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Prevalence of diarrhoea and associated risk factors among children under-five years of age in Efoulan health district- Cameroon, sub-Saharan Africa

Abstract

Diarrhoeal disease is one of the main public health problems, although recent findings show that deaths due to diarrhoea among children less than 5 years decreased by 34.3% between 2005 and 2015 and decreased by 20.8% among people of all ages. It still remains an important preventable burden of disease, especially in south Asia and sub-Saharan Africa. The objectives of this study were to determine the prevalence of diarrhoea and its associate determinants after community vaccination with *rotavirus* vaccine among under-five children visiting health structures in the Efoulan health district of Yaoundé. This is hospital-based, cross-sectional study carried out among mothers/caregivers with under-five children during postnatal consultation at the various health structures of Efoulan health district. The prevalence of diarrhoea among under-five children in the four preceding weeks was 26.1% (95% CI 20.5- 32.3) with the age groups 6-12months the most affected ($p < 0.0005$). The duration of diarrhoea was between one and seven days with an average of 3.1±1.9 days. The diarrhoea symptoms mostly felt by participants were stomach ache/cramps, fever and vomiting and loss of appetite. Multivariable analysis showed that mothers'/caregivers' age, level of education, sex, child's age (≤ 12 months), mother's/caregiver's knowledge of diarrhoea, toilet facility, source of drinking water for the child, time trekked to fetch drinking water and rota vaccine were independently associated with diarrhoea. The study recommends effective actions to curb the diarrhoea prevalence by improving the basic hygiene practices, knowledge of diarrhoea, provision of portable water and the vaccination of the children against *rotavirus*.

Keywords: childhood diarrhoea, risk factors, rotavirus vaccine, Sub-Saharan Africa

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Introduction

Diarrhoeal disease is one of the main public health problems, although recent findings show that deaths due to diarrhoea among children less than 5years decreased by 34·3% between 2005 and 2015 and decreased by 20·8% among people of all ages.[1] Diarrhoea still remains an important preventable burden of disease, especially in south Asia and sub-Saharan

Africa.[1] About 94% of the diarrhoeal diseases burden is attributed to the environment and linked with risk factors such as unsafe drinking-water and poor sanitation.[2] The most of diarrhoeal diseases can be prevented by use of *rotavirus* vaccine along with the implementation of water, sanitation and hygiene (WASH) programmes, usually known as the five "F" (fluids, fields, flies, fingers and food).[3,4] Previous studies conducted on the effect of *rotavirus* vaccines have shown an excellent protection against diarrhoea mortality.[3] *Rotavirus* vaccines have the highest efficacy against severe *rotavirus* disease, rather than mild diarrhoea. The *rotavirus* vaccine known as 'Rotarix' was included in the routine vaccination calendar in all health units across Cameroon on April 1, 2014 and is administered orally free of charge in two does, the first at 6-12weeks of age and the 2nd dose from the 10-24 weeks of age to reduced childhood diarrhoea morbidity.

In Cameroon, paucity of data on diarrhoea morbidity and mortality exits and these epidemiological studies have indicated the community-based prevalence of acute diarrhoea to range from 16% to 23% among under-five under depending on the study site.[5,6] To our knowledge, there exist no epidemiological data on the prevalence of diarrhoea after the community vaccination with *rotavirus* vaccine. Thus, the aim of this study were to describe, the prevalence of diarrhoea and its associate determinants after community vaccination with *rotavirus* vaccine among under-five visiting health structures in the Efoulan health district of Yaoundé-Cameroon. This evaluative information will provide policy makers with knowledge on whether other measures such as actions that address social determinants and social inequities (social vaccines) are needed to be implemented alongside *rotavirus* vaccine or even the search for new vaccines against diarrhoeal diseases.

Method

Study design and setting

This study is a quantitative, cross-sectional study carried out among mothers/caregivers with under-five male and female children during their periodic postnatal consultation at the various health structures of Efoulan health district of Yaoundé namely the Efoulan district hospital and IMPM health centre between the months of January to May 2017. Efoulan health district is one of the six health district of Yaoundé city of Cameroon that provides health coverage to approximately 3million inhabitants.[7]

Sample size

The estimated sample size of the study was 230 mothers with under-five children calculated based on the 16% prevalence rate of childhood diarrhoea among under-five years children in Cameroon,[5] confidence interval of 95% (type value 1.96), random error of 5% (type value of 0.05) and a non-response rate of 10%, . The sample size was determined using the statistical formula of $N = Z2P (1-P)/d2$ for estimation of single population proportion in prevalence study.[8]

Data collection

We used well-structured interview schedule collect information from mothers/caregivers with children under five years. The questionnaire was developed after a thorough literature review of recent publications in the area of diarrhoea and its related factors. The interview schedule consists basically of two variables, namely outcome and explanatory variables. The incidence of childhood diarrhoea in an under-five child within the last four weeks preceding the study interview was considered to be the dependent variable and diarrhoea risk factors were the considered to be the independent variable. Diarrhoea was defined in our study as having three or more episodes of loose stools in any 24-h period within the preceding 28days before the interview[9] and rejected chronic diarrhoea previously experienced by the participants due to the underlying illnesses such as Crohn's disease, irritable bowel syndrome, colitis, diverticulitis of large intestine, or another chronic disease such as food allergy or medication use. After explaining the study goals and obtaining written informed consent, trained study staff interviewed mothers/caregivers in the various health center located at the Efoulan Health District using a well-structured Interview schedule, collecting information about participants demographics, environmental and behavioural characteristics, and the child's clinical diarrhoeal history.

Data analysis

All responses to the research data collection instrument were cleaned, coded and entered using Microsoft excel and exported to EPI info 7 for statistical analysis. Descriptive statistics was computed by means of frequency distribution and percentages and these were displayed using tables and graphs. Logistic regression analysis was performed individually for variables as a result of their dichotomous nature of dependent variable. The final model estimated the overall effect of the variables. Variables that had a likelihood ratio p-value < 0.05 at the bivariate analysis were included in the multivariate analysis to decrease the overcrowding of variables and to reduce the instability of the model. Also, previous variables that have been scientifically proven to affect diarrhoea prevalence were also included in the model and explored using a manual backward step wise method.[10] All the variables included in the analysis are specified in the tables below. The best-fit model was also verified by Bayesian Information Criterion (BIC) statistics of model comparison. The analysed variables were considered significant if p-value was < 0.05 level at 95% CI.

Ethical consideration

The study protocol was approved by the Centre Regional Ethics Committee for Human Health Research and ethical clearance obtained (CE N°00484/CRERSHC/2017). An administrative authorization was obtained from both the Centre Regional Delegation of Public Health and the Efoulan health district where the study took place. All data collected from the participants were anonymous and their confidentiality respected. Written consents were obtained from all participants after satisfactory explanation of the research objectives and questions answered before collecting data, and all participants were informed of their complete right to withdraw from the study at any time without any explanation, and without negative consequences.

Results

A total of 230 children were enrolled in the present study during the study period with only one child per family. There was no child for whom multiple diarrhoea cases were included in the results. The results revealed that the mean age of the mothers/caregivers was 27.2±4.4 years with most of them between the age of 16 and 29 years (62.6%). According to the results, 14.3% of the mothers were illiterates with no formal or had completed primary level of education (could not read and write) as compared to compared to 85.7% who were literate had secondary level of education and above (could read and write). Regarding the marital status of the mothers, 59.1% were married and 40.9% single. The majority (54.8%) of the participants' household had a family monthly income ≤100,000 FCFA (200 United States dollars).

Under-fives' demographics and health characteristics

The analysis revealed that majority (82.2%) of the children age were less than or equal 12months with an average age of 9.2±7.3 months. Over half (52.6%) of the under-five children were females while 47.4% were males. The number of children under 10 years of age living per household ranged between 1 and 6, with the average of 2.3±1.2 children. The analysis showed that 60 of the children had diarrhoea. Therefore, the prevalence of diarrhoea among under-five children the four preceding weeks was 26.1% (95% CI 20.5-32.3). Figure 1 shows the prevalence of diarrhoea by age group. The prevalence of diarrhoea is approximately equal between <6month olds (14 cases in 72 babies = 19.4%) and 6-12 month olds (23 cases in 117 babies = 19.7%) and highest in 13-59 month olds (23 cases in 41 children = 56%). The under-fives had diarrhoea for duration of between one and seven days, with an average of 3.1±1.9 days. Of the 60 children who had diarrhoea, over half (51.7%) had diarrhoea of at least two days duration "Percentage distribution of under-fives by diarrhoea duration is showed in Figure 2. The most prominent symptom experience by participants was also assessed, 55.9% of under-fives had stomach ache/cramps, 22.0% had fever and 22.0% other symptoms such as vomiting and loss of appetite as depicted in the Figure 3.

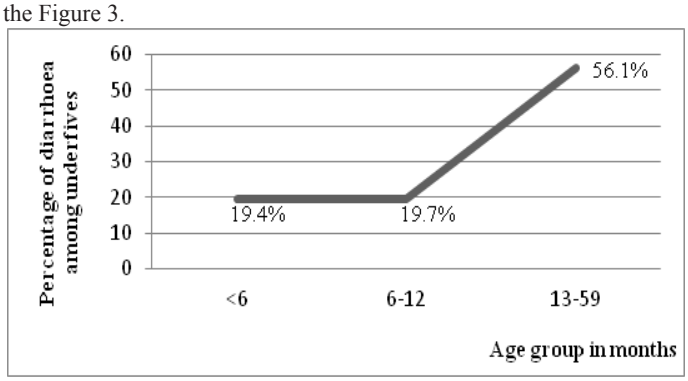

Figure 1 Prevalence of diarrhoea by age group in months at the Efoulan Health District.

Factors associated with childhood diarrhoea

At univariable analysis, mothers'/caregivers' age, marital status, level of education, sex, child's age (≤ 12 months), adult toilet, child's toilet, source of drinking water for the child and time trekked to fetch water were significantly associated with diarrhoea as depicted in Table 1 & Table 2 on multivariable analysis, mothers'/caregivers' age, level of education, sex, child's age (≤ 12months), mother's/caregiver's knowledge of diarrhoea, adult toilet, child's toilet, source of drinking water for the child, time trekked to fetch drinking water for the child and *rotavirus* vaccine were independently associated with diarrhoea (Table 1 & Table 2).

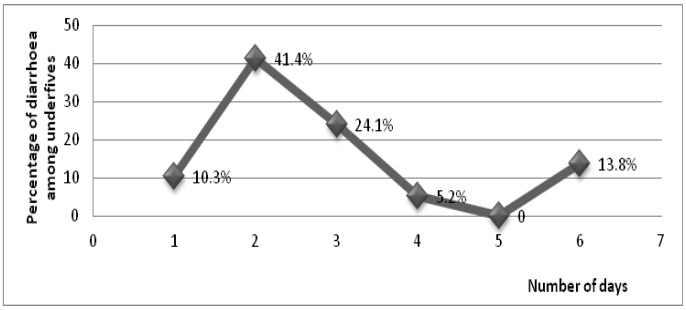

Figure 2 The percentage distribution by under fives and diarrhoea duration.

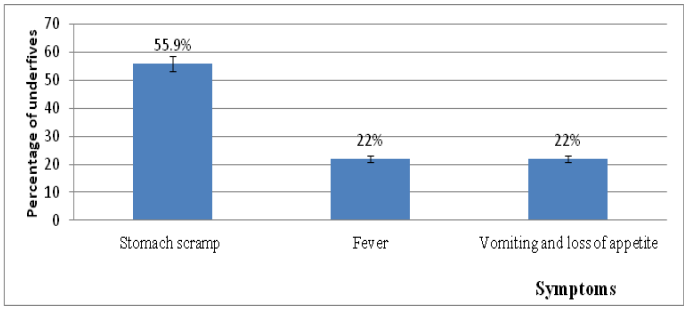

Figure 3 The percentage distribution by under fives and diarrhoea symptoms.

Table 1 participants' socio-demographic characteristics by diarrhoea prevalence (N=230)
*Statistically significant at P value < 0.05

	Diarrhoea rate		Total n(%)	Unadjusted Odd ratio (95% CI)	(P-Value)	Adjusted Odd ratio (95% CI)	(P-Value)
	Yes n(%)	No n(%)					
Mother's/caregiver's age							
16-25	13(12.6)	90(87.4)	103(100)	1		1	
26-38	47(37.0)	80(63.0)	127(100)	4.07(2.05- 8.06)	0.00*	5.26(2.38-11.60)	0.000*
Marital status of mother/caregiver							
Married	29(21.3)	107(78.7)	136(100)	1		1	
Single	31(33.0)	63(67.0)	94(100)	1.82(1.00-3.29)	0.04*	0.81(0.30-2.22)	0.685*
Level of education of mother/caregiver (years)							
Literate (8-20)	57(28.9)	140(71.1)	197(100)	1		1	
Illiterate (0-7)	3(9.1)	30(90.9)	33(100)	4.07(1.20-13.87)	0.02*	12.29(2.26-66.60)	0.003*
Monthly income in FCFA (US dollars)							
<50,000 ($100)	6(19.4)	25(80.6)	31(100)	1		1	
50,000-100,000 ($100-$200)	16(16.8)	79(83.2)	95(100)	0.84(0.30-2.39)	0.742	0.68(0.15-3.19)	0.6343
101,000-500,000 ($202-$1000)	38(36.5)	66(63.5)	104(100)	2.40(0.90-6.37)	0.079	3.56(0.72-17.68)	0.1205
Sex of the child							
Male	16(14.7)	93(85.3)	109(100)	1		1	
Female	44(36.4)	77(63.6)	121(100)	3.32(1.74-6.34)	0.00*	10.19(3.45-2.32)	0.000*
Age group of the child							
6	14(19.4)	58(80.6)	72(100)	0.19(0.08-0.44)	0.00*	0.36(0.13-0.96)	0.040*
12-Jun	23(19.7)	94(80.3)	117(100)	0.19(0.09-0.41)	0	0.20(0.08-0.49)	0.000*

Table 2 Diarrhoea risk factors among participants in Efoulan health district (N=230)
*Statistically significant at P value < 0.05

Characteristics	Diarrhoea rate		Total n(%)	Unadjusted Odd ratio (95% CI)	(P-Value)	Adjusted Odd ratio (95% CI)	(P-Value)
	Yes n(%)	No n(%)					
Type of toilet facility used by the adult							
Pit toilette/bushes/Stream	33(34.0)	64(66.0)	97(100)	1		1	
Flushing toilette	27(20.3)	106(79.7)	133(100)	0.46(0.25-0.83)	0.0104	0.08(0.03-0.20)	0.0000*
Type of toilet facility used by the Child							
Portable toilet	30(56.6)	23(43.4)	53(100)	1		1	

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Table Continued....

Characteristics	Diarrhoea rate		Total n(%)	Unadjusted Odd ratio (95% CI)	(P-Value)	Adjusted Odd ratio (95% CI)	(P-Value)
Diapers	30(18.8)	130(81.3)	160(100)	0.18 (0.09-0.35)	0.000*	0.10(0.04-0.24)	0.0000*
On soil around the compound/stream	0(0.0)	17(100.0)	17(100)	0.00(0.00-1.0e12)	0.9637	0.00(0.00-1.0e12)	0.9593
Source of drinking water for the child							
Mineral water	37(22.8)	125(77.2)	162(100)	1		1	
Tap	18(46.2)	21(53.8)	39(100)	2.90(1.40-6.00)	0.004*	12.51(3.75-41.70)	0.0000*
Borehole	5(55.6)	4(44.4)	9(100)	4.22(1.08-16.54)	0.038*	0.97(0.12-7.70)	0.9743
No water	0(0.0)	20(100)	20(100)	0.0(0.0-1.0e12)	0.9643	0.00(0.00-1.0E12)	0.9611
Time trekked to fetch drinking water (Minutes)							
0-9	57(28.8)	141(71.2)	198(100)	1		1	
10 and more	3(9.4)	29(90.6)	32(100)	0.26(0.08-0.87)	0.029*	0.26(0.08-0.88)	0.0316*
Gave first breast milk or Colostrums							
Yes	56(27.3)	149(72.7)	205(100)	1		1	
No	4(16.0)	21(84.0)	25(100)	0.51(0.167-1.5)	0.2312	0.82(0.18-3.8)	0.8
Rotavirus vaccine							
Yes	46(29.7)	109(70.3)	155(100)	1		1	
No	14(18.7)	61(81.3)	22(100)	0.54(0.28-1.07)	0.0771	0.18(0.04-0.79)	0.0237*
Living with domestic animal							
No	48(27.6)	126(72.4)	174(100)	1		1	
Yes	12(21.4)	44(78.6)	56(100)	1.40(0.68-2.87)	0.3627	1.34(0.60-2.99)	0.479
Mother's/caregiver's knowledge of diarrhoea							
Good	50(24.5)	154(75.5)	204(100)	1		1	
Poor	10(38.5)	16(61.5)	26(100)	1.93(0.82-4.51)	0.1319	14.28 (3.33-62.11)	0.0003*

Discussion

This study examined the prevalence and risk factors associated with the occurrence of childhood diarrhoea in a *rotavirus* vaccinated health district of Efoulan in Cameroon. Despite the availability of *rotavirus* vaccine, diarrhoea remains a high burden disease in the study area. The finding of the present study revealed that the prevalence of diarrhoea among under-fives in this vaccinated community was 26.1% in the previous four weeks preceding the interview. This rate was more prevalent compared to study findings by the Cameroonian Demographic and Health Survey of 2014, in which national prevalence rate of diarrhoea was 21% among five years children in Cameroon.[5] The possible reason might be that *rotavirus* was not the most significant cause of diarrhoea in the area of study. Furthermore, the great disparity in prevalence rates might be due to seasonal variation. The data for the present study was collected during the wet season, when diarrhoea prevalence has been reported to be high.[6,11] The findings of this study indicated that the duration of diarrhoea ranged between one and seven days. Over half (51.7%) of the under-fives had at least one or two days of diarrhoea. These findings aligned with the results of the previous studies carried out among under-fives in Tanzania.[12]

The mother's/caregiver's age had a significant impact on diarrhoea exposure. This may be explained through an increasing experience/knowledge in childcare, improving hygiene and feeding practices with advanced age. The study also revealed that mother's/caregiver's level of education was a crucial contributor to high prevalence of childhood diarrhoeal diseases in the areas study. The analysis revealed that the odds of diarrhoeal diseases of children whom mothers/caregivers were illiterate (could not read/write) were higher than children whose mothers were literate. The findings are similar with studies conducted in Ethiopia[13,14] and in the rural area of Zaire-Congo to determine diarrhoea morbidity among under-five.[15] In addition, the findings showed that mothers' knowledge of the causes and prevention of diarrhoeal diseases was a significant protective factor for childhood diarrhoea. This might be due to the fact that those who are informed of causes and preventions measures are likely to adopt a healthy habit to diarrhoea than those who are ignorant.

The sex of the child was significantly associated with diarrhoea prevalence in the area of study with more females infected than males. Contrary to an earlier study conducted in Ethiopia to evaluate the epidemiology of *rotavirus* infection among young children with acute diarrhoea revealed that there were more males than females, but the sex ratio among the *rotavirus* diarrhoea patients was not significant.[16] In addition, another study conducted in Burundi showed that gender did not play a considerable role as regards diarrhoea prevalence across the different age groups.[17] The risks of having diarrhoeal morbidity associated with the age of children remain highly significant after adjusting for all the socio-economic variables. The findings revealed that the risk of having diarrhoea in the four-week reference period reached its peak at 6-12 and 13-59months. This pattern aligned with the findings of previous studies conducted in Sub-Saharan Africa.

For instance, a prevalence study conducted in Ethiopia revealed that diarrhoea was significantly associated with children in the age groups 6–11months and 12–23months compared to children aged above 35months.[18] Additionally, crawling begins at this age and the probability of ingesting infected materials may cause diarrhoea and most of the children surveyed within these age groups did not take the second dose of *rotavirus* to be completely immunised. Also, the lower prevalence among less than 6 months children might be as a result of breast milk, inborn immunity, *rotavirus* vaccine and less exposure to contaminated agents during the early period. The portable toilet used by the child and pit toilette or bushes used by adult showed a significantly higher risk of diarrhoeal diseases among under-fives when examined in the both univariable and multivariable analysis. This corroborates with previous studies conducted to revealed diarrhoea determinants among under-fives in sub-Saharan Africa.[6,19] The finding is also in agreement with a study carried out in Nepal to evaluate mothers' beliefs and barriers about childhood diarrhoea and its management in Morang district.[20] This is due to the fact that diarrhoea is generally due to exposure to diarrhoea-causing organisms which is mainly found in faeces.

Another major concern revealed in this study is the significant association between diarrhoea prevalence and unsafe drinking water source of water for the children. This might be because drinking water is a potential risk of diarrhoea-causing organisms' transmission. However, this confirmed the findings of earlier studies that reported diarrhoeal causative agent in several waterborne outbreaks in the industrialized countries.[21,22] Another controversial debate, reflected by our study results, addresses the relationship of time trekked to fetch drinking water and diarrhoeal episodes. Our results were similar to findings from previous case-control study conducted among under-fives in Tanzania which showed a higher risk of diarrhoea when the time trekked to fetch drinking water decreased.[23] A possible explanation for our finding could be a higher exposure to contaminated drinking water and thus higher chances of pathogen uptake and transmission.[23] Still, these findings do not allow any conclusive decision about time trekked to fetch drinking water and diarrhoea exposure. *Rotavirus* vaccine showed a significant relationship with diarrhoea occurrence among children under-five. Evidence from studies suggests that *rotavirus* vaccines effectiveness and efficacy provide sufficient prevention against *rotavirus* episodes and *rotavirus* death among under-five thus reducing the morbidity and mortality of diarrhoea among this age group. Even though its efficacy varied from by setting, due to regional differences in circulating *rotavirus* vaccine strains[24] and reduced efficacy of oral vaccines in settings with a high prevalence of malnutrition and gastrointestinal infections.[25,26] Our study might have some limitations that should be considered when interpreting these findings. Our measure of diarrhoea prevalence and risk factors was based on mother's recall of episode of diarrhoea and care given during this period. This could have led to differential recall bias and may not completely reflect the level of quality of care in facilities. Further studies using qualitative methodologies are needed to explore local and cultural beliefs and practices in determining caregiver understandings of diarrhoea. Despite the shortcomings, our study clearly reports the baseline data regarding childhood diarrhoea in urban Cameroon after *rotavirus* vaccination. It reveals that the prevalence of diarrhoea in under-five in the Efoulan Health District remains high even after *rotavirus* immunisation with children between 6-12months of age being the most affected.

The study also identified important socioeconomic, behavioural and environmental determinants that contribute to the occurrence of diarrhoea in under-five children. Amongst others, our findings summarise how diarrhoea prevalence can be positively affected by improving the basic knowledge of diarrhoea and hygiene practices, provision of portable water and the vaccination of the under-fives against *rotavirus*. Upcoming projects should lay emphasis on the education of the mother/caregivers, hygiene education of the local population and the provision of portable water in order to maximize the impact on children's health.

Authors' contributions

ABT and JAN prepared the protocol. ABT, JAN, NEC, NAC, EVJ, BR, MNG and DNL participated in the data collection and analysis, writing and approval of the final manuscript before submissions.

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Conflict of interest

Authors declare that there is no conflict of interest.

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