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# Acute diarrhoeal disease among under-five children presenting at a paediatric referral Facility in Lagos, Nigeria

Comfort O. Ezegamba [1,*], Idowu Odunayo Senbanjo [2], Wasiu Bamidele Mutiu [3] and Fidelis Olisamedua Njokanma [2]

[1] *Department of Paediatrics and Child Health, Lagos State University Teaching Hospital, No 1-5 Oba Akinjobi Way, GRA, Ikeja. Lagos, Nigeria.*
[2] *Department of Paediatrics and Child Health, Lagos State University College of Medicine, PMB 21266, Ikeja. Lagos, Nigeria.*
[3] *Department of Microbiology, Lagos State University College of Medicine, PMB 21266, Ikeja, Lagos, Nigeria.*

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## Abstract

**Background**: The morbidity and mortality from acute diarrhoeal disease remain significantly high especially in low and middle income countries.

**Aim:** This study was carried out to determine the prevalence of acute diarrhoea, and the associated risk factors among under-five children seen at a paediatric referral facility in Lagos, Nigeria.

**Methods**: This was a cross-sectional descriptive study of under-five children who presented with acute diarrhoeal disease at the Children Emergency Room and General Out-Patient Clinic of Lagos State University Teaching Hospital (LASUTH), Ikeja, Lagos, South-Western Nigeria. Information was obtained on socio-demographic characteristics, environmental/ hygienic practices, feeding practices and immunization status.

**Results**: The prevalence of acute diarrhoea was 400 of 4836(8.3%) under-five children. Three hundred and ninety-five (73.7%) of these children were aged less than two years. The identified associated risk factors for acute diarrhoea among children aged less than two years were use of feeding bottles (OR 12.4; 95% CI 1.8-7.2; p= 0.000), failure to complete immunization(OR 13.0; 95% CI 3.1-43.3; p= 0.000), attendance of crèches (OR 47.1; 95% CI 15.6-141.1; p= 0.000), failure to exclusively breastfeed (OR 6.7; 95% CI 1.3-6.7; p= 0.010) and malnutrition (OR 3.9; 95% CI 1.0-20.3; p= 0.049).

**Conclusions:** Acute diarrhoea remain a significant public health burden affecting majorly children aged less than two years. Efforts at prevention of diarrhoeal disease burden should focus on improvement of hygienic and feeding practices.

**Keywords:** Acute diarrhoea; Children; Risk factors; Nigeria

## 1. Introduction

Diarrhoeal disease remained a leading cause of death among the under-five population affecting majorly children from low- and middle-income countries.[1-3] Most episodes of childhood diarrhoea are mild, but acute cases can lead to significant fluid loss and dehydration, which may result in death or other severe consequences if dehydration is not corrected.[1]According to the World Health Organization (WHO) and the United Nations Children Fund (UNICEF), about

* Corresponding author: Comfort O. Ezegamba

4 billion cases of diarrhoea are recorded worldwide every year causing 0.5 million child deaths.[1] This makes diarrhoea responsible for nearly one in five child deaths each year.[1,2]

In sub-Saharan Africa, diarrhoeal disease comes second after acute respiratory infections (ARI) in causing deaths among under-five children.[1] Diarrhoea has been noted to cause more deaths than malaria, measles and HIV infections combined.[1]One out of ten babies born in developing countries fails to reach their fifth birthday falling victim to diarrhoeal disease.[2]Furthermore, children who suffer from diarrhoea often have underlying malnutrition, which makes them more vulnerable to diarrhoea. Each diarrhoeal episode, in turn, makes malnutrition even worse.

In 2009, the United Nations Children's Fund (UNICEF)[1] reported that Nigeria is the second most affected country worldwide for diarrhoea disease next to India. In 2007, the mortality rate due to diarrhea among under-fives was 7.5% in Ebonyi State University Teaching Hospital,[4] while at the University of Port-Harcourt Teaching Hospital, Rivers State, Nigeria it was 5.8% in 2009.[5]The mortality rate due to diarrhoea among under-fives in a Specialist Hospital in Gusau, Zamfara State was 12.1% in 2014.[6] The burden of diarrhoeal disease remained persistent and therefore the significance in child health cannot be overemphasized.

The associated risk factors known to cause diarrhoeal diseases in under-five children are many.[3,7] It is believed to be due to interaction between biological, socioeconomic and behavioral factors. Interventional programs targeted at the identified risk factors have been successful.[1,3,7] In most areas of the world, the mortality rates from diarrhoea were expected to decrease by 30% to 50% yearly. However, this has not been achievable especially in developing countries due to geographical, economic, political, socio-cultural and personal factors which interact to intervene in prevention and control of diarrhoea in these areas of the world.[8]In sub-Saharan African countries, the decrease in mortality rates was noted to be only 3% yearly.[8] These non-dwindling mortality rates show that a lot still has to be done to meet the challenge to reduce these rates.

Therefore, there is need to determine the relation and interaction of these multiple factors simultaneously as this may help identified major factors associated with diarrhoeal disease. In Nigeria, information on factors associated with acute diarrhoea is inadequate. This study was carried out to determine the burden of acute diarrheal disease and the associated biological environmental and behavioral factors among under-five children in a paediatric referral facility in Lagos, Nigeria

## 2. Methods

The study was a cross-sectional and descriptive study carried out at the Children Emergency Room (CHER) and General Out-Patient Department of Lagos State University Teaching Hospital. The hospital is located in Ikeja, the capital city of Lagos State, in South-West Nigeria. It receives patients from private and public hospitals within the State and occasionally from neighboring Ogun State. When any under-five child presented with complaints of passing frequent loose stools in LASUTH at any of the fore mentioned places, and met the inclusion criteria the child was recruited for the study.

The calculation of sample size was done using the standard formula for single proportions[9] and was based on a major outcome variable, which is the prevalence of diarrhoea in a Nigerian study.[10]

$$n = \frac{p[1-p]a^2}{z^2}$$

Where,
n = Estimated sample size
a = Fraction of area under normal distribution curve covered by 2SD on either side of the mean of normal distribution. It is equal to 1.96 in a two tail table.
P = Prevalence of study.

Earlier reports of diarrhoea in Nigeria show prevalence range of 2.77%[11] to 38%.[10] The highest prevalence rate of 38% was used for the study.

Z = Tolerable error, which was fixed at 5% (0.05) in the study.

Therefore,

$$n = \frac{0.38\{1-0.38)1.96^2}{0.05^2}$$

$$= 362$$

Ten percent of three hundred and sixty two, which is thirty six, was added as attrition to the sample size bringing it to 398. The total sample size was rounded off to 400.

All the under-five children that presented with acute diarrhoea in LASUTH within the five months duration of recruitment (August 2015 to December 2015) for the study were consecutively recruited until the desired sample size was achieved. All under-five children including neonates that presented with diarrhoea that lasted seven days or less in LASUTH were recruited while children with obvious cases of mal-absorption, chronic diseases and congenital malformations of the gastrointestinal tract were excluded.

Ethical approval was obtained from the Health Research and Ethics Committee of Lagos State University Teaching Hospital.

A self-designed proforma was administered to obtain information from the parent or care-giver. Information obtained includes demography, clinical history, physical findings, nutritional history and laboratory data. The anthropometric parameters of all the under five children that presented with acute diarrhoea in LASUTH were obtained using the non-elastic tape rule, stadiometer and weighing scales.

### 2.1. Definition of terms

- **Diarrhoea** was defined as the passage of three or more loose stools per day or increased frequency of passage of stools more than normal for the child.
- **Acute diarrhoea** was defined as to diarrhoeal episode that resolves within the first week of onset.[12] It could be acute watery diarrhoea or acute bloody diarrhoea.

### 2.2. Statistical analysis

Analysis of data was carried out using the Statistical Package for the Social Sciences (SPSS) version 21 software. Statistical indices like mean, standard deviation and range was generated for quantitative data. Chi-square was used where appropriate to compare discrete data, and was used to determine associations between diarrhoea and the risk factors in the study. Probability values [p-value] less than 5% (0.05) was accepted as statistically significant. Fisher's exact probability test was used to analyse two groups of subjects with small numbers in each cell.[9] Multivariate logistic regression was carried out on all the significant risk factors for acute diarrhoea.

## 3. Results

### 3.1. Demographic characteristics of the study population

A total of four hundred children that presented with acute diarrhoea were recruited, studied and the results analyzed. Table I describes the socio-demographic characteristics of the study population. The age of the children ranged from fourteen days to fifty-nine months with a median of 13.0 months and mean of 17.4 ±14.3 months. There were 200 males and 200 females, giving a male: female ratio of 1:1. The equal number of male/ female study subjects recruited was not by design, rather it was a coincidence.

**Table 1** Socio-demographic characteristics of the study population

| Variable | Frequency | Percentage |
|---|---|---|
| **Child's age (months)** | | |
| 0-11 | 176 | 44.0 |
| 12-23 | 119 | 29.7 |
| 24-35 | 44 | 11.0 |
| 36-47 | 32 | 8.0 |
| 48-59 | 29 | 7.3 |
| Gender | | |
| Male | 200 | 50.0 |
| Female | 200 | 50.0 |
| Tribe | | |
| Yoruba | 176 | 44.0 |
| Igbo | 159 | 39.8 |
| Hausa | 24 | 6.0 |
| Others* | 41 | 10.2 |
| Religion | | |
| Christianity | 312 | 78.0 |
| Islam | 88 | 22.0 |
| Mother's level of education | | |
| No formal education | 12 | 3.0 |
| Primary | 33 | 8.3 |
| Secondary | 180 | 45.0 |
| Tertiary | 175 | 43.7 |
| Social class | | |
| I | 26 | 6.5 |
| II | 117 | 29.2 |
| III | 141 | 35.3 |
| IV | 106 | 26.5 |
| V | 10 | 2.5 |

Others* include Bini, Ijaw, Tiv

### 3.2. Prevalence and types of acute diarrhoea

The total number of under-five children seen in the General Out-Patient Clinic (GOPC) and the Children Emergency Room (CHER) during the five month recruitment period of the study was 4,836. Of the 4,836 children, 400 had acute diarrhoea with a period prevalence of 8.3% (400/4836). Children aged less than two years accounted for 295 (73.8%) of the children studied.

Seventeen (4.3%) children had dysentery, while 383 (95.7%) had acute watery diarrhoea.

### 3.3. Relationship between feeding practices, socio-economic status, immunization practices and occurrence of diarrhoea

Table 2 shows the relationship between socioeconomic status, feeding practices, immunization and occurrence of diarrhea according to age groups.

**Table 2** Relationship between socio-economic status, feeding practices, nutritional status immunization practices and occurrence of diarrhoea according to age groups

| Variable | Total | Age ≤ 2years | Age >2 years | χ2 | P |
|---|---|---|---|---|---|
| **Mothers level of education** | | | | | |
| No formal education | 12(3.0) | 10(83.3) | 2(16.7) | 4.722 | 0.317 |
| Primary | 33(8.3) | 29(87.9) | 4(12.1) | | |
| Secondary | 180(45.0) | 147(81.7) | 33(18.3) | | |
| Tertiary | 175(43.7) | 131(74.9) | 44(25.1) | | |
| Social class | | | | | |
| 1 | 26(6.5) | 23(7.3) | 3(3.6) | | |
| 2 | 117(29.2) | 84(26.5) | 33(39.8) | | |
| 3 | 141(35.3) | 117(36.9) | 24(28.9) | | |
| 4 | 85(26.8) | 85(26.8) | 21(25.3) | 6.548 | 0.162 |
| 5 | 8(2.5) | 8(2.5) | 2(2.4) | | |
| Exclusive breastfeeding | | | | | |
| Yes | 141(35.3) | 103(73.0) | 38(27.0) | 5.091 | 0.024 |
| No | 259(64.7) | 214(82.6) | 45(17.4) | | |
| Complementary feeding | | | | | |
| Yes | 60(15.0) | 47(78.3) | 13(21.7) | | |
| No | 340(85.0) | 270(79.4) | 70(20.6) | 0.036 | 0.849 |
| Bottle feeding | | | | | |
| Yes | 195(48.8) | 145(74.4) | 50(25.6) | | |
| No | 205(51.3) | 172(83.9) | 33(16.1) | 5.535 | 0.019 |
| Nutritional status | | | | | |
| Normal | 270(67.5) | 202(74.8) | 68(25.2) | | |
| Underweight | 100(25.0) | 90(90.0) | 10(10.0) | | |
| Kwashiorkor | 1(0.3) | 0(0.0) | 1(100.0) | | |
| Underweight Kwashiorkor | 3(0.8) | 3(100.0) | 0(0.0) | | |
| Marasmus | 25(6.3) | 22(88.0) | 3(12.0) | 19.845 | 0.001 |
| Marasmic Kwashiorkor | 1(0.3) | 0(0.0) | 1(100.0) | | |
| Immunization status | | | | | |
| Incomplete | 88(22.0) | 85(96.6) | 3(3.4) | | |
| Complete | 312(78.0) | 232(74.4) | 80(25.6) | 20.631 | 0.000 |

The figures indicate diarrhoeal cases and the numbers in bracket are percentages of the total in rows.

The duration of exclusive breastfeeding ranged from one month to six months with a median of 3.0 months and mean of 3.0 ± 3.0 months. The occurrence of diarrhea among children aged two years and below was significantly higher in those children not exclusively breasted for 6 months compared to those that were exclusively breastfed (82.6% vs. 73.0%, p = 0.0024).

The mean age of commencement of complementary feeds was 4.8 ± 3.3months. One hundred and ninety-five (47.5%) children commenced complementary feeds before age of six months. The food that was commonly used as complementary feeds was home-made feeds (corn-based gruel). Forty-seven (78.3%) children aged two years and below commenced complementary feeds at six months, while 270 (79.4%) children of same age group did not. The observed difference between the two groups with respect to age at commencing complementary feeds was not significant ($\chi^2 = 0.036$, $p = 0.849$)

The use of bottle-feeding was practiced by 172 (83.9%) children aged two years and below, while 145 (74.4%) children of same age range were not bottle-fed. Children that were bottle-fed had significantly higher prevalence of diarrhoea compared to those that were not bottle-fed ($\chi^2= 5.535$, $p =0.019$).

Thirty three (8.3%) mothers of the subjects recruited had received primary education, while 180 (45.0%) and 175 (43.8%) mothers had Secondary and Tertiary levels of education respectively. Twelve (3.0%) mothers had never received any form of formal education. Among children aged two years and below, the occurrence of diarrhoea was 10 (2.5%) in those whose mother had no formal education compared with 131 (32.8%) in those whose mothers had tertiary education.

Two hundred and eighty-six (90.2%) children aged two years and below were of social class 2, 3, and 4 had diarrhoea compared with 78 (94.0%) children aged greater than two years and of same social class. The observed difference with respect to social classes was not significant ($\chi^2 = 6.548$, $p = 0.162$).

Three hundred and twelve (78%) children completed their immunization for their age according to National Program on Immunization (NPI) schedule. None of the children received rotavirus vaccine. Children that failed to complete their immunization had significantly higher prevalence of diarrhoea compared to those that completed their immunization schedule appropriate for age ($\chi^2 = 20.631$, $p= 0.000$).

Using Modified Wellcome classification, 130 (32.5%) children were malnourished. Of the malnourished children, 115 (88.5%) children were aged two years and below and had significantly increased prevalence of diarrhoea compared to the 202 (74.8%) well-nourished children of the same age group ($\chi^2= 9.938$, p=0.002),

### 3.4. Acute diarrhoea and environmental characteristics of study population

Table 3 shows the relationship between environmental characteristics of the study population and occurrence of acute diarrhea. There were 145 (86.8%) children aged less than two years who resided in rural areas compared with 172 (73.8%) children of the same age group from urban areas and this was statistically significant ($\chi^2 = 10.01$, $p = 0.002$).

**Table 3** Distribution of cases of acute diarrhoea according to environmental characteristics and age groups

| Variable | Total (%) | Age ≤ 2years | Age >2 years | χ2 | p |
|---|---|---|---|---|---|
| Area of abode | | | | | |
| Urban | 233(58.3) | 172(73.8) | 61(26.2) | 10.01 | 0.002 |
| Rural | 167(41.7) | 145(86.8) | 22(13.2) | | |
| Housing characteristics# | | | | | |
| Tenement homes | 224(56.0) | 181(80.8) | 43(19.2) | 1.075 | 0.783 |
| Flat/duplex | 175(43.7) | 135(77.1) | 40(22.9) | | |
| Family size | | | | | |
| < 4 | 248(62.0) | 203(81.9) | 45(18.1) | 2.690 | 0.101 |
| 5 and above | 152(38.0) | 114(75.0) | 38(25.0) | | |

| | | | | | |
|---|---|---|---|---|---|
| Number of rooms | | | | | |
| 1 | 224(56.0) | 181(80.8) | 43(19.2) | 9.265 | 0.010 |
| 2 | 96(24.0) | 82(85.4) | 14(14.6) | | |
| 3 and above | 80(20.0) | 54(67.5) | 26(32.5) | | |
| Water source | | | | | |
| Borehole | 154(38.5) | 112(72.7) | 42(27.3) | 10.317 | 0.035 |
| Sachet/ bottle | 218(54.5) | 178(81.7) | 40(18.3) | | |
| Well | 8(2.0) | 7(87.5) | 1(12.5) | | |
| None | 20(5.0) | | | | |
| Sewage disposal | | | | | |
| Safe | 308(77.0) | 244(79.2) | 64(20.8) | 0.001 | 0.979 |
| Unsafe | 92(23.0) | 73(79.3) | 19(20.7) | | |
| Refuse disposal | | | | | |
| Safe | 282(70.5) | 224(79.4) | 58(20.6) | 0.019 | 0.889 |
| Unsafe | 118(29.5) | 93(78.8) | 25(21.1) | | |

The figures indicate diarrhoeal cases and the numbers in bracket are percentages of the total in rows. #- total not equal to 100% due to the single destitute child.

The number of rooms in which the children resided ranged from one to seven rooms. Children aged two year and below who lives with parents in single room apartment had significantly higher prevalence of diarrhoea compared to their counterparts that resided in three or more rooms ($\chi^2$=9.265, $p$=0.010).

Three hundred and ninety-two (98.0%) children drank water from sachets, bottled water or borehole, while 8 (2.0%) children drank water from wells. Seven (87.5%) children aged less than two years old drank from wells while 178 (81.7%) children of same age group drank water from sachet or bottled water sources. This observed difference in prevalence of diarrhoea with respect to sources of drinking water was significant ($\chi^2$= 10.317, $p$ = 0.035).

There was no observed difference in prevalence of acute diarrhea with respect to type of homes, family size, sewage and refuse disposal among children aged less than two year.

### 3.5. Acute diarrhoea, sanitary and hygienic practices of study subjects

Table 4 shows the relationship between occurrence of acute diarrhoea and sanitary or hygienic practices of the study population according to age groups. There was significantly higher prevalence of diarrhoea among children aged two years and below and nursed in crèches compared to those that were not in crèches ($\chi^2$= 12.399, $p$= 0.000).

The occurrence of diarrhoea in another sibling as at the time of this study was noted in 59 (14.8%) of the study population. Children aged two years and below with other siblings that had diarrhoea had significantly higher prevalence of diarrhoea compared to those above two years old ($\chi^2$=9.272, $p$ = 0.002).

The practice of hand washing before food preparation, after defecation or changing of diapers by the care-givers of children less than two years old was not significantly related to acute diarrhea illness (p> 0.05).

**Table 4** Distribution of cases of acute diarrhoea according to sanitary / hygienic practices and age groups of study population

| Variable | Total (%) | Age ≤ 2years (%) | Age>2years (%) | $\chi^2$ | p |
|---|---|---|---|---|---|
| Hand-washing (After defecation) | | | | | |
| Always | 166(41.5) | 122(73.5) | 44(26.5) | 5.917 | 0.052 |
| Never | 36(9.0) | 31(86.1) | 5(13.9) | | |
| Occasionally | 198(49.5) | 164(82.8) | 34(17.2) | | |
| Hand-washing (Before food) | | | | | |
| Always | 158(39.5) | 125(79.1) | 33(20.9) | 0.039 | 0.981 |
| Never | 26(6.5) | 21(80.8) | 5(19.2) | | |
| Occasionally | 216(54.0) | 171(79.2) | 45(20.8) | | |
| Care out of home | | | | | |
| Crèche/ daycare | 107(26.7) | 97(90.7) | 10(9.3) | 12.399 | 0.000 |
| Others# | 293(73.3) | 220(75.1) | 73(24.9) | | |
| Diarrhoea in another sibling | | | | | |
| Present | 59(14.7) | 38(64.4) | 21(35.6) | 9.272 | 0.002 |
| Absent | 341(85.3) | 279(81.8) | 62(18.2) | | |

The figures indicate diarrhoeal cases and the numbers in bracket are percentages of the total in rows; Others#- nursed at home, nursery and primary schools

### 3.6. Multivariate logistic regression of risk factors for acute diarrhoeal disease

The multivariate logistic regression of the significant risk factors is shown in Table 5. Identified risk factors were children that were not exclusively breastfed (OR 6.7; 95% CI 1.3-6.7; *p* 0.010 ), use of bottle feeding (OR 9.56; 95% CI 0.1-0.7; *p* 0.002), children that failed to complete their immunization schedule (OR 13.1; 95% CI 0.03-0.33; *p* 0.000), care in a crèche (OR 43.6; 95% CI 14.6-139.4; *p* 0.000) and malnourished children in the study population (OR 3.9; 95% CI 1.0-20.3; *p* 0.049).

**Table 5** Multivariate logistic regression of risk factors for acute diarrhoeal disease

| Variables | Odds ratio | 95% CI | | p value |
|---|---|---|---|---|
| | | Lower | Upper | |
| Residential area | 0.42 | 0.619 | 2.589 | 0.512 |
| Number of rooms | 1.67 | 0.604 | 1.366 | 0.196 |
| Water source | 0.40 | 0.162 | 34.953 | 0.527 |
| Diarrhoea in another sibling | 0.17 | 0.547 | 2.507 | 0.684 |
| Not exclusively breast fed | 6.72 | 1.302 | 6.703 | 0.010 |
| Bottle-feeding | 9.56 | 0.174 | 0.676 | 0.002 |
| Care in crèche | 43.63 | 14.554 | 139.446 | 0.000 |
| Incomplete immunization | 13.11 | 0.025 | 0.332 | 0.000 |
| Malnutrition (Modified Wellcome Classification) | 3.88 | 1.008 | 20.317 | 0.049 |

CI – confidence interval

## 4. Discussion

The period prevalence of acute diarrhoeal disease in the present study was 8.3%. This is comparable to 7.4% obtained from Ile-Ife[13] and 8.4% in Brazil.[14] However, it is lower than the prevalence rates of 25%, 33% and 38% reported from three senatorial districts of Lagos State[10] and 26% national value reported by UNICEF[15] between 2000 and 2015. The present study was hospital-based compared to the UNICEF[15] and Lagos[10] studies which were community-based. The lower prevalence in the present study could be because only severe cases of diarrhoea get to the hospital unlike the community based studies that have access to all diarrhoea cases within the community. The present study recorded a lower prevalence rate of acute diarrhoea among under-five children when compared with hospital-based studies in Accra, Ghana[16]and Soweto, South Africa[17]which reported prevalence of 28.0% and 21% respectively. The likely reason the present study reported a lower prevalence compared to the studies in Ghana and South Africa may be due to fact that the studies were carried out in cottage hospitals primarily caring for children with diarrhoea and malnutrition. These figures attest to the high burden of acute diarrhoeal illness in sub-Sahara African countries.

This study did not show any sex predilection in the prevalence of acute diarrhoea. This is in consonance with the findings of other authors in Sud*a*n.[18] It is however contrary to the reports by authors in Benin,[19] Jos[11,20] and Lagos[21] which found a higher prevalence among males. It also contrasts with finding of female preponderance in another study in India.[22] There is no clear scientific basis for gender predilection in diarrhea and this is reflected in the lack of uniformity of findings. The implication is that index of susceptibility should be equal for both sexes and any preventive measures should be equally applied to all.

In this study, the age-group with the highest prevalence of acute diarrhoea was children aged less than twelve months old. This is similar to findings by authors in most developing countries[23,24] which also reported highest incidence of acute diarrhoea in this age group. Interestingly, about three-quarter of the children in this study were aged less than two years old. The increased prevalence of diarrhoea in these age groups has been attributed to increased mobility (crawling), exploration of the environment, mouthing of objects that may contain pathogens and steady decline in the concentration of protective antibodies received by trans-placenta transfer.[1,25]

Majority of the children in the present study who were aged two years and below and nursed in crèches had a higher prevalence of acute diarrhoea. A similar study in Brazil reported a relationship between attendance at crèche and higher prevalence of bacterial pathogens in stool.[26] This was related to the higher risk of cross-infection that occurs by bringing many children together in an enclosure. The risk will of course be higher still if the rules of hygiene are not strictly observed by the care-givers in these crèches.

In the present study, failure to exclusively breastfeed children was associated with about seven-fold increased risk of diarrhoea in children aged less than two years. The association between failure to exclusively breastfeed and diarrhoea had earlier been reported in Jos,[11] Ilesa[27] and Enugu.[28] The scientific explanation may be due to the fact that breast milk contains immunoglobulin and other anti-infective properties which protect against diarrhoea. This immune function is kept in memory but could actually wane with age. Furthermore, breast milk contains healthy bacteria and galacto-oligosaccharides which further enhance the colonization of the gut with healthy bacteria. This healthy micro-biota is known to preserve the intestinal mucosal barrier function and improve the immune system of the body, thereby reducing the incidence of infection especially in the gastrointestinal tract.[29,30]

Failure to exclusively breastfeed for six months is intrinsically related to early commencement of formula feeds, particularly with the use of feeding bottles. It is therefore not surprising that bottle-fed children in the present study had twelve-fold increased risk of developing diarrhoea, an observation which agrees with studies in Aba[31]and Enugu.[28]

The presence of malnutrition as evidenced by the modified Wellcome classification was associated with a four-fold increased risk of developing diarrhoea in children aged two years and below. This may be due to reduced cellular and humoral immunity in malnourished children which predisposed children to different infections including acute diarrhoeal disease. Similar findings were observed by authors in Ilesa, South western Nigeria[27]

Majority of children in the present study who were aged two years and below failed to complete their immunization appropriate for age according to the National Program on Immunization (NPI) schedule. These children had a thirteen-fold increased risk of developing diarrhoea. The occurrence of higher incidence of acute diarrhoea among children that were poorly immunized was also similar to reports by World Health Organization and United Nations Children's Fund.[1] The explanation for this may be due to general lack of care by mothers and care-givers of these children. A mother who failed to complete their children immunization is also likely to fail in other child caring practices such as good hygienic and weaning practices and thereby predispose these children to acute diarrhoea.

A variety of other factors were tested in the current study but their contribution to prevalence of diarrhoea was not remarkable, such as large family size, residence in tenement homes, source of water, means of sewage disposal, refuse disposal, poor practice of hand washing before food preparation and after defecation, age at commencement of complementary feeds, social class and parents' educational status. There may have been peculiar conditions reported by other authors that make a potential risk factor more prominent or less prominent in contributing to increasing the prevalence of diarrhoea which were not noted in the current study.

This study had some limitations. Firstly, being a cross sectional study, it is difficult to determine the influence of season in the occurrence of diarrhoeal disease because this study was only conducted over a period of five months. Another limitation is that the prevalence of diarrhoea in this study may not reflect the actual burden of diarrhoea in the community because it is hospital based and period prevalence did not cover the raining and dry seasons.

## 5. Conclusion

In conclusion, the prevalence of acute diarrhoea remains high in Lagos, Nigeria, affecting mostly children aged less than two years. All the identified independent risk factors can be summed up as host factors which promotes susceptibility to pathogens and risk of contracting diarrhoeal disease. Therefore, efforts at reducing the burden of diarrhoeal disease should include educating parents and guardians on how to care for children especially exclusive breastfeeding in the first 6 months of life, avoiding use of feeding bottles, hygienic practices in all crèches and maintaining optimal feeding practices for optimal nutritional status. The effect of these various host factors on diarrhoea disease will need further cross sectional research to determine the commonly implicated pathogens.

## Compliance with ethical standards

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### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

## References

[1] Global Burden of Diarrhoeal Diseases Collaborators. Estimates of global, regional, national morbidity, mortality, and aetiologies of diarrhoeal diseases: a systematic analysis for the Global Burden of Disease Study 2015. Lancet Infect Dis 2017; 17: 909–948

[2] Bustreo F, Okwo-Bele JM, Kamara L. World Health Organization perspectives on the contribution of the Global Alliance for Vaccines and Immunization on reducing child mortality. Arch Dis Child 2015; 100(Suppl. 1): S34: S37

[3] Kotloff KL, Nataro P, Blackwelde WC, et al. Burden and aetiology of diarrhoeal disease in infants and young children in developing countries (the Global Enteric Multicenter Study, GEMS): a prospective, case-control study. Lancet 2013; 382: 209–222.

[4] Ogbu O, Agumadu N, Uneke C, Amadi E. Aetiology of acute infantile diarrhoea in the south-eastern Nigeria: an assessment of microbiological and antibiotic sensitivity profile. Internet J Third World Med. 2007;7:1–3.

[5] George IO, Alex-Hart BA, Frank-Briggs AI. Mortality pattern in children: a hospital based study in Nigeria. Int J Biomed Sci. 2009;5:369–72.

[6] Bilikisu GI, Aminu MS, Onazi OS, Bassey E, Aghadueki S, Muyideen AB. Pattern of medical childhood morbidity and mortality in a new Specialist hospial in Gusau , Nigeria. anmjournal. 2014;8:15–9.

[7] Akinbami FO. Paediatric and Child Health in a Tropical Region. In: Azubuike JC and Nkanginieme KEO, editors. 2007. p. 283–8.

[8] Hamer DH, Simon J, Thea D, Keusch G. Childhood diarrhoea in sub-Saharan Africa. In: Child Health Research Project Special Report. 2010. p. 7–11.

[9] Lwanga SK, Tye CY, Ayeni O. Teaching health statistics: twenty lessons and seminar outlines. WHO Geneva. 2008;69–94.

[10] Lawanson TO. Poverty and environmental conditions in the Lagos megacity: consequences for environmental health. Fourth Int Conf Environ Cult Econ Soc Sustain. 2008;

[11] Yilgwan CS, Okolo SN. Prevalence of diarrhoea disease and risk factors in Jos University Teaching Hospital, Nigeria. Ann Afr Med. 2012;11:217–21.

[12] Pickering LK, Snyder JD. Nelson Textbook of Paediatrics. In: Gastroenteritis. 2015. p. 1272–81.

[13] Elusiyan JBE, Obiajunwa PO, Adejuyigbe EA, Olowu WA, Adeodu OO, Owa JA. Pattern of morbidity and mortality among children hospitalized at the Obafemi Awolowo University Teaching Hospital, Ile-ife, Nigeria. Nig J Pediatr. 2009;36:22–8.

[14] Sejanes da Rocha MCG, Carminate DG, Tibirica SHC, Carvalho IP, Rosa e Silva ML, Chebli JMF. Acute diarrhoea in hospitalized children of the municipality of Juiz de Fora, MG, Brazil: prevalence, risk factors associated with disease severity. ArqGastroenterol Sao Paulo. 2012;49:18–24.

[15] United Nations Children's Emergency fund. diarrhoea remains a leading killer of young children, despite the availability of a simple treatment solution. http://data.unicef.org/topic/child-health/diarrhoea-disease/#. 2016.

[16] Osam-Tewiah. Prevalence and management of diarrhoea in out-patient children less than five years at the Princess Marie Louis Hospital (PML), Accra, Ghana [dissertation on the internet].[Accra]: Kwame Nkrumah University of Science and Technology. 2010.

[17] Groome MJ. The burden of severe acute gastroenteritis and risk factors associated with poor outcome in a cohort of Sowetan children under-five years of age [dissertation on the internet]. [Johannesburg]: University of the Witwatersrand. 2010.

[18] Siziya S, Muula AS, Rudatsikira E. Correlates of diarrhoea among children below the age of five years in Sudan. Afr Heal Sci. 2013;13:376–83.

[19] Imade PE, Eghafona NO. Viral agents of diarrhoea in young children in two Primary Health Centres in Edo State, Nigeria. Int J Microbiol. 2015;685821:1–5.

[20] Junaid SA, Umeh C, Atanda OO, Banda JM. Incidence of Rotavirus infection in children with gastroenteritis attending Jos University Teaching Hospital. Virol J. 2011;8:233.

[21] Ogunsanya TI, Rotimi VO, Adenuga A. A study of the aetiological agents of childhood diarrhoea in Lagos, Nigeria. J Med Microbiol. 1994;40:10–4.

[22] Stanly AM, Sathiyasekaran BW, Palani G. A population based study of acute diarrhoea among children under five years in a rural community in South India. SRJM. 2009;1:1–7.

[23] Kosek M, Bern C, Guerrant RL. The global burden of diarrhoea disease, as estimated from studies between 1992 and 2000. Bull World Heal Organ. 2003;81:197–204.

[24] O'Reilly CE, Jaron P, Ochieng B, Nyaguara A, Tate JE, Parsons MB. Risk factors for death among children less than five years old hospitalized with diarrhoea in rural Western Kenya, 2005-2007: a cohort study. Journals.plos.org/plosmed. 2009.

[25] WHO. WHO readings on diarrhoea, student manual. In 2010.

[26] Castro EDR, Germini MCB, Mascarenhas JD, Gabbay YB, Lima IC, Lobo PS. Enteropathogens detected in a day-care centre, South-eastern Brazil. REvInstMedTropSao Paulo. 2015;57:27–32.

[27] Ogunlesi T, Okeniyi J, Oseni S, Oyelami O, Njokamma FO, Dedeke O. Parasitic aetiology of childhood diarrhoea. Indian J Pediatr. 2006;73:1081–4.

[28] Korie FC, Ikefuna AN, Ibe BC. Bacterial agents associated with acute diarrhoea in under-five children in Enugu, Nigeria. IOSR J Dent Med Sci. 2012;2:40–5.

[29] Fleisher GR, Matson DO. Acute diarrhoea in children (beyond the basics). 2016. May.

[30] Cohen MB. Aetiology and the mechanisms of acute infectious diarrhoea in infants in the United States. J Pediatr. 1991;118:34–6.

[31] Achema G, Chigbo R. Perception about bottle feeding among mothers in selected health care settings in Aba-South LGA, Abia State, Nigeria. Cont J Nurs Sci. 2011;3:1–6.