

Survey and mapping of the leading causes of childhood mortality in Nigerian tertiary hospitals

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Received – 03 May 2016

Initial Review – 15 May 2016

Published Online – 23 Sep 2016

ABSTRACT

Background: Despite the modest gains made under the millennium development goals, indices of child health for Nigeria remain poor. Improvement on these indices requires mitigating the causes of childhood mortality. **Objective:** We undertook this study to determine the leading cause(s) of childhood mortality in Nigeria from 2005 to 2009. **Methods:** Using stratified random sampling techniques, data on demographics and cause(s) of death of under-five children, who had died between 2005 and 2009, were collected from the patients' records of seven teaching hospitals. Data were analyzed using IBM SPSS version 20.0. **Results:** The leading causes of childhood mortality from this survey were neonatal sepsis (30.1%), asphyxia (27.2%), preterm complications (25.8%), and acute respiratory illness (15.3%). Analysis of causes of death by geopolitical zones did not indicate any definite pattern, although the North-Central and South-West had the highest deaths due to respiratory tract infections. The highest death records from human immunodeficiency virus/acquired immune deficiency syndrome came from North-East. In addition, Lagos in South-West was the most likely to have recorded death due to malaria ($p < 0.05$). Preterm complications and neonatal sepsis accounted for the majority of the causes of death in low birth weight babies, whereas neonatal sepsis and asphyxia accounted for the majority of the causes of death in the appropriate birth weight group. **Conclusions:** This study supports the results of previous ones that childhood mortality was due to illnesses that were preventable and treatable. Knowledge of the causes and pattern of childhood mortality is essential to enable the health authorities to scale up appropriate interventions to reduce the burden. This will help the country to meet the target of reducing under-five mortality by two-thirds, few years after 2015.

Key words: Childhood mortality, Geopolitical zones, Mapping, Preventable illnesses, Survey, Tertiary hospitals

Maternal and child mortality rates are important indices of the level of development of countries. Due to socioeconomic instability, poor health systems among other factors, Africa is reputed to have one of the worst maternal and child health indices in the world (United Nations Children's Fund) [1-3]. Of approximately 10.8 million global child deaths annually, 41% occur in Africa, South of Sahara. Among African countries with little or no change in these indices, Nigeria features prominently [4]. For example, nearly 1 million of 5.9 million babies born in Nigeria every year die before their fifth birthday [5]. Although child deaths have reduced in Nigeria, the rate of decline is not sharp enough to attain the

millennium development goal (MDG) 4 target, which is a two-thirds reduction in maternal and child death by 2015.

While newborns die from various conditions associated with the delivery, older children die from common and preventable infectious diseases such as acute respiratory infections (ARI), malaria, diarrhea, vaccine-preventable diseases, and human immunodeficiency virus (HIV)/acquired immune deficiency syndrome (AIDS). Malnutrition is an underlying predisposing and aggravating factor in over half of these deaths [4]. A group of workers examined the pattern of childhood deaths in a Nigerian tertiary hospital which serves about three states of the federation in the South-western region between 1996 and 2005 and concluded

that the causes of the deaths were mostly infectious and other preventable conditions [6]. Childhood morbidity and mortality in Nigeria have also been associated with highly prevalent diseases such as malaria, HIV/AIDS, diarrhea, and bacterial infections [7-11]. These deaths have significant socioeconomic implications on national development; thus, emphasizing the need for improved health care to reduce childhood mortality.

This study sets out to estimate retrospectively the leading causes of child deaths in Nigeria from 2005 to 2009 in the six geopolitical zones of Nigeria and also identify any zonal-specific factors that may be associated with death rate. In addition, it would help to focus national programs on prevention of childhood deaths in Nigeria. This is the first known investigation to the best of our knowledge in tertiary hospitals in the five of the six geopolitical zones of Nigeria studied.

METHODS

Study Design

This was a retrospective study that looked at the most frequent causes of under-five mortality in seven tertiary hospitals in Nigeria.

Sampling

A multistage sampling procedure that entails the use of stratified, simple random, and purposive sampling techniques was used for the selection of hospitals for study. For the purpose of this study, having had the states stratified according to the six geopolitical zones, the country is divided into one or two state(s) was/were randomly selected from each geopolitical zone. Subsequently, tertiary hospitals from the selected states were purposively selected for the study. The states covered included Rivers, Enugu, Ogun, Lagos, Borno, Kwara, Plateau, and Sokoto states representing the South-South, South-East, South-West, North-East, North-Central (Kwara and Plateau), and North-West geopolitical zones of Nigeria, respectively.

Study Sites

The hospitals included as study sites were the University of Maiduguri Teaching Hospital, Borno State; Lagos University Teaching Hospital, Idi Araba, Lagos State; Olabisi Onabanjo University Teaching Hospital, Sagamu, Ogun State; University of Ilorin Teaching Hospital, Ilorin, Kwara State; University of Port Harcourt, Rivers State; University of Nigeria Teaching Hospital, Enugu State; Jos University Teaching Hospital, Jos, Plateau State.

Data Collection

Deidentified data were extracted from the medical records of deaths among under-five children. Data collection tools were structured to give information on the birth order, age at death, and cause(s) of death. The information was extracted from the hospital records of the children in the Teaching hospitals.

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board of the Nigerian Institute of Medical Research (IRB/10/106) and concurrent of the relevant IRBs of the study sites. Only hospital personnel in charge of such records were allowed to collect data from the hospital records.

Statistical Analysis

Data analysis was carried out using IBM SPSS Statistics version 20.0. Cause(s) of death was(were) disaggregated by age group and geopolitical zones. Test of association between cause(s) of death and geopolitical zone and cause(s) of death and age group was done.

RESULTS

A total of 3174 of deaths among under-five children were recorded. These comprise 1678 (52.9%) males, 1448 (45.6%) females, and in 48 (1.5%) cases, the sex of the children was not indicated in the record. Of the 3174 cases, 2300 (72.5%) were vaginal delivery, whereas 401 (12.6%) were delivered by cesarian section. The mode of delivery for the remainder 473 (14.9%) was not specified. The mean gestational age at birth was 36.1 weeks, whereas the mean birth weight was 2.31 kg. A total of 793 (25.0%) children had low birth weight. The mean age of their mothers at birth was 28.1 years, whereas 59.2% of the cases were first, second, or third births of their respective mothers.

The mortality pattern according to birth weight is shown in Table 1. Preterm complications and neonatal sepsis accounted for the majority of the deaths in low birth weight babies, whereas neonatal sepsis and asphyxia accounted for the majority of the causes of death in the appropriate birth weight group. Table 2 shows the death by birth order and the first born children account more for deaths (27%), although 18.7% case records did not indicate the birth order.

The leading cause of mortality from this survey was neonatal sepsis, (30.1%) followed by asphyxia (27.2%), preterm complications (25.8%), and acute respiratory illness (15.3%) (Table 3). The other causes included severe hyperbilirubinemia with suspected kernicterus as the cause of death among the cases with jaundice, congenital abnormalities, non-communicable diseases (NCD), and pneumonia among others. Chi-square analysis for the causes of death by age showed significance for all the causes of death except acute respiratory illness, sudden death, pertussis, and sickle cell anemia (Table 3). The analysis indicated that neonates and infants were more likely to die than children over 1 year of age.

Analysis of causes of death by geopolitical zones did not indicate any definite pattern, although the North-Central (Kwara and Plateau States) and South-West (Lagos and Ogun States) have recorded more deaths due to respiratory illnesses, whereas Lagos has recorded more deaths due to malaria ($p < 0.05$) (Fig. 1).

Table 1: Mortality pattern among birth weight categories

Diseases	Birth weight <2.5 kg	Birth weight ≥2.5 kg	Birth weight not indicated	Total
	Number of children n=795 (%)	Number of children n=676 (%)	Number of children n=1703 (%)	Number of children n=3174 (%)
Preterm complications	482 (60.6)	9 (1.3)	177 (10.4)	668 (21.0)
Neonatal sepsis	311 (39.1)	217 (32.1)	390 (22.9)	918 (28.9)
Asphyxia	234 (29.4)	243 (35.9)	262 (15.4)	739 (23.3)
Jaundice	147 (18.5)	73 (10.8)	160 (9.4)	380 (12.0)
ARI	138 (17.4)	120 (17.8)	344 (20.2)	602 (19.0)
Congenital Abnormalities	63 (7.9)	115 (17.0)	188 (11.0)	366 (11.5)
Anemia	33 (4.2)	25 (3.7)	89 (5.2)	147 (4.6)
Non-communicable diseases, e.g., nephrotic syndrome, acute glomerulonephritis	32 (4.0)	45 (6.7)	153 (9.0)	230 (7.2)
HIV/AIDS	15 (1.9)	27 (4.0)	125 (7.3)	167 (5.3)
Pneumonia	11 (1.4)	63 (9.3)	147 (8.6)	221 (7.0)
Meningitis	10 (1.3)	39 (5.8)	120 (7.0)	169 (5.3)
Neonatal tetanus	7 (0.9)	25 (3.7)	58 (3.4)	90 (2.8)
Chronic respiratory infection	3 (0.4)	14 (2.1)	58 (3.4)	75 (2.4)
Sudden death	3 (0.4)	0 (0.0)	10 (0.6)	13 (0.4)
Diarrhea	3 (0.4)	13 (1.9)	166 (9.7)	182 (5.7)
Accident	1 (0.1)	7 (1.0)	37 (2.4)	45 (1.4)
Pertussis	1 (0.1)	0 (0.0)	3 (0.2)	4 (0.1)
Poisoning	0 (0.0)	0 (0.0)	8 (0.5)	8 (0.3)
Malaria	0 (0.0)	10 (1.5)	151 (8.9)	161 (5.1)
Measles	0 (0.0)	0 (0.0)	19 (1.1)	19 (0.6)
Sickle cell anemia	0 (0.0)	2 (0.3)	15 (0.9)	17 (0.5)

ARI: Acute respiratory infections, HIV: Human immunodeficiency virus, AIDS: Acquired immune deficiency syndrome

Table 2: Death by birth order

Position of index child in the family (birth order)	Number of children (%)
1	858 (27.0)
2	575 (18.1)
3	449 (14.1)
4	273 (8.6)
5	171 (5.4)
6	128 (4.0)
7	53 (1.7)
8	35 (1.1)
9	15 (0.5)
10	12 (0.4)
11	4 (0.1)
12	3 (0.1)
13	3 (0.1)
Position not indicated	595 (18.7)
Total	3174 (100.0)

DISCUSSION

Childhood mortality rates remain an important index of a country's level of development and Nigeria measures poorly on this index, globally, as well as among her West African neighbors. Children in

sub-Saharan Africa are more than 15 times more likely to die before the age of five than children in developed regions [12]. According to the WHO report, about half of under-five deaths occur in only five countries: China, Democratic Republic of Congo, India, Nigeria, and Pakistan [2]. India (21%) and Nigeria (13%) together accounted for more than a third of all under-five deaths [2], although Nigeria was making progress according to UNICEF [13].

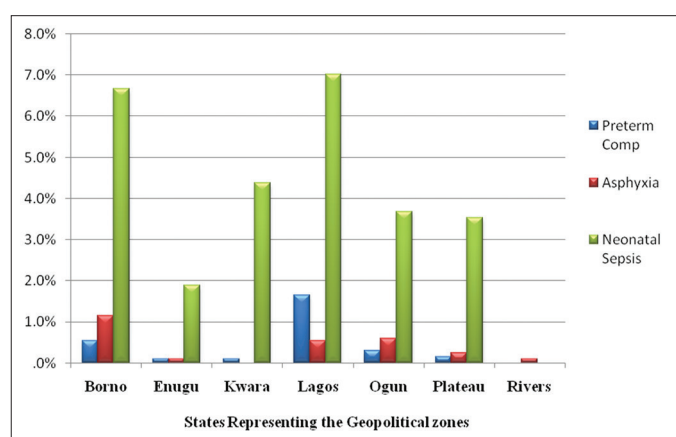
Among infants and children, congenital abnormalities, pneumonia, and NCD were the major causes of death in contrast to neonatal sepsis and asphyxia which was relatively absent among children and in low numbers among infants. Tetanus was not found as a cause of death in both children and infants. These conditions were also not associated with low birth weights. The commonly occurring conditions among this group were preterm complications, neonatal sepsis, and asphyxia, although asphyxia was found to be higher among those with healthy or appropriate birth weight children. A recent finding by Watkins et al. [14] attributed low birth weight to be associated with infant and later child occurring as a result of perinatal factors and congenital malformations. In the low birth weight group, their results showed that approximately 50% of the deaths were due to perinatal events (prematurity were the main causes) and congenital abnormalities. The latter corroborates the outcome of our retrospective study.

The mean birth weight of the children in this study was 2.31 kg which was classified as low birth weight (below 2.5 kg).

Table 3: Leading causes of death according to age group

Causes of death	Children	Infants	Neonates
Neonatal sepsis	0.2	2.4	30.1
Asphyxia	0.1	1	27.2
Preterm complications	0.1	1.6	25.8
ARIs	1.4	2.9	15.3
Neonatal jaundice	0	1	12.2
Congenital abnormalities	0.6	3.7	8.3
Neonatal anemia	0	0.4	4.1
Neonatal tetanus	0	0	2.6
Pneumonia	1.3	3.3	2.2
Non-communicable diseases	1.7	2.6	2.2
Meningitis	0.9	2.1	1.1
HIV/AIDS	1.3	1.9	0.9
Chronic respiratory infections	0.2	0.7	0.5
Accident	0.3	0	0.5
Sudden death syndrome	0.1	0.1	0.1
Malaria	0.8	1.2	0.1
Diarrhea	1.2	2.2	0.1
Poisoning	0.1	0	0
Measles	0.3	0	0
Sickle cell	0	0.2	0
Pertussis	0.1	0	0

ARI: Acute respiratory infections, HIV: Human immunodeficiency virus, AIDS: Acquired immune deficiency syndrome

**Figure 1: The three leading causes of death across geopolitical zone**

This could be a factor underlying all the other causes of death as studies have also shown that children with low birth weight were at increased risk of death than their counterparts with healthy weight birth weight [8,15-19]. However, one of the drawbacks to this study was that 46.4% (Table 3) of the case notes did not indicate the birth weight which could be as a result of the fact that some of the children were not brought in within 24-h of birth and so the birth weight was not recorded in the case notes.

Neonatal sepsis was reported in this study as the most important cause of neonatal death (30.1%) followed by asphyxia (27.2%). This agrees with 26.7% by Forae et al. [20] and 29.4% by Ezechukwu et al. [16] but lower than 13.2% reported by Eke et al. [21]. This high rate may be due to a number of factors such as illiteracy, poor health education, delivery conducted

by unqualified health personnel including the traditional birth attendants among others. Among infants, the common causes of death were congenital abnormalities (3.7%) and pneumonia (3.3%). Among the children, the common causes of death were NCD (1.7%) and ARI (1.4%).

Birth asphyxia as an important cause of mortality in this study was corroborated by Nwafor et al. [11], Ekwochi et al. [15], Forae et al. [21], and Ayoola et al. [22]. It is opined that exposure of health workers involved in delivery to resuscitation skills would go a long way in reducing mortality in children born with asphyxia.

Preterm complications were found to be the third most important cause of death in this study as reported by the WHO [19], Forae et al. [21], and Fajolu and Egri-Okwaji [23]. One of the reasons could be because our study is hospital-based and so there are more likely to be cases of high-risk deliveries and neonates. The implication of this is that if adequate attention is paid to antenatal care and skilled attendance at delivery, a lot of these deaths can be prevented.

ARIs were the fourth leading cause of death in this study. The risk factors for ARI as reported include inadequate breastfeeding, poor immunization, misuse of antibiotics, large family size, poor parental educational status, passive smoking, and overcrowding among other factors [19,24]. According to the study by Liu et al. [25], pneumonia was the highest cause of non-neonatal under-five mortality (14%) globally. This may be as a result low immunity in the children due to their age. The deaths from ARI may result from late presentation in tertiary hospitals hence late diagnosis and antibiotic treatment.

Neonatal jaundice, as reported in this study, was the fifth leading cause of death; severe hyperbilirubinemia was seen as the cause of death among these cases in this study. Research reports from Nigeria showed similar results [15,26]. Prenatal care and newborn resuscitation will go a long way in reducing deaths due to severe hyperbilirubinemia with suspected kernicterus associated with jaundice in these children.

It is surprising that malaria which accounts for under-five deaths in the country accounted for 3.1% of deaths in this study [3,27]. This may be due to home management of malaria while only the complicated cases get to the hospital. A recent report in North-Eastern Nigeria and from an Emergency Paediatric Unit in Bauchi showed malaria as the leading cause of death in 49.6% of total patient deaths (10.6%) [28].

The causes of mortality by age showed that neonates and infants were more likely to have died of most of the causes than the children over 1 year. This is an indication of better immune function with age and supports an overwhelming body of knowledge that survival of children gets better with age. A higher record of mortality due to respiratory illnesses found in the North-Central and South-West corroborated the report by Fajolu and Egri-Okwaji [23]. Lagos may have recorded the highest death due to malaria probably because of inadequate dosage or improper use of parenteral antimalarials in addition to the use of substandard drugs and more commonly as with other states blocked drainages and stagnant water bodies creating a favorable environment for mosquitoes to breed.

In view of the fact that this is a retrospective study, it is important to state that some other background causes of death such as malnutrition were not studied. Further studies would, therefore, be required in this regard as anticipated by the authors.

CONCLUSION

Childhood mortality is an index of a country's development and remains a burden in Nigeria which cannot meet the MDG4 goal. Childhood mortality is mostly caused in our setting by preventable conditions such as neonatal sepsis, birth asphyxia, prematurity low birth weight, and respiratory tract infections as previously reported. Knowledge of the causes and pattern of childhood mortality is essential to enable the health authorities' scale up appropriate interventions to reduce the burden.

Limitations of the Study

The limitation of the study is that during the period studied, of the total of number of deaths among under-five children reported in the hospitals, only 3174 were retrieved for analysis.

ACKNOWLEDGMENTS

The authors wish to thank the hospital personnel that helped with access to the records at all the study locations, including the Chief Medical Directors, the Pediatricians, and data management officials.

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Funding: None; Conflict of Interest: None Stated.

How to cite this article: Smith SI, Nwaokorie FO, Adagbada AO, Yisau JJ, David NA, Adeboye MAN, Adesida SA, Bamidele M, Adeneye A, Fowora MA, Musa ZA, Adedeji MA, Omonigbehin EA, Iroha E, Adedoyin OT, Eneh A, Ibeziako N, Jiya N, Oguche S, Bello M, Olowu AO, Ujah IAO. Survey and mapping of the leading causes of childhood mortality in Nigerian tertiary hospitals. *Indian J Child Health*. 2016; 3(4):281-285.