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The epidemiology of acute diarrhoea in a rural community in Imo State, Nigeria

SHARON R.A. HUTTLY[1], DEBORAH BLUM[2], BETTY R. KIRKWOOD[1], ROBERT N. EMEH[3] AND RICHARD G. FEACHEM[2]

[1]*Tropical Epidemiology Unit and* [2]*Department of Tropical Hygiene, London School of Hygiene and Tropical Medicine, Keppel Street, London, WC1E 7HT;* [3]*Ministry of Economic Development, Imo State, Nigeria*

Abstract

As part of an evaluation of a water supply and sanitation project, a baseline cross-sectional study of diarrhoea, and its putative risk factors, was conducted in 5 villages in Imo State, Nigeria. Data were collected from 4641 and 5920 persons during surveys in the dry and wet seasons, respectively. 8 d period prevalence rates for diarrhoea ranged from 5 to 50%, with the highest rates occuring in the 6 to 23 month age group. Diarrhoea was associated with up to 75% of all illnesses in young children and with about 20% in adults. Risk factors included lower socio-economic status, an unclean domestic environment, use of non-purified water, absence of soap, and feeding methods other than exclusive breast-feeding in the early months of infancy. These results suggest that the education component of water supply and sanitation projects should emphasize personal and domestic hygiene and infant feeding.

Introduction

An evaluation of a water and sanitation project is in progress in Ohaozara local government area, a rural area of Imo State in southeastern Nigeria. The project, supported by UNICEF and the Imo State Government, consists of an intervention "package" of water supply (boreholes with handpumps), sanitation (promotion and construction of ventilated improved pit latrines), and health and hygiene education (through the training of village-based workers). The evaluation is focussed on the impact of the project on water- and excreta-related diseases and on intervening factors. In this paper we present data collected during baseline surveys on the prevalence of, and risk factors for, diarrhoeal diseases in children and in adults. Such data are scarce in West Africa and are important for the design of projects to control diarrhoeal diseases.

Survey Design and Methods

5 villages were enrolled in the study, 2 in September 1982 and 3 in February 1983. Data collection continued until June 1986. 3 villages were from the area designated to receive the project (the intervention area), which was implemented throughout 1984, and 2 were from an area which would not receive the project during the time of the evaluation (the control area).

Cross-sectional surveys were conducted bi-annually, once in the late dry to early wet season (February to May) and once at the peak of the wet season (July to October) in each year. These will be referred to as the dry and wet season surveys respectively. The data presented were obtained from the surveys conducted in 1983, the first complete year of data collection in all 5 villages. As the intervention and control areas were initially very similar with respect to important socio-demographic characteristics, access to water supplies and hygienic practices, we present combined results from all 5 villages.

Questionnaires were administered by locally trained enumerators and all interviewing was conducted in Ibo, the local language. This is a polygamous society and each household consists of one or more household units, defined as a group of persons who feed from the same pot and usually share the same living quarters. One questionnaire per household unit was administered. Completed questionnaires were obtained from 85-90% of household units. Most of the households not interviewed were temporarily absent from the area.

The following questions were asked about each member of the unit who had been living in the unit for the 8 days (a period of 2 Ibo weeks) before the interview (a) "Has —— been ill during the last 8 days?" (b) "Has —— had diarrhoea during the last 8 days?" The answers were used to compute 8 d period prevalence rates for illness (including diarrhoea) and diarrhoea, respectively, which we will refer to simply as prevalence rates. The most common illnesses elicited by the first question included fever, diarrhoea, guinea worm, cough and skin infections. Diarrhoea was defined as 3 or more stools of a consistency less than normal in a 24 h period. For chidren under 5 years of age, the presence of diarrhoea during the previous 24 h was also recorded.

The person responsible for each unit, usually a wife of the head of the household, gave information for all members of the unit, except when other adults were present for the interview in which case they were questioned individually about illnesses. Questions were also asked about water supply and usage, sanitation practices, hygiene knowledge, treatment of diarrhoea and the breast-feeding and weaning practices of young children. Thus each individual contributed twice to the analyses, once with dry season data and once with wet season data. Data on pregnancy, occupation and educational status were also collected once a year from each individual, together with information on recent births and deaths in the household unit. In 3 villages this socio-economic questionnaire was administered during the dry season and in 2 villages during the wet season.

Observations were made about the type of housing and living conditions. Households living in premises with unrendered mud walls *and* mud floors were classified as having 'poor housing status', whilst those who had made an improvement to either of the 2 were considered to have 'improved housing status'. The possession of a luxury item, such as a radio, bicycle or motor-cycle, was also recorded.

All analyses were controlled for the possible confounding effects of age and sex. The Mantel-Haenszel summary χ^2 test was used to compare prevalence rates. A log-linear model with a binomial error was used to evaluate the role of various possible risk factors for diarrhoea, considered in 2 subsets, those relating to the environment and hygiene practices and those relating to socio-economic status. The protective effect of breast-feeding among children aged less than two years was also investigated.

Results

1364 household units in the dry season and 1459 in the wet season were successfully interviewed. 4641 of 6318 (73.5%) and 5920 of 7303 (81.1%) residents were living in the households during the 8 days before interview, in the dry and wet seasons respectively. About 57% were female and 53% were less than 15 years of age. Table 1 shows the age-sex distribution of the population included in the analyses, for each season.

Morbidity

Prevalence rates of diarrhoea varied considerably with age, ranging from 5% to 50% (Fig. 1a), with the highest rates occurring in the 6-11 month and 12-23 month age groups. Rates were similar throughout adulthood, with a slight tendency to increase in the later years of life. Among children aged less than 5 years, prevalence of diarrhoea was consistently higher for males than females in both seasons ($P<0{\cdot}01$), but this trend was reversed amongst adults ($P<0{\cdot}001$). Overall, prevalence rates were higher in the dry season than in the wet, although this was not consistent over all age-sex groups. The difference was statistically significant for children under 2 years of age ($P<0{\cdot}05$), and for adults ($P<0{\cdot}001$). In contrast, the prevalence of diarrhoea was higher in the wet season for children aged between 2 and 4 years ($P<0{\cdot}05$).

A high proportion (65% in the dry season and 44% in the wet season) of children recorded as having diarrhoea during the previous 8 d were also reported as having diarrhoea during the previous 24 h.

The prevalence rates of any illness showed a different age pattern to those of diarrhoea (Fig. 1b), with the proportion of illnesses associated with diarrhoea varying considerably with age (Fig. 1c). As well as peaking in the 6-23 month age range, the prevalence of any illness increased substantially throughout adulthood. In general the rates were higher for males in the young age groups ($P<0{\cdot}05$) and higher for females in the older age groups($P<0{\cdot}001$). In contrast to diarrhoea, the rates were, on average, slightly higher in the wet season than in the dry ($P<0{\cdot}05$).

Diarrhoea was associated with up to 75% of illnesses in young children and about 20% of illnesses in adults (Fig. 1c), confirming that it is a major cause of morbidity in this community. Males had a higher proportion of diarrhoea-associated illnesses than females among children aged less than 5 years ($P<0{\cdot}05$), but amongst adults the proportions were very similar. Overall, diarrhoea accounted for a higher proportion of illnesses in the dry season than in the wet ($P<0{\cdot}001$), the difference being most marked in the younger age groups.

Environmental/hygienic risk factors

The relative risks of diarrhoea associated with various environmental and hygienic factors are presented in Table 2. Results are shown separately for children aged 0-4 years, children aged 5-14 years and adults, and for the two seasons. Purification of water (filtering, boiling, or addition of alum) was a protective factor in the dry season, an increased risk of 1·3 (95% confidence interval (CI) = 1·1-1·6) being associated with non-purification of water. The presence of rubbish in the household compound was also a risk factor for diarrhoea (relative risk (RR) = 1·3, 95%CI = 1·0-1·6). Almost all households had animals within the compound (usually chickens, goats, dogs and cats). However, for those people living where animals were allowed inside the house, there was a significantly reduced risk of diarrhoea (RR = 0·8, 95%CI = 0·7-0·9), particularly amongst older children. The absence of soap in the household indicated an increased relative risk of diarrhoea although this was statistically significant only for children aged 5-14 years in the wet season. Not covering water containers and the presence of faeces in the compound each yielded slightly raised relative risks of diarrhoea, although these were not significant at the 5% level. There was no significant difference in the risk of diarrhoea for those drinking rainwater only compared to those drinking water from other traditional sources.

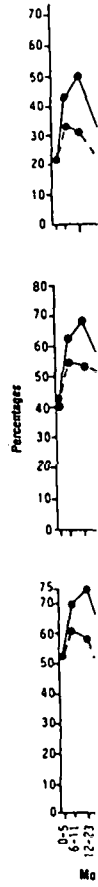
Socio-economic risk factors

The relative risks of diarrhoea associated with various socio-economic factors are shown in Table 3. Similar results were found in both seasons and so they have been combined. A significantly reduced risk of diarrhoea (RR = 0·8, 95%CI = 0·6-1·0) was found among those living in 'improved' housing. There was

Table 1—Age-sex distribution of the analysed population, by season

Age group	Dry season		Wet season	
	Male	Female	Male	Female
0-5 months	45(1)*	56(1)	51(1)	57(1)
6-11 months	60(1)	61(1)	63(1)	74(1)
12-23 months	75(2)	94(2)	151(3)	147(3)
2-4 years	352(8)	348(7)	370(6)	385(7)
5-9 years	426(9)	442(10)	582(10)	610(10)
10-14 years	216(5)	269(6)	283(5)	312(5)
15-29 years	192(4)	562(12)	293(5)	712(12)
30-44 years	250(5)	529(11)	319(5)	665(11)
45-64 years	252(5)	279(6)	334(6)	331(6)
65+ years	63(1)	43(1)	72(1)	56(1)

* Numbers in parentheses are percentages of seasonal total.



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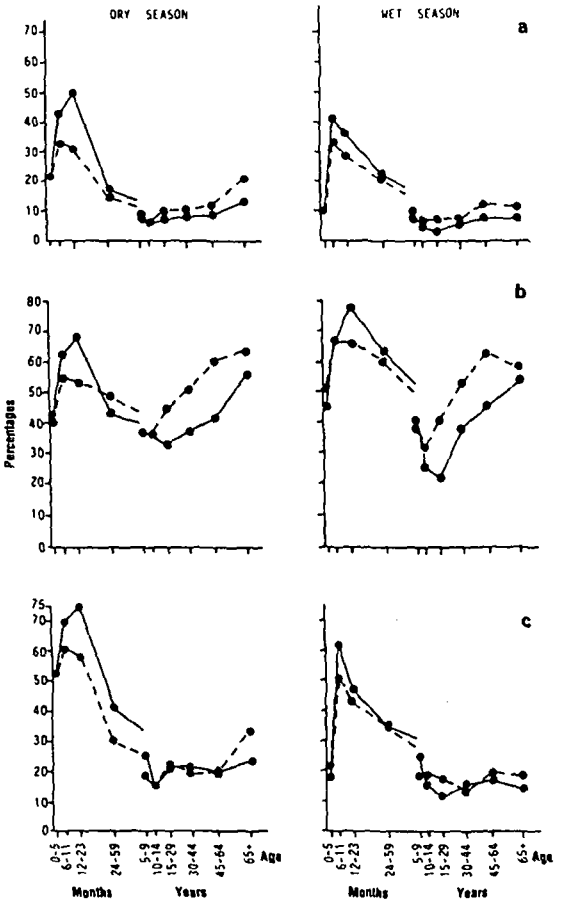

Fig. 1. Diarrhoea and morbidity during 8 days before interview by age, sex and season. a, Percentage with diarrhoea; b, percentage with any illness; c, percentage of illnesses associated with diarrhoea.

—— Males; --- females.
Age is shown on different scales <5 and ≥5 years old; discontinuities therefore exist in the curves at the change-over point.

also a tendency for the possession of a luxury item to yield a slightly reduced relative risk of diarrhoea, although this was statistically significant only amongst children aged 5-14 years.

Educational level was not associated with risk of diarrhoea for adults, nor was occupation. There was also little evidence of any influence of parental age, education or occupation on risk of diarrhoea among children. A significantly reduced risk was found in the wet season for children aged 5-14 years whose fathers had received some education compared to those whose fathers had received no education (RR = 0·5, 95%CI = 0·3-1·0). Those children under 5 years whose fathers were farmers experienced a raised risk of diarrhoea in the wet season compared to those children whose fathers had other occupations (RR = 1·3, 95%CI = 1·0-1·6).

Pregnant women experienced a considerably reduced risk of diarrhoea (RR = 0·3, 95%CI = 0·1-0·8).

Breastfeeding during the first two years of life

Fig. 2 shows, for each month of age, the percentages of children who, at the time of interview, were exclusively breast-fed, partially breast-fed and non-breast-fed. Further questioning of mothers and health workers established that, generally, mothers continued breast-feeding when their children had diarrhoea. Thus feeding mode at the time of interview was considered as the child's usual recent feeding mode.

During infancy (0-11 months) almost all children received breast milk. The percentage who were exclusively breast-fed declined sharply with age from 100% in the first month of life to around 5% in the last 6 months of infancy. This corresponded to a rise in the percentage of those partially breast-fed. During the next 12 months of life (12-23 months), the percentage of those exculsively breast-fed fell to zero, whilst that of partial breast-feeding fell rapidly to 10% and that of non-breast-feeding rose to almost 90% by the end of the second year of life.

588 mothers interviewed in the dry season and 645 interviewed in the wet season had recently completed breast-feeding a child. The median age at which supplementary feeding was introduced was 4 months, and the median duration of breast-feeding was 18 months.

The relative risks associated with different feeding modes are shown in Table 4. Infants in the first 3 months of life who were partially, or not, breast-fed experienced significantly raised risks of diarrhoea compared to those who were exclusively breast-fed. The risk associated with partial breast-feeding was also increased in the 3 to 5-month age group, but thereafter there was no significant risk of diarrhoea associated with feeding mode.

Discussion

Because of economic and time constraints, relatively inexpensive, simple and quick cross-sectional surveys were necessary and there was no attempt, therefore, to validate all the data collected. However, a number of quality control measures were carried out; randomly repeated interviews were conducted, direct observations were made and when possible 'control' questions were asked. For example, in order to check for 'over-response' to the question on whether hands were usually washed after defaecating, the respondent was also asked whether hands were washed *before* defaecating. We believe that the overall quality of the data is good.

The high proportion of children with diarrhoea during the previous 8 d who also had diarrhoea during the previous 24 h suggests that there may be under-reporting of diarrhoea during the past 8 d, possibly in particular for episodes of short duration or those finishing at the beginning of the 8-d period. However it is also possible that the 24 h rate is over-reported. Diarrhoea both on the day of interview and the entire previous day may have been reported. The discrepancy was considerably less in the wet season than the dry, which may have been due to an increased awareness of diarrhoea amongst mothers, since a detailed diarrhoea morbidity study was by this time underway in 4 of the villages.

We found high prevalence rates of diarrhoea amongst all subgroups of the study community. The

Table 2—Relative risks (RR) of diarrhoea for environmental/hygienic factors[a]

Risk factor	Level		Children (0-4 years) season		Children (5-14 years) season		Adults (15+ years) season		All ages[b] season	
			Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Water quality	Non-purified	%	73	81	74	83	73	84	73	83
		RR	1·2	0·9	1·5	0·9	1.4*	1·0	1·3*	0·9
Water storage	Container uncovered	%	3	3	3	3	4	3	3	
		RR	0·9	1·1	1·4	2·3	0·8	1·6	1·1	
Absence of soap	Soap not in household	%	33	32	37	40	34	37	36	
		RR	1·1	1·0	0·8	1·8**	1·0	1·3	1·1	
Rubbish in yard	Yes	%	91	90	91	92	91	91	91	
		RR	2·1**	1·1	1·0	1·6	0·9	1·7	1·3*	
Faeces in yard	Yes	%	58	58	59	60	55	58	58	
		RR	1·2	1·0	1·2	1·3	1·0	1·1	1·1	
Animals in house	Yes	%	58	55	58	54	53	51	54	
		RR	1·0	0·8	0·6*	0·7	0·9	0·8	0·8**	
Drinking water	Rainwater only	%	0	13	0	11	0	12	0	12
		RR	—	1·1	—	1·0	—	1·0	—	1·1

* $P<0·05$
** $P<0·01$
[a] Age and sex of subject controlled for in analysis.
[b] Risks are presented separately for each season, only where a seasonal influence is present.

Table 3—Relative risks (RR) of diarrhoea for socio-economic factors[a]

Risk factor	Level		Children (0-4 years)		Children (5-14 years)		Adults (15+ years)	All ages
Housing status	Improved status	%	17		15		14	15
		RR	0·8*		0·9		0·7	0·8*
Wealth status	Possesion of a luxury item	%	77		70		67	70
		RR	1·0		0·6**		0·9	0·9
Pregnancy (*females* 15+ years)	Yes	%					7	
		RR					0·3**	
Education (adults)	Any education	%	29[b]	10[c]	22[b]	7[c]	26	
		RR	1·0	1·0	1·7/0·5*[d]	1·2	1·0	
Occupation (adults)	Farming vs other	%	51[b]	50[c]	57[b]	58[c]	44	
		RR	1·0/1·3*[d]	1·0	0·9	1·1	1·1	

* $P<0·05$
** $P<0·01$
[a] Age and sex of subject controlled for in analysis.
[b] Father's education/occupation.
[c] Mother's education/occupation.
[d] Dry season RR/wet season RR, where these differ.

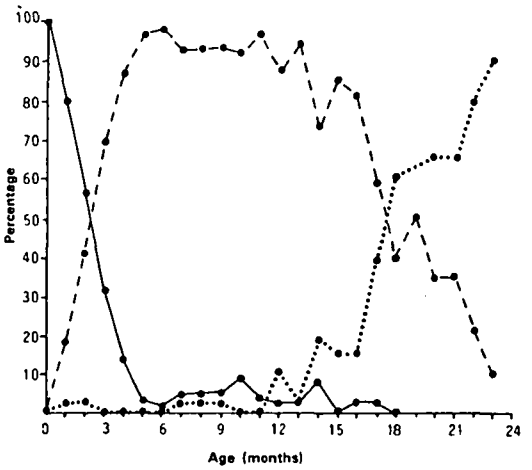

Fig. 2. Feeding mode of children aged 0-23 months, according to age.
... Not breast-fed; ---- partially breast-fed; ——exclusively breast-fed.

age-specific pattern was similar to that seen in other countries (GUERRANT *et al.*, 1983; SNYDER & MERSON, 1982), with the highest prevalence rates occuring amongst children aged less than 5 years, and the peak between 6 and 23 months. A higher prevalence rate for male children aged less than 5 years was evident in both seasons. The reverse sex difference was seen in adults, although this may be due to reporting bias, since the men were rarely present for interview. This is substantiated by an observed difference in illness rates between the adult sexes, but with a similar proportion of illnesses associated with diarrhoea. This was not so for children, however, for whom no difference was found between the sexes for illnesses not related to diarrhoea, suggesting that the higher illness rates among male children were attributable to higher diarrhoea rates.

Assuming that on average an episode of diarrhoea lasts 4 d, the observed prevalence rates suggest that adults would experience on average about 1·5 episodes of diarrhoea during the dry season and about 1 episode during the wet season. The corresponding

Table 4—Relative risks (RR) of diarrhoea for feeding modes in children 0-1 years[a]

Feeding mode		Age (months) 0-2 $n = 77$	3-5 $n = 122$	6-11 $n = 240$	12-17 $n = 257$	18-23 $n = 186$
Exclusively breast-fed	%	71	18	5	3	0
	RR	1·0	1·0	—	—	—
Partially breast-fed	%	26	82	94	81	32
	RR	3·3	4·8	1·0	1·0	1·0
Not breast fed	%	3	0	1	16	68
	RR	10·2	—	0·8	0·9	0·8
χ^2 Test[b] (df = 1)		4·9*	4·5*	1·0	0·1	1·6

* $P<0·05$
[a] Age and sex of subject controlled for in analysis.
[b] Where 3 feeding categories are included within an age group, a χ^2 test for linear trend is presented.

rates for young children are up to 8 episodes during the dry season and up to 6·5 episodes during the wet season. These incidence rates provide only an approximation to the true rates that a continuous surveillance study would show; such a study has recently been completed and is currently being analysed. Combining the estimates for the 2 seasons within age groups gives a maximum rate of about 14 episodes per year in the 6 to 11 m age group, yielding a diarrhoea illness rate of 56 d per child-year. These estimated rates are higher than those reported in other studies (SNYDER & MERSON, 1982), although our definition of diarrhoea would include milder episodes than those recorded in some of those studies. The 56 d per child-year is, however, similar to the 61 d per child-year found in a one-year prospective cohort study in Matlab, Bangladesh (BLACK *et al.*, 1982), and to the 50 d per child-year found in a 30-month village surveillance study in Pacatuba, northeastern Brazil (GUERRANT *et al.*, 1983).

The influence of environmental and hygienic risk factors was more apparent in the dry season, when water is scarce and sources are more heavily polluted (BLUM *et al.*, 1987). Children in particular seem to be at risk of diarrhoea in an unhealthy environment. 18% of dry season episodes of diarrhoea (95%CI = 5%-31%) could be attributed to non-purification of water and 21% of all episodes (95%CI = 6%-37%) were associated with presence of rubbish in the yard, suggesting that a considerable reduction in diarrhoea rates could be achieved by improving these factors. The protective effect of animals in the house against diarrhoea is not easily explained and may be due to confounding by other factors. The lack of association between type of drinking water source and the risk of diarrhoea suggests either that water is contaminated after collection, irrespective of the quality of the source, or that other environmental or hygienic factors are involved.

As might be expected, people of lower socio-economic status were at increased risk of diarrhoea. Poor housing status accounted for 18% of episodes in the population (95%CI = 5%-30%). However, little association was found between diarrhoea and level of education or occupation. The finding of the protectiveness of pregnancy against diarrhoea was surprising. It is possible that pregnant women, being more confined to their nearby surroundings, are less exposed to certain environmental risk factors, such as might be found when farming or collecting water, or it may be that pregnancy confers other benefits. There were insufficient numbers of pregnancies to investigate any relationship between diarrhoea rates and stage of pregnancy.

The protective effect of exclusive breast-feeding in infancy against diarrhoea has been found in other studies, reviewed by FEACHEM & KOBLINSKY (1984). In the 0 to 2 month age group, 47% of episodes (95%CI = 8%-86%) could be attributed to non-exclusive breast-feeding, whilst in the 3-5 month age group, 76% of episodes (95%CI = 32%-100%) could be attributed to this factor. These findings suggest that exclusive breast-feeding or improvement of weaning practices, or both, could greatly reduce the diarrhoea rates in children of these ages. If bias in the risk estimation is operating with regard to socio-economic status, it would be in the direction of under-estimating the risk of diarrhoea associated with non-exclusive breast-feeding since those of poor socio-economic status are both more likely to be breast-fed and to be at higher risk of diarrhoea. Of the socio-economic factors examined, only housing status was associated with diarrhoea. Controlling for this did not, however, affect the results obtained for the relationship between feeding mode and diarrhoea.

Few children were exclusively breast-fed beyond 6 months and so we concentrated on a comparison of partial and non-breast-feeding in this age range. Although the risk of diarrhoea was, overall, higher for the 6-23 month age group, there was no difference between children who were non-breast-fed compared to those who were partially breast-fed. This suggests that other factors, possibly environmental, against which partial breast-feeding offers inadequate protection, start to play a role in this age range.

In conclusion, a carefully designed cross-sectional study can be a useful, quick and low-cost tool for the collection of epidemiological data on diarrhoea. The cross-sectional data collected in Imo State demonstrated a high diarrhoea prevalence rate, particularly in children 6-23 months of age. Risk factors identified included lower socio-economic status, living in an

unclean environment, use of non-purified water, absence of soap, and non-exclusive breast-feeding in the early months of infancy. These results suggest that the health and hygiene education component of rural water and sanitation projects should emphasize the improvement of personal and domestic hygiene and the feeding practices of young children, in order to reduce the prevalence of diarrhoea. The study also suggests that households of lower socio-economic status merit particular consideration in the planning and implementation of water and santitation projects.

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References

Black, R.E., Brown, K.H., Becker, S. & Yunus, M. (1982). Longitudinal studies of infectious diseases and physical growth of children in rural Bangladesh. I. Patterns of morbidity. *American Journal of Epidemiology*, **115**, 305-314.

Blum, D., Huttly, S.R.A., Okoro, J.I., Akujobi, C., Kirkwood, B.R. & Feachem, R.G. (1987). The bacteriological quality of traditional water sources in northeastern Imo State, Nigeria. *Epidemiology and Infection* (in press).

Feachem, R.G. & Koblinsky, M.A. (1984). Interventions for the control of diarrhoeal diseases among young children: promotion of breast-feeding. *Bulletin of the World Health Organization*, **62**, 271-291.

Guerrant, R.L., Kirchoff, L.V., Shields, D.S., Nations, M.K., Leslie, J., de Sousa, M.A., Araujo, J.G., Correia, L.L., Sauer, K.T., McClelland, K.E., Trowbridge, F.L. & Hughes, J.M. (1983). Prospective study of diarrheal illness in northeastern Brazil: patterns of disease, nutritional impact, etiologies and risk factors. *Journal of Infectious Diseases*, **148**, 986-997.

Snyder, J.D. & Merson, M.H. (1982). The magnitude of the global problem of acute diarrhoeal disease: a review of active surveillance data. *Bulletin of the World Health Organization*, **60**, 605-613.

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