

East African Medical Journal Vol. 86. No. 11 November 2009

DETERMINANTS OF ACUTE DIARRHOEA IN CHILDREN AGED 0 – 5 YEARS IN UGANDA

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ABSTRACT

Background: Diarrhoea disease remains one of the leading causes of morbidity and mortality in sub-Saharan Africa. Using a large national dataset, this study determines its prevalence and identifies some of the determinants in one of these countries, Uganda.

Objective: To establish the prevalence and determinants of acute diarrhoea in children aged 0 – 5 years in Uganda.

Design: Cross-sectional study using the 2000/2001 Uganda Demographic and Health Survey (UDHS) dataset.

Subjects: Information was derived from the women's questionnaire done on sampled mothers aged 15 – 49 years and with living children aged 0 – 5 years.

Results: Overall prevalence of diarrhoea in children aged 0 – 5 years was 23.8%. The Northern and Eastern regions of the country had the highest prevalence of diarrhoea in children (29.3% and 26.9% respectively). Independent determinants of diarrhoea were: age-group below two years, Northern and Eastern regions of residence, and children with history of fever in the two weeks preceding survey. Mother attaining secondary or higher level of education, covered well or borehole as source of drinking water, and duration of breastfeeding less than six months, were found protective factors.

Conclusion: According to results of the UDHS 2000/2001, every two weeks, one in four children in Uganda is affected by diarrhoea. Factors associated with increased diarrhoea include: age-group one to two years, children living in Eastern and Northern parts of the country, and children who had fever within those two weeks. Factors associated with reduced diarrhoea incidence include: mother's education level higher than primary school, covered well or borehole as family source of drinking water, and duration of breastfeeding less than six months.

INTRODUCTION

In the year 2000, Uganda had the 14th highest number of under-5 child deaths (145,000) in the world and is one of the 42 countries in the world that contribute about 90% of all under-5 childhood deaths in the world (1). At 134 deaths per 1000 live births, Uganda has the worst under-5 mortality rate of the three East African countries. Worldwide, more than 10 million children under five years die each year, 41% of these occurring in sub-Saharan Africa (2). Using a prediction model to estimate under-5 causes of deaths in the 42 countries, Lopez *et al* (3) attributed 22% of these deaths to diarrhoea.

Acute diarrhoea, lasting between 1 and 14 days, is a serious cause of dehydration and electrolyte imbalances in children. Although rotavirus is the most common cause of diarrhoea in the developed

world (4), in the developing world infectious causes contribute to a large proportion of the diarrhoea, common organisms being *E.coli*, *Shigella*, *E. histolytica*, *G. lamblia* and *C. parvum* (5).

A number of factors have been found to be associated with occurrence of diarrhoea in children in the developing world. Many of these factors are dependent on level of poverty of the family and community as whole, including socioeconomic characteristics, education level of parents etc. Infant feeding and food preparation practices are very crucial determinants in the first year of life largely because of immature local defense mechanisms (6). Thus it is recommended that in the developing world, where unhygienic food preparation is common, infants be exclusively breastfed for the first six months of life (7) as this has been found to reduce the incidence and severity of diarrhoea.

A major proportion of diarrhoeal disease in the developing world is related to the quality and quantity of drinking water and this is dependent in part, on the water source. In Mali, Plate *et al* (8) found that children whose water was drawn exclusively from wells had a significantly lower prevalence of diarrhoea compared to those whose water was drawn from a spring (5.9% vs 8.7% $P=0.04$). Other studies have identified a number of socioeconomic factors that may be contributory to diarrhoea incidence. In an analysis of DHS data, Woldemicael (9) found diarrhoea in under-5s in Eritrea to be associated with age of child as well as number of children in household. Another study done in the three East African countries in 1997, Tumwine *et al* (10) concluded that unsafe disposal of faeces and wastewater, education level of household head and surface sources of water were determinants of diarrhoea.

Although a few studies have examined factors associated with diarrhoea in various parts of Uganda, none has been done using data from the whole country. Uganda has made enormous strides in social and political development over the last twenty years, but unfortunately this has not been evenly distributed as a result of unstable security situation in parts of the country. As this situation is reversed following promising political reconciliation, there is need for data showing spatial variations in health indicators that indicate corresponding contributory factors.

MATERIALS AND METHODS

Study design: This study was carried out using a raw dataset abstracted from the Uganda Demographic Health Survey (UDHS), a nation-wide cross-sectional survey done in 2000/2001. A detailed description of the design of demographic and health surveys is given elsewhere (11). Included in this analysis were all the sampled children in the survey, aged 0-5 years who had responses on whether they had or not an episode(s) diarrhoea within the two weeks preceding the interview. These responses were extracted from women's questionnaire of the DHS, done on mothers aged 15 – 49 years and with living children aged five years and under.

The outcome variable was categorised as having (case) or not having (non-case) had diarrhoea from the mothers' responses for each eligible child. Diarrhoea was defined as two or more watery stools occurring in a child in the two weeks preceding the survey. A number of selected explanatory factors were studied to determine their effect on the outcome variable (Table 1).

Statistical analysis: The distribution of the selected demographic and socio-economic characteristics

was compared between those children with and those without diarrhoea. The effect of each of the selected explanatory variables was estimated with odds ratios (ORs) and their 95% confidence intervals (CIs), derived from unconditional logistic regression analysis taking into account the clustering effect of the child's household. For ease of comparison, continuous variables such as age and duration of breastfeeding were categorised into the following groups: <1, 1-2, 2-5 years and <6, 6-11, 12-23, 24+ months, respectively. Trend tests for ordered variables were performed by assigning the score j to the j^{th} exposure level of a categorical variable (where $j = 1, 2, \dots$) and treating it as a continuous predictor in logistic regression. In the univariate analysis, each of the explanatory variables was put alone in the logistic regression model and all the explanatory variables were put at the same time in the model in the multivariate analysis to adjust for the effect of confounding.

Due to variability in sampling distribution from the various regions, individual responses were weighted in calculating effects. All analysis was done using STATA version 8 (Stata corporation 4905 Lakeway drive, College Station, Texas 77845 USA).

RESULTS

A total of 6,336 children under five years from 6,004 mothers had responses available on whether they had had or not, diarrhoea within the two weeks prior to the mother's interview during the survey. Of these children, 1,510 (23.8%) were reported to have had an episode of diarrhoea during this period. Table 1 shows the distribution of socio-demographic characteristics among children with and without diarrhoea. About half of the children were males in both cases and non-cases. The majority of cases were aged less than two years (53.5%) whereas the majority of non-cases were 2-5 years (59%). The mean age of the cases was significantly lower than that of the non-cases (2.1 versus 2.4 years, $p\text{-value} < 0.001$). In both cases and non-cases, a similar majority were living in the rural areas (over 74% in both), were of mothers who had some formal education (76% in both), were from Christian families (over 77% in both), had no electricity in the home (approximately 90% in both), and had no refrigerator in the home (98% in both). The proportion of children coming from families with no toilet facility was higher in the cases than non-cases (22.5% versus 15.7%). A higher proportion of non-cases than cases had been breastfed for at least two years (16.7% versus 11.7%) and the mean duration of breastfeeding was longer among the non-cases and the cases (15 versus 14 months, $p\text{-value} = 0.005$). Furthermore, a higher proportion of cases than non-cases had had a fever in the last two weeks (67% versus 38.1%).

Table 1
Socio-demographic characteristics of children with and without diarrhoea in Uganda

Number	No diarrhoea	(%)	Had diarrhoea	(%)
	4,826		1,510	
Sex				
Male	2,382	49.4	757	50.1
Female	2,444	50.6	753	49.9
Age group (years)				
2-5	2,846	59.0	702	46.5
1-2	967	20.0	432	28.6
<1	1,013	21.0	376	24.9
Mean (SD)**	2.4	1.5	2.1	1.3
Region of residence				
Central	1,487	30.8	444	29.4
Eastern	1,265	26.2	465	30.8
Northern	679	14.1	281	18.6
Western	1,395	28.9	320	21.2
Urban/Rural				
Urban	1,172	24.3	389	25.8
Rural	3,654	75.7	1,121	74.2
Mother's education				
None	1,129	23.4	354	23.4
Primary	2,938	60.9	964	63.8
Higher	759	15.7	192	12.7
Religion of head of family*				
Catholic	1,914	39.7	592	39.2
Protestant	1,942	40.3	582	38.5
Muslim	678	14.1	235	15.6
Other	282	5.9	101	6.7
Source of drinking water				
Piped	689	14.9	202	14.3
Open well	1,104	23.8	309	21.8
Covered well/borehole	1,877	40.5	559	39.5
Surface water	964	20.8	345	24.4
Other	192	4.1	95	6.7
Type of toilet*				
Flush toilet	92	1.9	25	1.7
Pit latrine	3,971	82.4	1143	75.8
None	755	15.7	339	22.5
Electricity in home*				
No	4,146	89.6	1,267	89.5
Yes	479	10.4	148	10.5
Radio in home*				
No	1,902	41.1	628	44.4
Yes	2,731	58.9	786	55.6

Refrigerator in home*				
No	4,507	97.6	1,385	98.0
Yes	113	2.4	28	2.0
Duration of breastfeeding (months)*				
24+	797	16.7	176	11.7
12-23	2549	53.3	786	52.5
6-11	799	16.7	403	26.9
<6	639	13.4	133	8.9
Mean (SD)**	14.9	7.6	14.3	6.8
Had fever in last two weeks*				
No	2,967	61.9	393	33.0
Yes	1,826	38.1	798	67.0

* Figures do not add up to total because of missing information

** Significantly different with p-value less than 0.05

Table 2 shows the determinants of the children having had diarrhoea in the two weeks preceding the interview using logistic regression analysis. The characteristics that independently stood out as significantly associated with history of diarrhoea were: age of child with over 2.5 fold risk increased in age groups lower than two years compared to those 2-5 years of age (p for trend <0.001); region of residence, with children living in the Eastern (OR=1.49, 95%CI=1.19-1.87) and Northern (OR=1.81, 95%CI=1.40-2.34) regions of Uganda showing a significantly increased risk compared to those living in Central region; and history of fever within

the same period, with a three-fold increased risk of diarrhoea. In addition, mother's education level was a protective factor whereby children of mothers with higher education had a 35% reduction in having had diarrhoea compared to children of mothers with no formal education (OR=0.65, 95%CI=0.47-0.89). Also found at reduced odds for diarrhoea, surprisingly, were children breastfed for less than six months compared to those breastfed at least two years (OR=0.54, 95%CI=0.35-0.85). All other explanatory variables considered did not come out independent determinants of risk of diarrhoea among the children in the multivariate analysis.

Table 2
Determinants of having diarrhoea among children using logistic regression

	Total	Had diarrhoea	(%)	Univariate		Multivariate**	
				OR	(95%CI)	OR	(95%CI)
Number	6,336	1,510	23.8				
Sex							
Male	3,139	757	24.1	1.00		1.00	
Female	3,197	753	23.6	0.99	(0.87 - 1.12)	0.89	(0.77 - 1.04)
Age group (years)							
2-5	3,548	702	19.8	1.00		1.00	
1-2	1,399	432	30.9	1.81	(1.55 - 2.11)	2.52	(2.06 - 3.09)
<1	1,389	376	27.1	1.60	(1.36 - 1.87)	2.91	(2.07 - 4.08)
p for trend							
<0.001							
Region of residence							
Central	1,931	444	23.0	1.00		1.00	
Eastern	1,730	465	26.9	1.39	(1.16 - 1.66)	1.49	(1.19 - 1.87)
Northern	960	281	29.3	1.57	(1.30 - 1.91)	1.81	(1.40 - 2.34)
Western	1,715	320	18.7	0.86	(0.71 - 1.04)	1.12	(0.88 - 1.42)
Urban/Rural							
Urban	1,561	389	24.9	1.00		1.00	
Rural	4,775	1,121	23.5	0.99	(0.84 - 1.17)	0.95	(0.70 - 1.29)

Mother's education								
None	1,483	354	23.9	1.00		1.00		
Primary	3,902	964	24.7	1.01	(0.86 - 1.19)	1.02		(0.84 - 1.23)
Higher	951	192	20.2	0.70	(0.55 - 0.89)	0.65		(0.47 - 0.89)
Religion of head of family*								
Catholic	2,506	592	23.6	1.00		1.00		
Protestant	2,524	582	23.1	0.98	(0.85 - 1.14)	1.08		(0.90 - 1.29)
Muslim	913	235	25.7	1.05	(0.85 - 1.29)	0.98		(0.75 - 1.27)
Other	383	101	26.4	1.14	(0.84 - 1.54)	1.27		(0.89 - 1.82)
Source of drinking water								
Piped	891	202	22.7	1.00		1.00		
Open well	1,413	309	21.9	0.98	(0.77 - 1.27)	0.73		(0.48 - 1.12)
Covered well/ borehole	2,436	559	22.9	1.04	(0.82 - 1.31)	0.66		(0.44 - 0.97)
Surface water	1,309	345	26.4	1.27	(0.99 - 1.63)	0.86		(0.56- 1.31)
Other	287	95	33.1	1.78	(1.27 - 2.49)	0.51		(0.04 - 6.12)
Type of toilet*								
Flush toilet	117	25	21.4	1.00		1.00		
Pit latrine	5,114	1,143	22.4	1.01	(0.57 - 1.79)	1.12		(0.46 - 2.69)
None	1,094	339	31.0	1.70	(0.95 - 3.06)	1.54		(0.63 - 3.80)
Electricity in home*								
No	5,413	1,267	23.4	1.00		1.00		
Yes	627	148	23.6	0.95	(0.74 - 1.21)	1.20		(0.84 - 1.70)
Radio in home*								
No	2,530	628	24.8	1.00		1.00		
Yes	3,517	786	22.3	0.83	(0.72 - 0.95)	0.95		(0.80 - 1.13)
Refrigerator in home*								
No	5,892	1,385	23.5	1.00		1.00		
Yes	141	28	19.9	0.74	(0.44 - 1.25)	0.47		(0.20 - 1.08)
Duration of breastfeeding (months)*								
24+	973	176	18.1	1.00		1.00		
12-23	3,335	786	23.6	1.33	(1.08 - 1.63)	0.89		(0.68 - 1.16)
6-11	1,202	403	33.5	2.31	(1.83 - 2.91)	1.19		(0.81 - 1.73)
<6	772	133	17.2	0.97	(0.74 - 1.28)	0.54		(0.35 - 0.85)
p for trend								<0.001
Had fever in last two weeks*								
No	3,360	393	11.7	1.00		1.00		
Yes	2,624	798	30.4	3.67	(3.15 - 4.29)	3.14		(2.66 - 3.72)

* Figures do not add up to total because of missing information

** Adjusted for all other variables

Highlighted results are the statistically significant ones at level of significance 0.05

DISCUSSION

Diarrhoea is a major cause of childhood morbidity and mortality, not only in Uganda and the East African region, but all through the developing world. This study established that at least one of every five children aged less than five years in Uganda, has an episode of diarrhoea within a period of two weeks. An earlier (1988-'89) prospective survey of 4,320 children aged less than five years in southwestern Uganda found that condition accounted for up to 23% of all deaths in the study population (12).

As mentioned earlier, infant diarrhoea is more prevalent around the weaning period. This is when mothers start introducing other feeds to the child's diet, in addition to breast milk. Although breastfeeding is almost universal in developing countries including Uganda, it is rarely exclusive (12) up to six months of age as recommended, and is generally continued longer than in developed countries. It is during this period of mixed feeding that diarrhoea is most prevalent due to multiple factors including contaminated feeds and immature gut defense mechanisms. In this study, children aged

below two years were significantly associated with increased diarrhoea compared to children between two and five years. After two years not only is the child's gut defense more mature, but mixed feeding is less as children are fed on adult diet.

Although much of Uganda has seen appreciable social and political advancement in the last 20 years, the Northern and Eastern regions have been plagued by a 'rebel' insurgency that prevented these areas similar progress. This study demonstrates that the health sector has not been spared this decline. The Northern and Eastern regions have the highest prevalence of diarrhoea in the country at 29.3% and 26.9% respectively. Compared to the most stable Central region, this difference in prevalence is highly significant (OR = 1.81 95% CI 1.40-2.34; OR = 1.49 95% CI 1.19-1.87 respectively).

Many mothers in Uganda do not attain high education levels. About 60% have primary school level as their highest education level. Mothers in the Northern region have the lowest education level attainment record, with 39% never having gone to school at all, only 8% attain secondary level or higher education. The study found that children whose mothers had some higher-level school education were significantly at reduced risk of diarrhoea than those whose mothers had no formal education. Basu and Stephenson (13) found that even low levels of maternal education increase child survival and health-related behaviour. Tumwine *et al* (10) identified lower education level of household head to be associated with higher diarrhoea morbidity in children.

Children who'd had fever in the two weeks preceding the interview were more than three times more likely to also have had diarrhoeal disease within the same period (OR 3.14; 95% CI 2.66-3.72). Diarrhoea caused by the most common agents (*rotavirus*, *E. coli* etc) is not usually associated with fever. This raises the possibility of parenteral diarrhoea i.e. resulting not from primary gastrointestinal tract infestations, but from other acute systemic infections like malaria (14) and community-acquired pneumonia (15).

Use of surface water and 'other' sources of drinking water showed significant association with increased diarrhoea prevalence in a univariate model, but not after multivariable analysis. Tumwine *et al* (10) found similar findings. However a study in Mali showed that surface water as a primary or secondary water source exposes children to a greater risk of diarrhoeal disease than using only improved sources such as wells (16). At the time of this study, only 13% of mothers reported using piped water as source of drinking water. In the Northern region, only 4% used piped water. Children from homes using covered wells or boreholes were at reduced risk of diarrhoea than those using piped water.

Children from families with no toilet facilities were found at increased odds of diarrhoea compared to those from families with flush toilets; however this association was not found statistically significant in this study. In Sri Lanka, children from households where excreta were reported to be disposed of in a latrine were less likely to have diarrhoea than children whose families improperly disposed of excreta (17). An earlier study in a rural Uganda area found absence of a latrine in a home, to be associated with diarrhoea in children less than two years of age (18).

Although this study showed that children breastfed for less than six months were at reduced risk of developing diarrhoea (OR 0.66 95% CI 0.44 - 0.97), there is overwhelming evidence that breast feeding is the best form of feeding for infants and should be exclusive for the initial six months of life in developing countries (19). This result is contrary to most other studies including a case control study in Brazil that found breastfeeding for less than six months to be associated with increased risk for diarrhoea (OR = 2.06; 95% CI 1.26-3.38) (20). Going into details of type of breastfeeding by these children was out of the scope of this study.

Treatment of diarrhoea in children in Uganda was also sub-optimal. Of the 1,510 children less than five years who had diarrhoea in this study, only 559 (37%) were taken to see a trained health worker. Oral rehydration salts (ORS), the solution recommended for the prevention and treatment of diarrhoea, in developing countries, were given to only 51% of the children with diarrhoea in this study. About 41% were reportedly offered no treatment.

Diarrhoea in children is to a large extent, a preventable illness. Yet it continues to contribute to high mortality of children in the developing world, especially those 40 countries including Uganda, identified in the Lancet child survival series, as contributing to over 90% of under-5 childhood mortality in the world. All efforts must be taken to study factors that contribute to this scenario at local as well as regional levels in these countries to aid in the planning and implementation of preventive measures. Using nationwide data from the DHS 2000/2001 in Uganda, this study was able to identify some determinants of diarrhoea in children aged 0 - 5 years in the country. Factors associated with increased risk were: child's age-group below two years, children from the Northern and Eastern regions of the country, and fever in the previous two weeks. Factors showing reduced risk of diarrhoea in children were: a mother whose level of education was up to secondary school or higher, use of protected wells or boreholes as family source of drinking water, and, surprisingly, breastfeeding for less than six months.

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