fore in recent literature with calls for collection of better quality data in these areas [9]. Challenges can also be brought to the forefront which can be tackled by appropriate authorities. This is a review over 5 years to assess causes of post-neonatal infant morbidity and mortality in an emergency unit of a tertiary health facility.

Materials and Methods

The study was carried out at the Emergency Paediatric Unit (EPU) of Usmanu Danfodiyo University Teaching Hospital (UDUTH), Sokoto which is a tertiary health facility as part of a five-year study on the pattern and outcome of admissions in the EPU [8]. It was conducted from January 2017 to December 2021. The study subjects comprised all children below 1 year but excluded neonates ie only post-neonatal infants admitted into the EPU during the period. The admission records in the unit inputted by the nurses and health information officers every day was accessed. The information entered into the proforma were age, gender, diagnosis and outcome. Age was categorized using standard paediatric age group classification into infants aged > 1 month to 3 months, 4 months to 6 months, 7 months to 9 months and 10 months to 12 months.

Data was analysed using IBM SPSS statistical software version 23. Mean and standard deviation was done for the continuous variables such as age. Frequency and proportions were used for categorical variables such as age groups, gender, type of diagnosis, month of admission and outcome. These were presented as tables and charts. Chi square or Fisher's Exact test was used to compare outcomes of different diagnosis based on age group, gender and period of admission. A p-value of <0.05 was considered statistically significant.

Results

Age and gender distribution

Out of the 6088 total admissions of children aged 1 month to 15 years in the five-year review, 1776 (29.2%) were infants aged 29 days to 12 months. Males accounted for 1030 (58%) with M:F ratio of 1.38:1. 978 (55.1%) were aged 7 to 12 months and less than 20% were aged less than 29 days to 3 months. There was no significant difference in the age and gender distribution as shown in Table 1.

Table 1: Age and gender distribution of admitted post-neonatal infants

	Gender				
Age range	**Male**	**Female**	**Total**	**Test statistic**	**p-value**
29 days to 3 mo	206 (61.3)	130 (38.7)	336 (18.9)	$\chi^2 = 4.2$	0.24
4 mo – 6 mo	270 (58.4)	192 (41.6)	462 (26.0)		
7 mo – 9 mo	260 (59.1)	180 (40.9)	440 (24.8)		
10 mo – 12 mo	294 (54.6)	244 (45.4)	538 (30.3)		
Total	**1030 (58.0)**	**746 (42.0)**	**1776 (100.0)**		
Mean age (months)	**7.2 ± 3.4**				

mo = months

Cumulative monthly distribution of admissions and mortalities of post-neonatal infants

Majority of the infants were admitted in the months of November and April accounting for 185 (10.4%) and 180 (10.1%) respectively while fewest admissions were in the months of July 98 (5.5%) and June 112 (6.3%) respectively and this is displayed in Fig 1. Cumulative mortality was highest however in April and October.

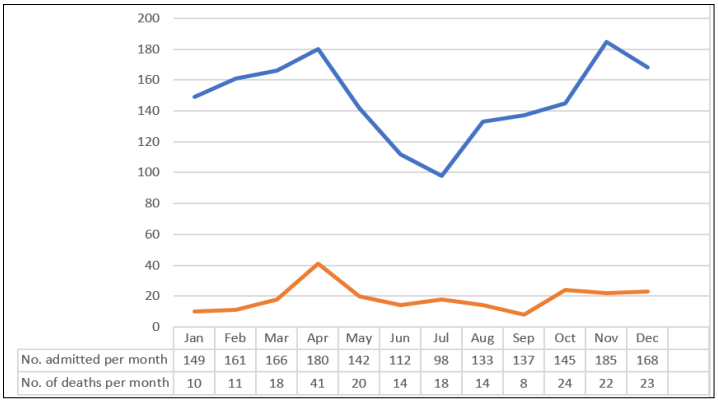
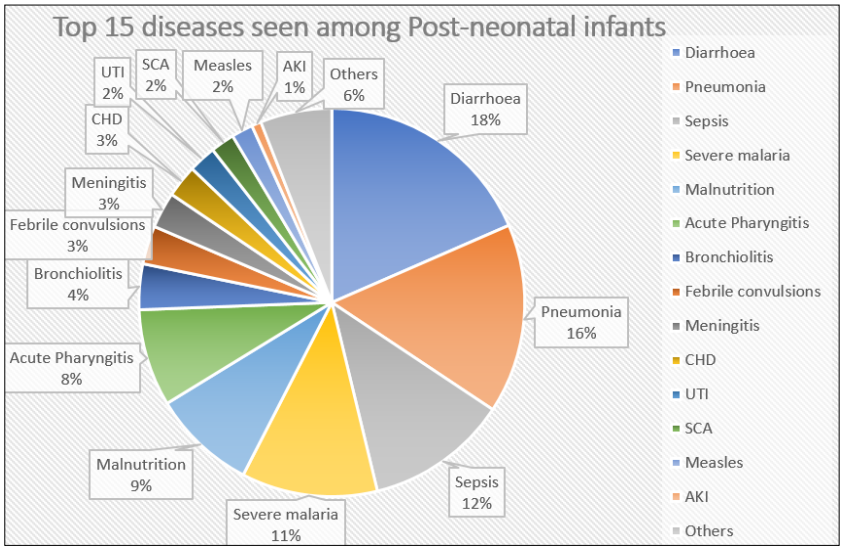


Fig 1: Cumulative distribution of admissions and mortality of post-neonatal infants over 5 years



CHD=Congenital Heart Disease; UTI=Urinary Tract Infection; SCA=Sickle Cell Anaemia; AKI=Acute Kidney Injury

Fig 2: Pie chart showing pattern of diseases among the post-neonatal infants

Table 2: Age distribution of different diagnosis

Diagnoses	Age distribution (months)				Total
	<3	4-6	7-9	10-12	
Diarrhoea disease	46 (14.0)	96 (29.3)	94 (28.7)	92 (28.0)	328 (18.5)
Pneumonia	73 (26.1)	96 (34.3)	61 (21.8)	50 (17.9)	280 (15.8)
Sepsis	58 (27.5)	64 (30.3)	43 (20.4)	46 (21.8)	211 (11.9)
Severe malaria	20 (9.9)	41 (20.3)	51 (25.2)	90 (44.6)	202 (11.4)
Severe acute malnutrition & FTT#	19 (12.3)	20 (13.0)	40 (26.0)	75 (48.7)	154 (8.7)
Acute pharyngotonsillitis	7 (4.9)	24 (16.8)	56 (39.2)	56 (39.2)	143 (8.1)
Bronchiolitis	32 (47.1)	18 (26.5)	7 (10.3)	11 (16.2)	68 (3.8)
Febrile convulsions*	0 (0.0)	15 (16.9)	14 (25.0)	27 (48.2)	56 (3.2)
Meningitis	9 (17.0)	24 (45.3)	8 (15.1)	12 (22.6)	53 (3.0)
Congenital heart disease	22 (45.8)	20 (41.7)	4 (8.3)	2 (4.2)	48 (2.7)
Urinary tract infection	5 (12.2)	10 (24.4)	17 (41.5)	9 (22.0)	41 (2.3)
Sickle cell disease	0 (0.0)	7 (20.0)	14 (40.0)	14 (40.0)	35 (2.0)
Measles	0 (0.0)	7 (21.9)	8 (25.8)	17 (53.1)	32 (1.8)
Acute kidney injury	6 (40.0)	5 (33.3)	2 (13.3)	2 (13.3)	15 (0.8)
Others*	29 (8.6)	24 (5.2)	21 (4.8)	35 (6.5)	110 (6.2)
Total	336 (18.9)	462 (26.0)	440 (24.8)	538 (30.3)	1776 (100)
(χ^2 = 14.7, p = 0.001)					

* tuberculosis, tetanus, intussuception, diphtheria, HIV, accidental ingestions, asthma etc
*febrile convulsions causes: Malaria, Acute pharyngitis, UTI, Diarrhoea disease
Failure to thrive

Pattern of diseases seen among the admitted post-neonatal infants

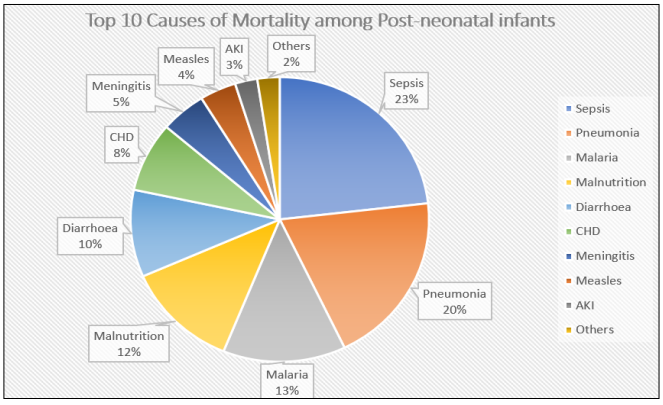
Top indications for admissions were diarrhoea disease 328 (18.5%), pneumonia 280 (15.8%), sepsis 211 (11.9%), malaria 202 (11.4%) and malnutrition 154 (8.7%) as shown in Fig 2. The top four indications were infections which accounted for 57% of the total.

Age distribution of diagnosis

Table 2 showed the ages of the infants stratified three-monthly and the distribution of the different diagnoses by age. While sepsis, pneumonia and meningitis were more in those less than six months, diarrhoea, malaria and malnutrition were more in those above six months.

Outcome of the admissions

Majority 1553 (87.4%) were either discharged or transferred from the emergency while mortalities accounted for 223 (12.6%). The highest fatality was from sepsis with 47 deaths (21.1%), pneumonia was 40 (17.9%), malaria was 27 (12.1%), and malnutrition was 25 (11.2%) while diarrhoea was 20 (9.0%). Fig 3 shows the top 10 causes of mortality among the infants.



CHD=Congenital Heart Disease; AKI=Acute Kidney Injury

Fig 3: Pie chart showing top 10 causes of mortality among the post-neonatal infants

Distribution of mortalities by age and gender

A higher proportion of the mortalities were in females 14.5% vs 11.2% which was statistically significant as shown in Table 3 ($X^2 = 4.3$; p=0.038). Table 4 shows the percentage of mortality by age category which was actually constant (12.5% and 12.6%) throughout infancy with no difference statistically ($X^2 = 0.006$; p=1.0).

Table 3: Distribution of outcome of mortality by gender

	Outcome				
Gender	**Alive (%)**	**Died (%)**	**Total (%)**	**Test statistic**	**p-value**
Male	915 (88.8)	115 (11.3	1030 (58.0	$\chi^2 = 4.32$	0.04
Female	638 (85.5)	108 (14.5)	746 (42.0)		
Total	**1553 (87.4)**	**223 (12.6)**	**1776 (100.0)**		

Table 4: Distribution of outcome of mortality by age

	Outcome				
Age range	**Alive (%)**	**Died (%)**	**Total (%)**	**Test statistic**	**p-value**
29 days to 3 mo	294 (87.5)	42 (12.5)	336 (18.9)	$\chi^2 = 0.006$	1.0
4 mo – 6 mo	404 (87.4)	58 (12.6)	462 (26.0)		
7 mo – 9 mo	385 (87.5)	55 (12.5)	440 (24.8)		
10 mo – 12 mo	470 (87.4)	68 (12.6)	538 (30.3)		
Total	**1553 (87.4)**	**223 (12.6)**	**1776 (100.0)**		

Distribution of mortalities by age and diagnosis

Fig 4 shows the trend of percentage of total mortality by age category and diagnosis. Sepsis was the topmost consistently throughout the post-neonatal period followed by pneumonia which dipped by 7 to 9 months. Congenital heart disease which was the 3rd highest cause of mortality at age less than 3 months, was also high by 4 to 6 months then reduced significantly subsequently. Percentage mortality from diarrhoea disease was highest at 4 to 6 months. Other conditions such as complicated malaria, malnutrition, measles and meningitis gradually increased in percentage mortality throughout the post-neonatal infancy period.

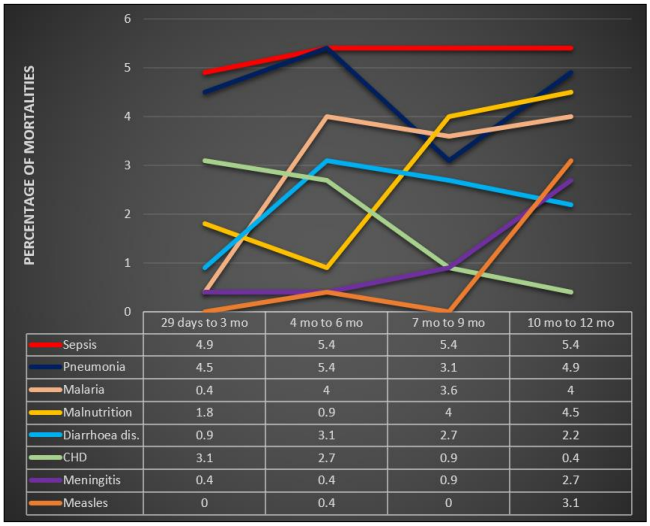


Fig 4: Showing the percentage mortality of each disease condition in relation to age

Discussion

The study assessed the morbidity and mortality pattern of admitted post-neonatal infants in a tertiary facility over five years. Peak admissions months were in April and November which coincides with hot dry and onset of the cold dry seasons respectively. Highest mortalities were also during this period. These dry seasons are usually windy too facilitating spread of infectious agents.

The highest proportion admitted were those aged 10 to 12 months of age. This is possibly due to increased rates of infections from exposure as the infant grows as he /she is no more sheltered as before and becomes more exploratory thereby coming in contact with more microbes in the environment [1]. In a study on top five causes of infant admissions in a Bangladesh facility, the peak age was two months, probably because congenital disorders was among the top causes for admissions in their study [10].

More of the patients were male, however, this was not statistically significant. Other authors have similarly reported male predominance [10, 11]. Males are more in the general population probably accounting for this [12], however, it may also be due to selective presentation of males for care vs females due to cultural preference. This has been recognized in some areas in India where female infants are even being killed as they are viewed as a financial burden [12, 13].

Despite the higher proportion of male admissions, proportionate mortality was significantly higher in females than males. This is despite the genetically conferred immunological advantage of the female gender with two X chromosomes which encodes for immunity related genes [14]. Higher proportion of mortality in females in these settings have been linked to possibly late presentation with more severe illness, however, this would need a more controlled prospective study to ascertain this. Other authors have found that male infants were more at risk of death during the neonatal age and thereafter the advantage becomes more in favour of them due to environmental factors like proper child-care and feeding practices rather only biological reasons alone [13]. However, globally, mortality is higher in males than females due to the sheer numbers they have in comparison [12].

Infections were the four top main indications for admission accounting for almost 60% which may reflect the poor hygienic environs and care that these infants may be subject to. However, in a developed country in Europe, Iaccobelli [5] reported that 40.2% of admissions among similar subset of post-neonatal infants were due to infections. This high rate of infections could additionally reflect infants' susceptibility to infectious organisms regardless of location due to their immature immune system. The top infection in their series was bronchiolitis followed by gastroenteritis [5], while it was diarrhoea in our setting followed by pneumonia. Jalal Uddin [10], from a Bangladesh facility reported acute respiratory infection as top followed by acute watery diarrhoea amongst the post-neonatal infants in their facility. Waldearegawi, in Ethiopia [6] also opined that infections and parasites were the major causes in that country and the undeveloped countries bore the greater burden worldwide, in spite of concerted efforts to lessen the burden.

Acute diarrhoea was the top cause of admission but was responsible for less deaths as it ranked as top 5th cause of mortality. This could be due to better management of its complications (mainly dehydration) as compared to three decades back when it was top cause of mortality among post-neonatal infants in a report by Ibrahim [11]. Pneumonia was the 2nd commonest diagnosis at admission and also 2nd top cause of mortality while sepsis was the 3rd commonest cause of admission and topmost cause of mortality. It is worthy to note here that most of the cases of sepsis were probable

(diagnosed clinically and/ or in combination with supportive investigations like elevated white cell counts and acute phase reactants). Majority could not have a microbial diagnosis which is a predominant problem faced in the countries health facilities.

Morbidity pattern changed with age. Acute diarrhoea peaked from 4 months till end of infancy, while pneumonia and sepsis were highest at 4 to 6 months. Other infections like complicated malaria and measles start gaining dominance after 6 months of life when maternal immunity passed to the infant had most likely waned.

Malnutrition was the 5th in line as top cause of admissions in this study. Its onset typically emerges when complementary feeding is inappropriate from 6 months of life. Those with failure to thrive aged below 6 months were captured under malnutrition in this study. It was however the 4th top cause of mortality even though, it has been reported to underlie many infectious conditions causing mortality [15]. Nutritional status was not accessible for all the patients from the data source in the index study, so this assertion was not established.

The main causes of mortality in this study were from sepsis (21.1%), pneumonia (17.9%), malaria (12.1%), malnutrition (11.2%) and diarrhoea disease (9.0%). In the study reported over three decades ago by Ibrahim in UDUTH Sokoto [11], diarrhoea disease (35.0%), pneumonia (22.8%), sepsis (13.7%), anaemia (10.3%) and measles (4.9%) were the commonest causes of mortality in the post-neonatal cohort. Another old study in Lagos at similar period by Ekanem [16], showed diarrhoea topped the list (14.7%) followed by malnutrition (11.4%), pneumonia (8.8%) and meningitis (4.4%) in the similar age bracket. This analysis shows probable changing causes of top mortality in post-neonatal infants despite still being infectious diseases mainly.

When pattern of mortality was analysed with age, interesting findings were that sepsis mortality was constantly high throughout infancy, while pneumonia was also high but reduced slightly at age 7 to 9 months probably due to onset of mortality from malaria and malnutrition at those ages. Congenital heart disease was third common cause from 29 days to 3 months and dropped gradually after 4 to 6 months. Acute diarrhoea also dropped as a cause of mortality slightly after 6 months of age. Malaria, malnutrition, measles and meningitis all rose steadily as causes of mortality after 6 months of age.

The proportion of mortality was however constant when analysed with age. Some have suggested that younger infants may be more vulnerable given their maturity and immune status, however given different pattern of diseases based on exposure, the proportion of mortality was constant at 12.5%/12.6% from less than 29 days up to 12 months. It was observed as noted above that some infections occurred more in those less than 6 months while others predominated in older infants possibly explaining the constant mortality proportion by age.

In the study by Bassat [15], malnutrition was found to contribute as the main underlying cause of death. Minimally invasive tissue sampling was done to ascertain an infection link and this was present in the causal chain in 86.9% of cases. It substantiated the link between malnutrition and infection. Such studies on ascertaining the infectious agents are also important in guiding antimicrobial therapy. In that study, lower respiratory infection was present in the causation of death in about 50%, sepsis in 39.4%, malaria in 19.5% and diarrhoea in 14.2%. While in Singapore, Chong [17] found that deaths were related to respiratory causes in 68.1% of total cases.

Conclusion

The study showed that infections contributed highly to morbidity and mortality during the post-neonatal period. Males were more in proportion but females had higher proportionate mortality. Sepsis and pneumonia were top causes of mortality. Diarrhoea disease was the top morbidity but caused less mortality compared to a previous review. The pattern of mortality showed individual disease contribution varied with age while sepsis mortality was high constantly. There is need for concerted efforts by all cadres of health workers and Government at all levels to reduce the burden of disease in this vulnerable group.

Limitations

Being a retrospective study, some data may be missing or not correctly recorded. Some of the diagnosis were not microbiologically confirmed.

Lines of future study

Encouraging such studies in tertiary facilities such as assessing the contribution of neonatal mortality to infant deaths, likewise infant mortality (neonatal and post-neonatal) as a component of under-five mortality. Also, assessing the pattern of presentation according to gender vis-a-viz the outcome throughout childhood. These would help contextualize the disease burden in the country better for holistic interventions.

Author's contributions

KOI conceptualized the study and wrote the first draft. MO contributed to the concept, manuscript writing and review. Both authors conducted the literature searches, data collection, read and approved the final draft.

They declare no potential conflicts of interest in this research work.

No external source of funding was used for this project except authors' personal funds.

Acknowledgements

We acknowledge all those who participated in the care of the patients.

References

1. OECD/World Health Organization. "Infant mortality", in Health at a Glance: Asia/Pacific 2020: Measuring Progress towards Universal Health Coverage, OECD Publishing, Paris, 2020. Doi: https://doi.org/10.1787/f7b3e551-en.
2. Tashiro A, Yoshida H, Okamoto E. Infant, neonatal, and postneonatal mortality trends in a disaster region and in Japan, 2002–2012: A multi-attribute compositional study. BMC Public Health. 2019; 19:1085. Doi: https://doi.org/10.1186/s12889-019-7443-4.
3. Wolfe D. Infant mortality: Tragic, unjust… and usually preventable, Nov 15, 2021. https://wwwworldvisionca/stories/health/infant-mortality-rate.
4. Ezeh OK, Agho KE, Dibley MJ, Hall JJ, Page AN. Risk factors for postneonatal, infant, child and under-5 mortality in Nigeria: A pooled cross-sectional analysis. BMJ Open. 2015; 5(3):e006779. Doi: 10.1136/bmjopen-

2014-006779.
5. Silvia Iacobelli, Evelyne Combier, Adrien Roussot, Jonathan Cottenet, Jean-Bernard Gouyon Catherine Quantin. Gestational age and 1-year hospital admission or mortality: A nation-wide population-based study. BMC Pediatrics. 2017; 17:28.
6. Weldearegawi B, Melaku YA, Abera SF, *et al*. Infant mortality and causes of infant deaths in rural Ethiopia: A population-based cohort of 3684 births. BMC Public Health. 2015; 15:770. Doi: https://doi.org/10.1186/s12889-015-2090-x.
7. Samantha M. Paediatric deaths within the first 24 hours in a metropolitan hospital system, South Africa. Nigerian Journal of Paediatrics. 2019; 46(4).
8. Isezuo K, Sani U, Waziri U, Garba B, Adamu A, Jiya F, *et al*. Patterns and outcomes of Emergency Pediatric Unit admissions in Usmanu Danfodiyo University Teaching Hospital in Sokoto State, Nigeria: A five-year review. Pyramid Journal of Medicine. 2024; 7:498. Doi: 10.4081/pjm.2024.498.
9. Hama Diallo A, Meda N, Sommerfelt H, Traore GS, Cousens S, Tylleskar T. PROMISE-EBF Study Group. The high burden of infant deaths in rural Burkina Faso: A prospective community-based cohort study. BMC Public Health. 2012; 12:739.
10. Jalal Uddin M, Sultana K, Baidya C, Akhter N. Top Five Indications of Hospital Admission of Infants. Chattogram Maa-O-Shishu Hospital Medical College Journal. 2022; 21(1):3-6.
11. Ibrahim M, Udoma M, Abdulwahab I. Infant mortality at Usmanu Danfodiyo University Teaching Hospital, Sokoto. Nig J Paed. 1993; 20:17-20.
12. Ranking of the 20 countries* with the highest infant mortality rate in 2024 (child deaths in the first year of life per thousand live births). https://www.statista.com/statistics/264714/countries-with-the-highest-infant-mortality-rate/.
13. Katz J, WestJr K, Khatry S, Christian P, LeClerq S, Pradhan E, *et al*. Risk factors for early infant mortality in Sarlahi district, Nepal. Bulletin of the World Health Organization. 2003; 81:717-725.
14. Schurz H, Salie M, Tromp G, Hoal EG, Kinnear CJ, Möller M. The X chromosome and sex-specific effects in infectious disease susceptibility. Hum Genomics. 2019; 13(1):2. Doi: 10.1186/s40246-018-0185-z.
15. Bassat Q, Blau DM, Ogbuanu IU, Samura S, Kaluma E, Bassey IA. Child Health and Mortality Prevention Surveillance (CHAMPS) Network. Causes of Death among Infants and Children in the Child Health and Mortality Prevention Surveillance (CHAMPS) Network. JAMA Netw Open. 2023; 6(7):e2322494.
16. Ekanem EE. Causes of neonatal and postneonatal mortality in Nigerian children. Early Child Development and Care. 1990; 57(1):9-13.
17. Chong S. A Review of Infantile Deaths in the Children Emergency, Singapore. Pediatr Res. 2010; 68(Suppl 1):640. Doi: https://doi.org/10.1203/00006450-201011001-01292.