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RISK FACTORS FOR DEATH IN UNDER-FIVE CHILDREN PRESENTING WITH ACUTE DIARRHOEA IN AN URBAN TEACHING HOSPITAL IN NIGERIA

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ABSTRACT:

Dehydration is believed to be the primary cause of acute diarrhoea-related mortality. However, it is likely that a number of demographic and clinical risk factors may also interact to create the continued mortality due to acute diarrhoea. This study sought to explore the contributory role of some of these risk factors on diarrhoea-related mortality. This was a descriptive cross-sectional study involving 135 children between 29 days and 59 months admitted into the Diarrhoea Treatment and Training Unit during the period of July 2010 and January 2012. A range of demographic and clinical variables as well as outcome were obtained using a structured interviewer-administered questionnaire.

To identify risk factors that were independently associated with mortality, a multivariate analysis was done after controlling for confounders. Fourteen (10.4%) children, nine males and five females died following admission. The odds of a child dying of an acute diarrhoea disease following admission was increased in children with co-diagnosis of pneumonia (AOR = 16.38, p = 0.03), non-usage of ORS (AOR = 16.52, p = 0.00), diarrhoea episodes > 6 times in 24 hours (AOR = 23.63, p = 0.00) and Duration of diarrhoea > 3 days before admission (AOR = 3.63, p = 0.04).

Acute diarrhoea related mortality can be further reduced if awareness is created concerning these risk factors such that high risk children can easily be identified and targeted for intensive intervention.

INTRODUCTION:

The Millennium Development Goals (MDG 4) call for a reduction of child mortality by two thirds between 1990 and 2015 [1]. As the deadline approaches, the reality is that although progress is being made, much more remains to be done especially in sub-Saharan Africa [2]. Worldwide, nearly nine million children under five years of age die each year and diarrhoea contributes about 17% only second to pneumonia [3]. The burden of disease is greatest in the African region, which accounts for 46% of the deaths from diarrhoea despite only contributing to 18% of the world under-five population [4]. Nigeria is ranked second in the world among the countries with the highest diarrhoea related deaths among under-five children. It accounts for over 16 % of under-five mortality and an estimated 194,000 deaths annually [5].

In the 1970s and 1980s, the international community committed itself to reducing child mortality from diarrhoea largely by scaling up the use of oral rehydration therapy (ORT) – a low-cost and highly effective solution – coupled with programmes to educate caregivers on its appropriate use [6]. This effort which was very successful has since dwindled. Now, only about 39% of children with diarrhoea in the developing world receive ORT [3]. The implication is that less effective home treatment modalities such as the use of antibiotics, herbal concoctions and sometimes "watchful waiting"

are now being used [7]. These inappropriate home management approaches may be partly responsible for the increasing mortality from acute diarrhoea. Some other risk factors that have been reported to be significantly associated with diarrhoea-related mortality include, lack of breast feeding, lack of immunization, under nutrition [8]. Although, government and nongovernmental bodies have formulated policies and programmes aimed at reducing diarrhoea-related mortality, the situation has remained virtually unchanged. It is therefore possible that other than dehydration, a number of other risk factors interact to create the continued mortality from acute childhood diarrhoea. Given the importance of diarrhoeal diseases as a major contributor to childhood mortality in Nigeria, and to support a policy redesign, there is a clear need to further explore the role of some demographic and clinical risk factors on reported mortality of hospitalized children with acute diarrhoea.

The purpose of the present study was to determine the contribution of demographic and some clinical risk factors to diarrhoea-related mortality in under-five children admitted into the diarrhoea treatment and training unit (DTTU) of the University of Benin Teaching Hospital in Nigeria.

SUBJECTS AND METHODS:

This was a descriptive cross-sectional study undertaken at the DTTU of the University of

Benin Teaching Hospital. The DTTU is a subunit of the Children Emergency Room and provides care for children with acute diarrhoea and training on home management of acute diarrhoea to mothers, nurses, medical students, house officers and resident doctors. The study population consisted of children between 29 days and 59 months admitted into the DTTU with a diagnosis of acute diarrhoea either singly or with co-morbidities.

The study was conducted between July 2010 and January 2012. The sample size for the study was calculated assuming an exposure rate of 10% with 80% power and 5% significant level [8]. Acute diarrhoea in this study was defined as the passage of unusually loose or watery stool at least 3 or more times in a 24 hour period lasting less than 14 days [9].

Ethical approval for this study was obtained from the Ethics Committee of the University of Benin Teaching Hospital and written informed consent obtained from parents/caregivers of subjects.

The data collection instrument was a structured interviewer-administered questionnaire that was pre-tested; appropriate modifications were made prior to its use in the study. Information was collected by the researchers and trained junior paediatric residents on a range of demographic, some clinical risk factor(s) and outcome variable that included age and sex of child, weight, social status using the classification proposed by Olusanya et al [10], nature of stools, number of episodes, duration

of diarrhoea before presentation, vomiting and number of times as well as the presence or absence of fever. Other variables included home treatment, ORT preparation and application as well as laboratory or radiological evidence of co-morbidities such as malaria, pneumonia and hypoglycaemia. Home treatment that excluded the use of ORS was classified as non-usage of ORS.

The level of dehydration was assessed and categorized as severe dehydration (> 10% body weight loss), some dehydration (5-10% body weight loss) or no sign of dehydration (<5% body weight loss) using World Health Organization (WHO) criteria [11]. Weight-for-age Z-scores for boys and girls respectively, from birth to five years (WHO child growth standards), were used to classify children as being malnourished or not. The weight and age of each participant on admission was compared to the corresponding weight-for-age Z-score. Those with weight-for-age less than minus two standard deviations were classified as being malnourished on admission. All patients were appropriately evaluated and management instituted as per unit protocol. The primary outcome variable was mortality following admission.

Statistical Analysis:

Data collected was entered into Statistical Package for Scientific Solutions (SPSS) version 16 software. Key punching errors were rectified and logical errors corrected. Recoding of

existing variables into dichotomous variable was done while descriptive and inferential statistics were employed in the analysis of the data. A range of demographic and clinical variables recorded for children with and without the primary outcome variable were compared using a chi-square test or fisher exact where applicable. Strength of association was determined by calculating Odds ratio (OR), and 95% confidence interval. To identify risk factors independently associated with the primary outcome, a multiple logistic regression analysis was done after controlling for confounders

RESULTS:

During the 18-month study period, 153 children, constituting 8.9% of all patients under- 5 years of age were admitted to the DTTU with acute diarrhoeal disease. Of these, questionnaires were successfully administered on 135, which is equivalent to a response rate of 88.2%.The mean age of the study population was 13.5 months and a median of 11.0 months with a male female ratio of 1.3: 1. Fourteen children, 9 males and 5 females of the 135 study subjects died following admission.

The distribution of the demographics and clinical risk factors in children with or without the outcome variable is shown in Table 1. The univariate analysis of risk factors associated with diarrhoea-related death shows that diarrhoea of more than three days before admission was significantly associated with death, (p= 0.01).

Other risk factors associated with death included age less than 12 months, low socioeconomic status, under nutrition,, non-usage of ORS pre-admission, diarrhoea episodes of more than six times in 24 hours as well as moderate/severe dehydration as shown in Table 2

However, to identify variables independently predictive of death, we performed a multivariate logistic regression. The results of which are shown on Table 3. The odds of dying of a diarrhoeal disease following admission in this study was increased by 16.52 times in children who had inappropriate home management (non-usage of ORS), (AOR = 16.52, P =0.00) as well as those with co-diagnosis of pneumonia (AOR = 16.38, p= 0.03).

The result also showed an increased odd of a diarrhoea related death in children who had had diarrhoea for more than 3 days before admission and those with more than 6 diarrhoeal episodes in 24 hours. The confidence intervals were, however wide due to small numbers in some of the cells after categorizing the variables.

Table 1: Characteristics of Study Population

Characteristics	Number (%)
Gender	
Male	80 (59.3%)
Female	55 (40.7%)
Age	
≤ 12 months	77 (57.0%)
>12 months	58 (43.0%)
Nutritional Status (*WFA z-score)	
< 2SD	24 (17.8%)
>2SD	111 (82.2%)
Mother's Educational Status	
None/Primary	21 (15.6%)
Secondary/Tertiary	114 (84.4%)
Family Socio-economic Status	
Lower	57 (42.2%)
Middle/Upper	78 (57.8%)
Frequency of Diarrhoea in 24 hours	
≤6 times	91 (67.4%)
>6 times	44 (32.6%)
Diarrhoea Duration at admission	
≤3 days	70 (51.9%)
>3 days	65 (48.1%)
Associated Vomiting	
Present	117 (86.7%)
Absent	18 (13.3%)
Home Treatment	
Oral Rehydration Therapy (ORT)	66 (48.9%)
Drugs/Nothing	69 (51.1%)
Co-diagnosis of Pneumonia	
Present	5 (3.7%)
Absent	130 (96.3%)
Co-diagnosis of Malaria	
Positive	82 (60.7%)
Negative	53 (39.3%)
Serum Glucose Level	
<40mg/dl	8 (5.9%)
≥40mg/dl	127 (94.1%)
Dehydration	
Mild	51 (37.8%)
Moderate/Severe	84 (62.2%)

*WFA: Weight for Age

Table 2: Demographic and Clinical Risk Factors Associated with Mortality among Hospitalized Children with Acute Diarrhoea: Univariate Analysis

Factors	Clinical Outcome following admission		OR* (95% CI)	p-value
	Died (n=14) N (%)	Discharged (n=121) N (%)		
Male	9 (64.29)	71(58.68)	1.27 (0.36-4.67)	0.69
Age ≤ 12 months	12 (85.71)	65(53.72)	5.17 (1.03-35.03)	0.02
Under nutrition (WFA z score <3SD) **	9 (64.29)	14 (12.40)	12.72 (3.29 – 51.64)	0.00
Mother's educational status ***	4(28.57)	15 (12.40)	2.83 (0.65-11.67)	0.10
Low social class	11 (78.57)	46(38.02)	5.98 (1.44-28.68)	0.00
Diarrhoea episode > 6 times in 24 hours	11(78.57)	33(27.27)	9.78 (2.32-47.48)	0.00
Duration of diarrhoea > 3 days	12(85.71)	53 (43.80)	7.70 (1.53-52.20)	0.00
Associated vomiting	11(78.57)	106 (87.60)	0.52 (0.11-2.66)	0.35
Non-usage of ORS pre-admission	12(85.71)	57(47.11)	6,74 (1.34-45.65)	0.00
Co-diagnosis of pneumonia	3(21.43)	2 (1.65)	16.23 (1.90-60.12)	0.00
Co-diagnosis of Malaria	10 (71.43)	72 (61.16)	1.70 (0.45-6.88)	0.39
Hypoglyceamia	3 (21.43)	5 (4.13)	6.33 (0.39-10.41)	0.30
Moderate/Severe Dehydration	13(92.86)	71(58.68)	9.16 (1.18-93.46)	0.01

*OR: Odds ratio; ***Mother's educational status below secondary school*

Table 3: Demographic and Clinical Risk Factors Associated with Mortality among Hospitalized Children with Acute Diarrhoea: Multivariate Analysis

Factors	B	Adjusted Odds ratio	p-value	95% CI
Moderate/Severe dehydration	1.41	4.10	0.14	1.62 – 16.93
Under nutrition (WFA z score <3SD)	1.12	3.06	0.11	1.79 – 11.89
Co-diagnosis of pneumonia	2.80	16.38	0.03	3.36 – 97.54
Non usage of ORS pre-admission	2.82	16.52	0.00	3.81 – 41.58
Diarrhoea episodes > 6 times in 24 hours	3.16	23.63	0.00	6.50 – 55.94
Duration of diarrhoea > 3 days	1.29	3.63	0.04	1.07 – 12.33

DISCUSSION:

A reduction in diarrhoea-related mortality is paramount if we are to attain the MDG goal 4. This study has brought to the fore some risk factors associated with diarrhoea-related mortality in hospitalized under-five children in Nigeria. The clinical risk factors identified include under nutrition, more than 6 diarrhoea episodes in a 24 hour period, duration of diarrhoea of more than 3 days before hospitalization, non-usage of ORT before hospitalization, co-diagnosis of pneumonia and moderate/severe dehydration; the sociodemographic factors were age less than 12 months and low socioeconomic class.

However, more than 6 diarrhoea episodes in a 24 hour period, duration of diarrhoea more than 3 days before hospitalization, non-usage of ORT before hospitalization, and co-diagnosis of

pneumonia were more predictive of mortality after controlling for confounders.

The non-usage of ORT pre- admission conferred on the child about sixteen fold risk of mortality. Although the low usage of ORT by mothers for treatment of childhood diarrhoea has been previously reported [12], its contribution to diarrhoea–related mortality in hospitalized children has not been adequately highlighted. As was the case in a previous report [3], only about half of the mothers in this study gave ORT prior to presentation. The reason for this practice may be traced to the mother's perception of the causes of childhood diarrhoea. The mothers often consider teething, bad water, amongst others as the reasons for their child's illness [12, 13], as result consideration is given to antibiotics as the preferred choice of treatment.

Furthermore, this study has also shown that a diarrhoeal illness lasting more than three days before presentation is associated with significant mortality. Late presentation to the hospital is very common in Nigeria [14], more so in children with diarrhoea. It is generally believed that only very serious illnesses are treated in the hospital. As a result, at the onset of illness, most mothers will attempt to manage at home or visit the patent medicine sellers who more often than not prescribe antibiotics. In addition, as noted previously, some of the mothers believe that teeth eruption is the cause of their child's illness and therefore anticipates a self limiting course. The children are only taken to a health facility when their conditions worsen, sometimes with unpleasant consequences. The result of this study therefore underscores the need for parental education on prompt presentation to a health facility for cases of childhood diarrhoea

In this study, another risk factor for a fatal outcome was diarrhoea episodes of more than 6 times in a 24 hour period. A previous study looked at frequency of diarrhoea episodes as it affects degree of dehydration and may be by implication its effect on mortality [15]. Although, in our study, dehydration failed to predict mortality in the multivariate analysis, one is still tempted to conclude that the deaths may have resulted from dehydration. Victoria et al [16] reported that frequent passage of stool (> 6 episodes) and repeated vomiting were associated with the development of life threatening dehydration.

The presence of pneumonia as a co-morbidity increased the odds of a diarrhoea death in the present study. This is consistent with findings of other studies [8, 17]. Although, the number of children with pneumonia in this study was small, it impact on mortality was very evident. It is believed that the hypoxaemia, which is often experienced by affected children, is responsible for the deaths [18]

Various studies have shown undernutrition as an independent risk factor for diarrhoea related mortality [8, 19]. Although, it was found to be significantly associated with mortality in the univariate analysis, it however failed to retain its significance after controlling for confounding variables in the multivariate analysis. The plausible reason for this could be the non-adjustment of the weight measured on admission for the level of dehydration present. Acute gastroenteritis presents with dehydration which can cause acute weight loss. Some of the children may have been misclassified as having malnutrition, as the corrected weight (after rehydration) may have been slightly higher, and may no longer have met one of the criteria (< 2 SD weight-for-age) for malnutrition. There was also the possibility of falsely classifying ex-premature infants as being malnourished when using their chronological age. This may have overestimated the number of participants classified as having malnutrition.

Data obtained in this study, supports the general clinical opinion that diarrhoea is one of the major causes of under-five mortality, and that it is of considerable public health importance. The case fatality rate was 10.4%, a finding that is similar to that of Ibeziako et al in south eastern part of Nigeria about 10 years ago [20], suggesting that perhaps not much progress has been made to reduce the incidence of diarrhoea and diarrhoea-related deaths in Nigeria.

In conclusion, the study has brought to the fore some risk factors that contribute significantly to diarrhoea-related mortality. Considering the limited resources available in developing countries, a reduction in diarrhoea –related death may be possible by identifying high risk children and targeting them for intensive intervention.

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Conflict Of Interest: The authors have no conflict of interest.

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