Population Review

An Examination of the Combined Effects of Maternal Characteristics, Environment and Treatment Programs on the Prevalence of Diarrhea amongst Infants and Children in Uganda

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Abstract

At least two decades of research identifies Diarrhea as among the leading causes of morbidity and mortality among children in developing countries. Some estimate that approximately 20% of all deaths amongst children are directly related to diarrhea. In 1993, the World Health Organization estimated that in some sub-Saharan countries more than 50% of the deaths of children are due to diarrhea. Studies show that the risk of exposure to the causes of diarrhea is strongly related to both environmental characteristics and the socioeconomic characteristics of mothers. Indeed, infant mortality itself continues to be used as an indicator of standard of living and environmental conditions. This is especially true for children below the age of 2 years. Studies indicate that the characteristics of the primary caregivers, the cleanliness of the environment, and the availability of treatment, are all significant factors in the prevalence of diarrhea amongst infants in a population. While these patterns are frequently documented in research, few studies have examined in detail the separate and combined effects of mother's characteristics, environment, and the availability of health care.

   The present study examines the interrelationship of socioeconomic characteristics of mothers, selected environmental factors, treatment options, and the prevalence of diarrhea in Ugandan infants. The research utilizes data from the Uganda Demographic and Health Survey. This study elaborates the specific conditions and circumstances that account for variation in the health of children and how these relate to the characteristics of the mothers and well as the environment.

Keywords

Morbidity, mortality, infants, diarrhea, environment, educational attainment

Introduction

The rate at which infants die in many developing countries is a major concern for policymakers and a continuing focus of research on mortality. This research examine incidence of diarrhea amongst infants in Uganda. Diarrhea has been identified as one important casual factor related to infant mortality. In almost every developing country, diarrhea is the most common cause of illness and death among children under 5 years old (UNICEF, 1990). Two decades of research identifies diarrhea as among the leading causes of morbidity and mortality among children in developing countries. According to the World Health Organization, two million children die each year in developing countries from diarrhea diseases (WHO, 1998). In 1993, the World Health Organization estimated that in some sub-Saharan countries more than 50% of the deaths of children are due to diarrhea. While malaria and fever are also significant contributors to infant mortality, the incidence of malaria is related to some of the same factors as diarrhea. Studies show that the risk of exposure to the causes of diarrhea is strongly related to both environmental factors, and to the socioeconomic characteristics of mothers. Indeed, infant mortality itself continues to be used as an indicator of standard of living, and environmental conditions (Yankauer, 1990). This is especially true for children below the age of 5 years. Studies indicate that the characteristics of the primary caregivers, the cleanliness of the environment, and the availability of treatment, are all significant factors in the prevalence of diarrhea amongst infants in a population. While these patterns are frequently documented in research, few studies have examined, in detail, the separate and combined effects of mother's characteristics, environment, and the availability of health care.

   The present study examines the interrelationship of socioeconomic characteristics of mothers, selected environmental factors, treatment options, and the prevalence of diarrhea in Ugandan infants. The research utilizes data from the Uganda Demographic and Health Survey 2000 – 2001.

Background of the Study

Diarrhea is a major cause of malnutrition and places children at a greater risk of infection, severe illness, and mortality (Hirschhorn and Greenough, 1991). The case fatality rate is highest for diarrhea episodes during the neonatal period and drops progressively during the first year of life (Becker and Black, 1999). Children in developing countries suffer from 3-4 episodes of acute diarrhea yearly and each episode lasts an average of 3-4 days. The effects of diarrhea include lower dietary intake, since children who are ill may refuse food, and fecal nutrient losses leading to malnutrition and reduced immunity to infectious diseases (Hirschhorn and Greenough, 1991). If the caretakers's response is not immediate and effective, the child's chances of survival are minimal.

   Diarrhea definitions include an increase in daily stool weight above 200g per day and an increase in stool liquidity and frequency (Njemaze et al, 1999); a passage of three or more and four or more unformed stools in 24h (Cogswell et al., 1991). Persistent diarrhea episode lasts more than 14 days while a dysentery episode is when there was reported presence of blood in the diarrhea (Fauvean et al, 1991). For this study, diarrhea was not defined; the presence of any diarrhea reported among the children was considered. The types of diarrhea reported were acute watery diarrhea (the passage of three or more loose or watery stools), persistent diarrhea, and dysentery (bloody diarrhea).

Risk Factors

Most diarrhea is caused by bacterial, viral, and parasitic infestations transmitted through water, food, and contact with fecal matter. Pathogens like *Campylobacter jejuni, Salmonella typhi, Escherichia coli, Vibrio cholerae, Giardia lamblia* infections require medical attention. These infectious agents can be transmitted from one child to the next, and often flourish under the kind of environmental conditions in which many Ugandan children live.

Among the significant risk factors for the transmission of diarrhea, various studies have found the lack of domestic and personal hygiene (improper washing hands, non use of soap, improper handling of diapers, using a cloth rag to clean after defecation), unprotected water supply, lack of sanitation facility or poor fecal disposal, a recent diarrhea episode, presence of other children of the same age in the household, a crowded home, lack of maternal education, lack of maternal care, use of pond water, poor water storage, and presence of domestic animals in the home to name a few. (Molbak et al., 1997; Birmingham et al., 1997; Ghosh et al., 1997; Gorter, et al., 1998; Zodpey et al., 1998). In addition, Alam (1995) found that the number of children age 5 and below in the household were an independent predictor of diarrhea episodes in the age group 6-23 months.

Persistent diarrhea and dysentery are significant cause of morbidity, malnutrition, and death (Fauvean et al, 1991). Preventing diarrhea thus requires better sanitation and adequate supply of clean water, health education aimed at promoting breastfeeding, immunization, improved personal hygiene and food handling practices, and the penning of farm animals such as chickens and cattle (UNICEF ,1990).

The absence of a tap water supply and sanitation facility or toilet at home is a particularly significant environmental source of infections of many types (Molbak et al., 1997; Birmingham et al., 1997; Ghosh et al., 1997; Gorter, et al., 1998). Biritwum (1995) reported that wells or unprotected springs or ponds were the main source of water for 83% in a population sample of 5018 inhabitants in the Iganga district of Uganda. Thirty percent of the same population did not have individual house toilet facility. The use of unsafe water and unhygienic latrine contributes to repeated infections in the child (Islam et al, 1994). Becker and Black (1996) discuss the finding that clean water and good sanitation provide a 25% reduction in the incidence of diarrhea.

Studies show that infants and children in developing countries whose parents are of a lower socioeconomic status and with particular demographic and environmental characteristics are consistently at higher risk contracting diarrhea. Infant mortality has been shown to be the most sensitive index for social and economic welfare and sanitary administration (Yankauer, 1990). In particular, maternal characteristics have been implicated in child health and mortality such that an examination of data with respect to mothers provides the key socioeconomic, environmental, and behavioral factors associated with child mortality (Lafond, 1995). Typically, the mother is the principal care provider and, therefore, the chief mediator between the child and the surrounding environment (McMurray, 1997). It is the mother who generally determines the content and amount of the child's diet (within available choices), and makes decisions when health intervention is needed (Lafond, 1995; Lubanga, Norman, Ewbank, & Karamagi, 1997).

In some studies, maternal education of greater than three years (Gorter, et al, 1998) or seven years or more of primary education is associated with severity of illness due to diarrhea (Mahalanabi et al., 1996). A study by Abidoye and Tomin-West (1999) found an increase in mortality before age 5 to be associated with little or no maternal education. More schooling was indicated to produce better hygiene practices (Gorter, et al, 1998). The effect of maternal education remained high after adjusting for other confounding factors (Mahalanabi, Faruque, Islam, and Hoque, 1996). Mahalanabi and collegues (Mahalanabi et al., 1996) concluded that maternal education independent of economic power influenced child survival through its impact on disease from acute diarrhea. Sastry (1996) also found a one-year increase in maternal education to be associated with an 8% decline in the risk of death. Women's illiteracy was indicated to be an additional risk factor for diarrhea disease for children under age five.

(Immink & Payongayong, 1999). It has been suggested that education functions through the ability of the mother to understand health messages (Islam et al, 1994). However, the impact of maternal education has been varied in some of the studies because of several intervening variables.

   Socioeconomic variables operate through a set of proximate variables to influence child survival. Poverty in the home limits a mother's ability to provide good care for the child (Islam et al, 1994). In one study, maternal possession of a radio had a positive influence on general hygiene behavior (Gorter et al, 1998). Education was found to have a stronger effect when a radio was present in the household (Gorter et al, 1998). Caldwell (1979) showed that maternal education had a more positive impact on child health than did income.

   Sastry (1996) found an increase in household income to be significantly associated with child survival. According Casterline,et.al. (1989) the income variable is not a dominant determinant of child survival. They argued that income operates in a subset of the proximate determinants such as its role in improving household sanitation and hygiene. Low-income households may be located in less sanitary, less hygienic environments than higher income households. In their analysis income affected early childhood survival and not survival of infants (Casterline, et al, 1989).

   Sastry (1996) developed a model to measure the relationship between household attributes and child survival. Results indicated that the quantity of water had a greater impact on health than water quality (Sastry, 1996). Household toilet facilities were weakly associated with child survival but the researchers stated that in developing countries, sanitation facilities were more important than water supply in improving child survival (Sastry, 1996). The water quality was more important than water supply to households of children with less educated mothers. The research further indicated that when water supply and sanitation services are limited, more educated mothers use their knowledge and skills to protect their children from contamination and promote hygiene and cleanliness in the home.

   Positive health seeking behaviors are important to child survival and health seeking is influenced by the perceived cost of health services, treatment, and adequacy of formal health services (Ndyomugenyi, Neena, & Magnussen, (1998). Grace (1998) found that people are deterred from using health services due to the physical, financial, and social inaccessibility. Poor understanding of illness and the appropriate treatment serve to complicated and exacerbate the situation. Grace (1998) found that parents used home treatments and local healers compared to the health services to treat ill children. Medical treatment was sought if the illness got serious. Mothers with ill children may delay seeking medical attention because of these factors.

Procedures

This study examines maternal socioeconomic characteristics, environmental factors, health seeking practices, and the prevalence of diarrhea amongst infants in Uganda. The principal objective is to investigate how the maternal socioeconomic characteristics and the environmental context interact in effecting the prevalence of infant diarrhea. The independent variables employed are educational achievement, and selected environmental factors. The dependent variable is the incidence of diarrhea.

   The source of the data is the Uganda Measure DHS+ survey conducted in 2000 and 2001 by the Ugandan Government in collaboration with the Demographic and Health Surveys (DHS) Program funded through the United States Agency for International Development (USAID). Similar surveys were conducted in 1988 and in 1995. (Information on the surveys and methodology can be found on the DHS website http://www.measuredhs.com.) The DHS data provides information on number of years of schooling as well as highest level of education completed. Environmental factors include the type of toilet facility available to the household

and the primary source of water used in the household. Mother's response to illness is measured as the type of treatment sought after the onset of diarrhea.

Uganda offers a good setting for this investigation between the factors under examination because of the political upheavals it has undergone during the past three decades. There have been reports regarding the breakdown in the economy, brain drain, unemployment, declines in education, declines in health services, poor sanitation and water supply. The main source of household income is the agriculture sector and employment outside of the home. Although health and environmental factors vary by region and by rural or urban setting, an overall indication of conditions is presented in the data along with regional variations.

Characteristics of the Sample

Data for the 2000/01 survey study were collected from 7246 female respondents between the ages of 15 and 49 years and 1,962 male respondents age 15-54. The data were collected by interview. The study includes data for 7885 households. Table 1 shows characteristics of the sample for 1995 and table 2 shows characteristics of the sample for the most recent survey.

Table 1: Selected Characteristics of Mothers: 1995 Data

	Frequency	Percent
Age		
15-19	614	10.7
20-24	1797	31.2
25-29	1486	25.8
30-34	1010	17.5
35-39	562	9.8
40-44	228	4.0
45-49	59	1.0
Total	5756	100.0
Marital Status		
Never married	190	3.3
Married	4386	76.2
Living together	631	11.0
Widowed	169	3.0
Divorced	80	1.4
Not living together	300	5.2
Total	5756	100.0
Area of residence		
Urban	1630	28.0
Rural	4126	72.0
Total	5756	100.0
Education level attained		
No education	1539	26.7
Incomplete primary	2805	48.7
Complete primary	547	9.5
Incomplete secondary	524	9.1
Complete secondary	332	5.8
Higher	9	0.2
Total	5756	100.0

The distribution of characteristics for the 5 to 6 year period is not substantially different for age distribution. The number women who report that they are married declined while the

number who reported that they are cohabitating increased. The population continues to be largely rural. There has been a slight decrease in the number of women who report that they have no education and a significant increase in those who report receiving a higher education. Still, the majority of the women in Uganda, about 84%, have less than a primary school education. With the population still largely rural and minimally educated, the implications for infant health continue to be important.

Table 2: Selected Characteristics of Mothers: 2000 - 2001 Data

Age Group	Frequency	Percent
15-19	512	7.20
20-24	2146	30.17
25-29	1969	27.68
30-34	1264	17.77
35-39	799	11.23
40-44	320	4.50
45-49	103	1.45
Total	7113	100.00
Martial Status		
Never married	210	2.95
Married	4110	57.78
Living together	2073	29.14
Widowed	137	1.93
Divorced	47	0.66
Not living together	536	7.54
Total	7113	100.00
Area of residence		
Urban	1692	23.79
Rural	5421	76.21
Total	7113	100.00
Educational level attained		
No education	1693	23.80
Primary	4400	61.87
Secondary	846	11.90
Higher	173	2.43
Total	7112	100.00

Results

Table 3 shows he incidence of diarrhea and the treatment response. The table shows that 18.59 % reported an incidence of diarrhea. Of those reporting an incidence 52.72% did not seek medical treatment. The remainder of this study examines the differences between those who received treatment and those who did not receive treatment. It also examines the differences between the mothers reporting an incidence of diarrhea and those who did not report an incidence.

Table 3: Frequency and Percent of Children With Diarrhea and Medical Treatment

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Had Diarrhea Recently

	Number	Percent
No	4826	76.17
Yes, last two weeks	1178	18.59
Don't know	332	5.24
Total	6336	100.00

Received Treatment

	Number	Percent
No	620	52.72
Yes, medical treatment	556	47.28
Total	1176	100.00

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Table 4 shows that the primary sources of drinking water which includes mostly wells, and boreholes. Surface water is the primary source for relatively fewer households. Public sources in each of these categories include 11.8 percent public tap, 24.1% open public well, 16% protected public well, and 23% borehole. These figures indicate that most households in Uganda did not, at the time of this survey, have a protected source of water. Also, most of the water sources allow public access and therefore make the possibility of the spread of diseases and infections more likely.

The table also shows figures for the type of toilet facility available to the household. The overwhelming majority, 82%, of households have a traditional pit toilet. As indicated in the review of literature, this can be a primary source of infections and transfer of disease.

Table 4: Selected Household and Environmental Factors

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Source of Drinking Water	Number	Percent
Piped into dwelling	61	0.90
Piped into yard/plot	94	1.39
Public tap	800	11.85
Open well in yard/plot	1	0.01
Open public well	1629	24.13
Protected well in yard/plot	14	0.21
Protected public well	1081	16.01
Borehole in yard/plot	12	0.18
Borehole public	1614	23.91
Spring	495	7.33
River, stream	459	6.80
Pond, lake	321	4.76
Dam	95	1.41
Rainwater	26	0.39
Tanker truck	1	0.01
Bottled water	2	0.03
Gravity flow scheme	45	0.67
Total	6750	100.00

Table 4: Selected Household and Environmental Factors, Continued

Type of Toilet Facility	Number	Percent
Flush toilet	129	1.91

Traditional pit toilet	5539	82.07
Ventilated improved pit latrine	165	2.44
No facility, bush, field	916	13.57
Total	6749	100.00

Unreliable water supplies and poor water storage was indicated to account for this effect. According to Carterline (1989), the water source and toilet facilities in a household may influence sanitation and hygiene conditions and thus provide channels for the influence of other factors on child survival.

Incidence of Diarrhea and Environmental Factors

Table 5 shows cross tabulations for reported incidences of diarrhea, source of drinking water, and type of toilet facility. The data indicated that the variation by source of drinking water is not as high as one would have expected. Those households using piped water including the public tap, show a slightly lower incidence of diarrhea with 8.7 for water piped into the dwelling 11.2 piped into the yard, and 15.7 for the public tap. Other public facilities are slightly higher with 18%, 17%, and 19% for open wells public wells, and public boreholes, respectively. Those reporting the highest incidence are households using spring and river stream water. Previous research suggests that there is a relationship between socioeconomic status and source of drinking water. Therefore the significant relationship, as indicated by chi-square, between incidence of diarrhea and source of drinking water may be an indirect effect. Diarrhea is less likely to occur in households with piped water compared to those that use other water sources.

Table 5: Residence by Incidence of Diarrhea

	Type of Place of Residence	
	Urban	Rural
Had diarrhea recently		
No	75.08	76.52
Yes, last two weeks	16.14	19.39
Don't know	8.78	4.08

*Chi-Square p<.0001

Table 6 shows cross tabulation of incidence of diarrhea and type of toilet facility available to the household. The most striking observation is that for the category of "no facility", 69%., an that for a flush toilet at almost 79 percent. This finding is consistent with the findings in previous research that indicate that the type of toilet facility available is important in the overall hygiene of the environment. This variable, again, may be the indirect effect of socioeconomic status. Those who are more affluent have access to better water and to a more hygienic environment. Chi-square analysis showed this relationship to be statistically significant at p =.0001 (p < .05). When examining the effect of residence, there is a slightly higher incidence in rural than in urban areas. Although the chi-square is significant, the difference is between urban and rural is not as great as one would have expected based upon past research.

Table 6: Presence of Diarrhea and Household Characteristics

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Source of Drinking Water

	No Diarrhea		Diarrhea		Don't know	
	Freq	%	Freq	%	Freq	%
Piped into Dwelling	45	78.95	5	8.77	7	12.28
Piped into Yard/plot	70	78.65	10	11.24	9	10.11
Public Tap	574	77.05	119	15.97	52	6.98
Open public well	1103	78.12	257	18.20	52	3.68
Protected public well	751	78.56	169	17.68	36	3.77
Borehole in public	1104	75.88	281	19.31	70	4.81
Spring	319	72.17	103	23.30	20	4.52
River, stream	302	74.38	89	21.92	15	3.69
Pond, lake	203	74.09	51	18.61	20	7.30
Dam	69	80.23	13	15.12	4	4.65
Rainwater	13	59.09	7	31.82	2	9.09
Gravity flow scheme	35	83.33	7	16.67	0	

*Chi-Square p<.0001 (Note: Frequency < 15 eliminated from table but not calculation of statistic)

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Type of Toilet Facility

	Flush Toilet		Traditional Pit Toilet		Ventilated Improved Pit Latrine		No facility bush, field	
	Freq	%	Freq	%	Freq	%	Freq	%
Had diarrhea recently								
No	92	78.63	3851	77.66	120	77.42	542	69.49
Yes last two weeks	13	11.11	871	17.56	23	14.84	209	26.79
Don't know	12	10.26	237	4.78	12	7.74	29	3.72

*Chi-Square p<.0001

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The Influence of Education of Mother

Table 7 shows figures for education of mother, incidence of diarrhea and medical treatment. The data indicate that mother's at the highest level of education report significant fewer incidences of infant diarrhea. For those in the higher education groups 9% report an incidence within the last two weeks while almost 20% of those in the lowest group report the same. Similarly, the mothers with the highest level of education were more likely to seek medical treatment than were those with less education. Also those mothers at the highest educational level are far more likely to have a flush toilet. At the highest educational level approximately 15 percent has flush toilets as opposed to about 1 percent of those at the lowest level of education.

Table 7: Level of Education, incidence of diarrhea, and medical treatment

	Incidence of Diarrhea							
	No Education		Primary		Secondary		Higher	
	Freq	%	Freq	%	Freq	%	Freq	%
Had diarrhea recently								
No	1129	76.13	2938	75.29	612	78.06	146	87.95
Yes, last two weeks	296	19.96	749	19.20	118	15.05	15	9.04
Don't know	58	3.91	215	5.51	54	6.89	5	3.01
Total	1483		3902		784		166	

*Chi-Square p<.0001

	Medical Treatment							
	No Education		Primary		Secondary		Higher	
	Freq	%	Freq	%	Freq	%	Freq	%
No	178	60.14	396	53.01	41	34.75	5	33.33
Yes, medical treatment	118	39.86	351	46.99	77	65.25	10	66.67
Total	296		747		118		15	

*Chi-Square p<.0001

	Type of Toilet Facility							
	No Education		Primary		Secondary		Higher	
	Freq	%	Freq	%	Freq	%	Freq	%
Flush	20	1.23	32	0.77	53	6.62	24	14.63
Trad Pit	1219	74.88	3541	85.22	659	82.27	119	72.56
Vent Pit	14	0.86	68	1.64	62	7.74	21	12.80
No Facility	475	23.98	514	12.37	27	3.37	0	0

Chi Square p< .0001

In all education categories, there is a down ward trend in the number of children reported to have diarrhea from among mothers with no education mothers as compared to those with some schooling. A similar trend is indicated for mothers who sought some treatment for the sick child. Level of education was shown to be significant in this as well.

Summary and Conclusions

According to recent Demographic and Health Survey figures, the under –five mortality rate in Uganda is 151/ 1000 live births. This represents an increase over the figure of 1995 which was 147/1000 live births. An increase in general mortality and morbidity affected by insufficient access to health and sanitation services is strongly indicated. An unhealthy environment and a lack of routine medical intervention are the main causes of mortality and morbidity. While education of mother continues to be a mediating factor between environment and child, education may have less effect as environmental factors take on new forms. In the instance of water supply, for example, the main problem is one of infrastructure and access. Individual level characteristics, such as mother's knowledge, awareness and education cannot counteract the

effects of increase pollutants of different types and from multiple sources. While mother's education has, for some time, had a significant effect on outcomes for health factors that effect the incidence of diarrhea, it will have less effect on the available of health care and the environmental quality unless education becomes instrumental in significant social and structural changes.

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