Determinants of diarrhoea and acute respiratory infection among under-fives in Uganda

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RESEARCH

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Abstract

Background

Diarrhoea and acute respiratory infection (ARI) are leading causes of mortality and morbidity in children under the age of five in developing countries. On the African continent, pneumonia (14%) and diarrhoea (17%) cause more child deaths than Malaria (16%), HIV/AIDS (4%), and measles (1%) combined. This paper set out to investigate the factors associated with the occurrence of diarrhoea and ARI incidence for children under five years in Uganda.

Method

We used a nationally representative Uganda Demographic and Health Survey (UDHS) (2006). Sampling was done in two stages. In the first stage 321 clusters were selected from among a list of clusters sampled in the 2005/06 Uganda National Household Survey (UNHS), 17 clusters from the 2002 Census frame from Karamoja, and 30 internally displaced camps (IDPs). In the second stage, households in each cluster were selected as per UNHS listing. In addition 20 households were randomly selected in each cluster. Questionnaires were used during data collection. During the analysis, a maximum likelihood probit model was used in order to ascertain the probability of occurrence of diseases.

Results

On average, 32% and 48% of children in the survey suffered from diarrhoea and ARI in the two weeks prior to the survey date. The occurrence was concentrated amongst children aged 0–24 months. Mother's education, especially at post-secondary level, reduced the probability of diarrhoea occurrence but had no effect on ARI occurrence. First hour initiation and exclusive breastfeeding reduced the probability occurrence of both diarrhoea and ARI. Other significant factors associated with the occurrence of both diseases include: regional and location differentials, wealth status, type of dwelling, mother's occupation, child age, and child nutritional status.

Conclusion

Policy interventions should target female education, eliminate location and regional disadvantages, and educate the population to adopt breastfeeding practices recommended by the World Health Organization (WHO). The government should also ensure proper dwelling places for the population that are associated with favourable health outcomes. Other proper feeding practices together with breastfeeding (after six months), should be made known to the masses so as to reduce the number of children that are malnourished and growth retarded.

Key Words

Diarrhoea, acute respiratory infections, children, under-five years, Uganda

What this study adds:

1. Whereas much discussion is ongoing in this field, a literature survey failed to identify a study, using a nationally representative survey, published for the case of Uganda.
2. The study highlights the important association between breastfeeding practices recommended by WHO and the incidence of diarrhoea and ARI.
3. Older mothers are associated with fewer incidences of diarrhoea and ARI.

Background

Diarrhoea and ARI are leading causes of mortality and morbidity in children under the age of five in developing countries and definitely threaten the attainment of Millennium Development Goal 4. Diarrhoea is caused by ingesting certain bacteria, viruses or parasites found in faecal matter which may be spread through water, food, hands, eating and drinking utensils, flies, and dirt under fingernails. Respiratory infections are caused by viruses, fungi, or bacteria and can manifest in any area of the respiratory tract, including the nose, middle ear, throat, voice box, air passage, and lungs.[1] Diarrhoea occurs world-wide and causes 4% of all deaths and 5% of health loss to disability. In Africa, it is responsible for 7.7% of all deaths. It is associated with 2.2 million deaths globally each year, most of whom are children under five years of age in developing countries. Each year there are approximately 4 billion cases of diarrhoea worldwide.[2] ARIs, on the other hand, account for virtually 3.9 million deaths every year globally.[2]

Comparing the percentages of death due to the major killer diseases globally, pneumonia (14%) and diarrhoea (14%) cause more child deaths compared to malaria (8%), HIV/AIDS (2%) and measles (1%) combined. On the African continent, pneumonia (14%) and diarrhoea (17%) cause more child deaths than Malaria (16%), HIV/AIDS (4%), and measles (1%) combined.[3] In Uganda, 15% of children under-five of years of age showed symptoms of ARI at some time in the two weeks preceding the survey. On the other hand, 26% of all children under five had diarrhoea while 6% had diarrhoea with blood. The prevalence of diarrhoea is more pronounced among young children aged 6–23 months compared to other age groups.[4] These statistics show the severity of diarrhoea and ARI in causing child mortality and therefore underscore the need to understand the factors fuelling their occurrence. Determining the causes of diarrhoea and ARI prevalence is very imperative for policy formulation and advocacy and for a general assessment of resource requirements and prioritisation. We sought to answer the following pertinent questions that capture key policy parameters: controlling for other socioeconomic factors: Is mother's education associated with the prevalence of diarrhoea and ARI amongst her children? Does the housing environment matter? Do breastfeeding practices; early initiation, exclusive, and duration of breastfeeding matter? Answers to these questions should identify the key policy parameters that the government and the global health actors need to target in order to mitigate the occurrence of these diseases. To the best of our knowledge, this is the first paper to address these questions for the case of Uganda.

Literature in different parts of the world reveals distinctly unique factors associated with the prevalence of diarrhoea and ARI. This implies that policy options are also unique underscoring the need to undertake a country-specific analysis. In India socioeconomic class, sanitary practices, nutritional status, and weaning practices were revealed to be significantly associated with the prevalence of recurrent diarrhoea.[5] In southwestern Ethiopia, water source, immunisation, measles and ARI were found to be significantly associated with diarrheal disease.[6] In Nigeria, the fuel type (cooking method) and the age of the child were significantly associated with diarrhoea disease.[14] In Pakistan, it was found that sanitation facilities were more importantly associated with diarrheal infections than the supply of drinking water.[7] Other findings, in Arif and Ibrahim[7], corroborate those of Mekasha and Tesfahun[6] for child immunisation and those of Oni et al[14] for child age. In

Egypt, it was revealed that residence, birth order, weather condition, age of mothers, education of mothers and fathers, occupation of fathers, overcrowding, refuse disposal, toilet type, and maternal labour force participation significantly correlated with diarrhoea incidence.[8] There are also several factors that have been revealed to be associated with the occurrence of ARI in different parts of the world. In Greenland, it was found that household size, parity, sharing facilities like bedding, birth weight, immunisation, breastfeeding practices, and child gender and age were important factors associated with the prevalence of ARI.[9] In Soweto (South Africa), it was revealed that only father's level of education and the number of people living in the household remained significant in the multivariate analyses.[10] In Turkey, the factors found to be significantly associated with ARI are education of the mother and father, source of heating, birth weight, breastfeeding and nutritional status.[11] In summary, previous literature presents different associated factors in different countries thus there is a need to undertake a study for relevant factors in Uganda.

Method

The study obtained approval from Macro International to use the UDHS data set of 2006. The 2006 UDHS is a nationally representative survey of 8,531 women aged 15–49 and 2,503 men aged 15–54. The sample was designed to allow separate estimates at national level and for rural and urban areas of the country. Three questionnaires were used, namely: a household questionnaire, women's questionnaire, and men's questionnaire. Sampling was done in two stages; in the first stage 321 clusters were selected from among a list of clusters sampled in the 2005–2006 UNHS. An additional 17 clusters were selected from the 2002 Census frame from Karamoja to accommodate special regions of Karamoja. Finally, 30 internally displaced camps (IDPs) were selected from a list of camps compiled by the United Nations Office for Coordination of Human Affairs. In the second stage, households in each cluster were selected based on a complete listing of households as per UNHS listing, however, in addition to the UNHS sampled households 20 households were randomly selected in each cluster.

The UDHS provides information on the demographic characteristics of the country. It contains information on household size, age and sex distribution, region, location, religious affiliation, occupation of household members, the number of children ever born by a woman, child mortality, marital status, and educational attainment of women and men. It also contains information on breastfeeding; early initiation, exclusive, and duration. Mothers were also asked if their children experienced diarrhoea in the last two weeks preceding the survey; either loose stool or blood in the stool. Mothers also provided information concerning ARI; cough or running nose, difficulty breathing, and blocked chest. The wealth index is provided in the data set and is constructed by combining information on household assets, such as ownership of consumer items, type of dwelling, source of water, and availability of electricity into a single asset index. The sample is split into five equal groups (quintiles) from 1 (lowest, poorest) to 5 (highest, richest).

The dependent variables were constructed as follows: (a) Diarrhoea prevalence: this was constructed as a discrete binary variable equal to one if a child had diarrhoea or stool with blood in the two weeks preceding the survey and zero otherwise. (b) ARI prevalence: A child was considered to have experienced ARI if the mother reported that the child had a cough in the last two weeks preceding the survey date along with running nose, difficulty breathing, and blocked chest. The variable was constructed as a discrete binary variable equal to one if a child experienced ARI in the two weeks preceding the survey and zero otherwise.

We controlled for various socioeconomic, demographic, and behavioural factors: Education level of the mother and her husband. This was categorised into four outcomes as follows; 0=no education, 1=primary education, 2=secondary education, 3=postsecondary education. We used no

education category as the reference during the analysis. Age of the mother; this was broken into five year age cohorts as; 15–19, 20–24, 25–29, 30–34, 35–39, 40–44, and 45–49. The 15–19 age cohort was used as the reference category during the analysis. Occupation of the mother and her husband was broken down into various categories such as 1=white collar jobs, 2=agriculture, 3=services, and 4=blue collar jobs. White collar jobs category was used as the reference category. Birth order was categorised as those who had the 1, 2, 3, and those with at least the 4th born. Those who had the first birth order were used as the reference category. The first half an hour initiation of breasting was defined as equal to one if a mother initiated breastfeeding in the first half an hour after birth and zero otherwise. Exclusive breastfeeding is equal to one if a baby was given nothing else in the first six months apart from breast milk and zero otherwise. The duration of breastfeeding is defined as the number of months until breastfeeding is terminated. Location was defined as equal to one if a child was in the rural area and zero otherwise. Four region dummies were defined as 1=central, 2=east, 3=north, and 4=west. The central region was used as the reference category. To capture the traits or traditional beliefs of mothers, we defined three religious dummies as 1=Catholics, 2=Protestants, 3=Muslims, and 4=Others which include Evangelicals, Adventists, Orthodox, and Traditionalists. Catholics were used as the reference category. The wealth index is provided in the data set in terms of quintiles; 1=poorest quintile, 2=poor, 3=medium, 4=rich, and 5=richest. The poorest quintile was used as the reference category. We also defined a discrete binary variable equal to one if a mother was married and zero otherwise. Child sex is equal to one if it is a male baby and zero otherwise. Child age is defined in months; 0–12, 13–24, 25–36, 37–48, and 49–59 months. Children in the age cohort 0–12 months were used as the reference category. Our analysis also included a measure for the household environment where we defined the source of drinking water, building materials, and toilet type. We generate different categorical variables for the source of drinking water; piped water, protected well, and unprotected well. The toilet type included; flush toilet, VIP, pit latrine (covered), pit latrine (uncovered), and bush. We also used anthropometric measures; stunting (the height-for-age index) and wasting (weight-for-height index). Children whose height-for-age Z-score is below minus two standard deviations (-2 SD) are considered short for their age (stunted). Children whose weight-for-height Z-scores are below minus two standard deviations (-2 SD) are considered thin (wasted).

The analysis was undertaken at two levels. The first was a bivariate approach in which we generated the average percentages of children who suffered from diarrhoea and ARI by background characteristics. The second approach was a multivariate analysis where we employed the maximum likelihood probit model in order to obtain the probability of occurrence of diarrhoea and ARI given the background characteristics.

Results

On average, 32% and 48% of children in Uganda suffered from diarrhoea and ARI respectively in the two weeks preceding the survey (Table 1). Mother's education is importantly associated with the prevalence of diarrhoea but not ARI (Tables 2 and 3). Mothers with secondary education reduce the probability of occurrence of diarrhoea by 5–7% compared to their counterparts with no education. The coefficients are statistically significant at 5% level ($p<0.05$). The effect of maternal education is even more pronounced at a higher level of education. Children of mothers with post-secondary education have an 11% reduced chance of having had diarrhoea compared to counterparts whose mothers had no education (Table 2). The coefficients are statistically significant at 5% level ($p<0.05$). Our descriptive findings in Table 1 confirm the empirical findings in Table 2 and also show the important association of mother's education and the occurrence ARI.

Being in a rural area increases the probability of ARI occurrence by 8–9% compared to counterparts in the urban area (Table 3). The coefficients are statistically significant at 1% level ($p<0.01$). Being a Muslim increases the probability of diarrhoea occurrence by 5–10% compared to Catholics (Table 2). The coefficients are statistically significant at 5% level ($p<0.05$). Our findings also reveal the importance of the wealth status of households. Being in a higher wealth quintile, compared to the lowest (poorest), reduces the probability of diarrhoea and ARI occurrence by 5–10% and 5–18%, respectively (Tables 2 and 3). The coefficients are statistically significant at 5% level ($p<0.05$). These findings are in line with the descriptive statistics in Table 1.

Table 1: Average percentages of under-fives who suffered from diarrhoea and acute respiratory infection by background characteristics

Characteristic	Diarrhoea incidence	Acute respiratory incidence
Mother's education: None	37.3	51
Primary	33	48
Secondary	25.4	46
Post-secondary	12	46
Location: Urban	24	37
Rural	34	50
Region: Central	27.2	43
East	32.2	47
North	38.4	54
West	32	49.3
Father's education: None	31.1	49
Primary	35	49
Secondary	28	47
Post-secondary	22	44.1
Religion: Catholic	33	50
Protestant	31.2	46.2
Muslim	36	44
Other	31.2	52
Wealth status: poorest	40	55.1
Poor	36	51
Middle	31	44
Rich	31	48
Richest	23	42
Breastfeeding in 1st half an hour: yes	31	47
No	34.4	50
Exclusive breastfeeding: yes	31	46.2
No	34	50
Duration of breastfeeding: up to 6 months	20.2	40.4
Over six months	36	50.3
Birth order: 1	34	53
2	31	51
3	30	45.4
4 +	33	47
Child gender: Male	33.4	48
Female	31.3	49
Age cohorts: 15-19	44	54.2
20-24	33	52
25-29	30	49
30-34	33	47
35-39	31.4	42.3
40-44	32	45
45-49	21	43
Cooking fuel: electricity/gas	0	44
Charcoal	25.1	42.4
Wood	34	49.4
Wall material: Bricks	27.3	42.4
Not bricks	34.3	51
Floor material: Cement	24.4	40.2
Not cement	34.1	50
Mother's occupation: white collar	21.1	46.4
Agriculture	34.2	49.3
Services	30.3	46
Blue collar	36	44
Father's occupation: white collar	26	45
Agriculture	34.3	49
Services	35	52
Blue collar	32.2	48.2
Wasted: yes	36.3	53
No	20	44
Stunted: yes	35	52
No	24.2	47
Child age in months: 0-12	34.1	52.3
13-24	42	53
25-36	21.5	46.1
37-48	16.5	46
49-59	23.1	47
Total	32	48
Source: Author's own calculations from UDHS, 2006		

Breastfeeding practices in line with WHO recommendations are significantly associated with the occurrence of diarrhoea and ARI. Children that were exclusively breastfed reduce the probability of diarrhoea and ARI occurrence by 5% and 4–5%, respectively, compared to their counterparts (Tables 2 and 3). The coefficients are statistically significant at 1% level ($p<0.01$). Additionally, children that were breastfed in the first half an hour after birth reduce the probability of diarrhoea and ARI occurrence by 4–5% and 4%, respectively, compared to their counterparts (Table 2 and 3). The coefficients are statistically significant at 5% level ($p<0.05$). Additionally, terminating breastfeeding at six months increases the probability of occurrence of diarrhoea and ARI by 19% and 25%, respectively, compared to counterparts that breastfeed longer than six months (Tables 2 and 3). The coefficients are statistically significant at 1% level ($p<0.01$). The experience of the mother in childcare is captured by age cohorts. Mothers in a higher age cohort, compared to

15–19, reduce the probability of diarrhoea and ARI occurrence by 5–21% and 6–11%, respectively. For the diarrhoea regression, the coefficients are statistically significant at 1% level ($p<0.01$) and for ARI regression the level of significance is not uniform across cohorts. The descriptive findings in Table 1 confirm these quantitative results.

Table 2: Determinants of diarrhoea prevalence among under-fives (marginal effects after a probit estimation)

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
Mother's education: primary	-0.01	-0.03	-0.04**		0.00
	(0.34)	(0.10)	(0.03)		(0.93)
Secondary	-0.05*	-0.06**	-0.07**		-0.05
	(0.07)	(0.04)	(0.01)		(0.31)
Post-secondary	-0.11**	-0.10**	-0.10*		0.03
	(0.04)	(0.04)	(0.06)		(0.754)
Location: Rural	0.037	0.037	0.057*	0.047	0.00
	(0.17)	(0.18)	(0.06)	(0.19)	(0.84)
Region: East	0.00	0.00	0.01	0.02	0.00
	(0.79)	(0.73)	(0.46)	(0.26)	(0.92)
North	0.04*	0.05**	0.07***	0.1***	0.11**
	(0.08)	(0.02)	(0.00)	(0.00)	(0.01)
West	0.02	0.02	0.00	0.02	0.06
	(0.34)	(0.38)	(0.76)	(0.43)	(0.13)
Father's education: primary	0.06***	0.06***	0.05**		0.09**
	(0.00)	(0.00)	(0.03)		(0.02)
Secondary	0.04	0.03	0.02		0.02
	(0.13)	(0.16)	(0.36)		(0.59)
Postsecondary	-0.00	-0.00	-0.00		-0.04
	(0.94)	(0.89)	(0.80)		(0.53)
Religion: Protestant	5.80e-05	-0.0	-0.00	-0.00	-0.03
	(0.99)	(0.96)	(0.88)	(0.84)	(0.24)
Muslim	0.06**	0.05**	0.05*	0.06**	0.1**
	(0.01)	(0.02)	(0.05)	(0.02)	(0.02)
Other	-0.00	-0.00	-0.01	-0.02	-0.02
	(0.82)	(0.80)	(0.59)	(0.40)	(0.52)
Wealth status: Poor	-0.05**	-0.05**			-0.058
	(0.016)	(0.01)			(0.11)
Middle	-0.07***	-0.07***			-0.04
	(0.00)	(0.00)			(0.29)
Rich	-0.07***	-0.07***			0.01
	(0.00)	(0.00)			(0.78)
Richest	-0.1***	-0.1***			-0.04
	(0.00)	(0.0)			(0.45)
Exclusive breastfeeding		-0.05***	-0.05***	-0.05***	
		(0.00)	(0.00)	(0.00)	
Mother age cohorts: 20-24		-0.05*	-0.06*	-0.09**	
		(0.07)	(0.05)	(0.01)	
25-29		-0.09***	-0.1***	-0.1***	
		(0.00)	(0.00)	(0.00)	
30-34		-0.07**	-0.082**	-0.1***	
		(0.01)	(0.01)	(0.00)	
35-39		-0.09***	-0.11***	-0.1***	
		(0.00)	(0.00)	(0.00)	
40-44		-0.11***	-0.11***	-0.1***	
		(0.00)	(0.00)	(0.00)	
45-49		-0.19***	-0.21***	-0.2***	
		(0.00)	(0.00)	(0.00)	
Child sex: Male	-0.0162	-0.01	-0.01	-0.00995	-0.02
	(0.253)	(0.27)	(0.38)	(0.51)	(0.23)
Breastfeeding in the 1st half of an hour	-0.03**				-0.04*
	(0.01)				(0.07)
Birth order: 2	-0.04				
	(0.131)				
3	-0.05*				
	(0.05)				
4+	-0.06***				
	(0.00)				
Wall material: bricks			-0.03*	-0.04*	
			(0.054)	(0.06)	
Cooking fuel: Charcoal			0.86***	0.83***	
			(0)	(0)	
Wood			0.56***	0.5***	
			(0)	(0)	
Mother's occupation: Agriculture				0.08***	
				(0.00)	
Services				0.051	
				(0.32)	
Blue collar jobs				0.08*	
				(0.05)	
Father's occupation: Agriculture				0.03	
				(0.18)	
Services				0.06	
				(0.16)	
Blue collar jobs				0.05*	
				(0.05)	
Child age in months: 13-24					-0.04
					(0.2)
25-36					-0.2***
					(0.0)
37-48					-0.2***
					(0.0)
49-59					-0.2***
					(0.00)
Breastfeeding up to six months					0.2***
					(0.00)
Nutritional status:					0.14***

wasted					
					(0.00)
Observations	4,40	4,38	4,22	3,87	1,47
p-value in parentheses; *** p<0.01, ** p<0.05, * p<0.1					

Birth order is also revealed to be important in our analysis. Having a higher birth order, compared to the first, reduces the probability of occurrence of diarrhoea and ARI by 5–6% and 6–7%, respectively (Tables 2 and 3). The coefficients are statistically significant at 1% level (p<0.01).

It is not surprising that the individual components of the household wealth index are importantly associated with disease occurrence. Using bricks in construction, compared to mud, reduces the probability of occurrence of diarrhoea and ARI by 4% and 7%, respectively (Tables 2 and 3). Additionally having a cemented floor, compared to a dirt floor, reduces the probability of ARI occurrence by 7%. The coefficients are statistically significant at 5% level (p<0.05). Compared to those using electricity/gas, those using wood and charcoal increase the probability of diarrhoea occurrence by 50–86% (Table 2). The coefficients are statistically significant at 1% level (p<0.01). On the other hand, considering occupation type, mothers in agriculture and blue collar jobs, compared to white collar workers, increase the probability of diarrhoea occurrence by 8% (Table 2).

Child age and nutritional status are imperatively associated with the incidence of diseases. Compared to children who are 0–12 months of age, children in older age cohorts reduce the probability of occurrence of diarrhoea and ARI by 16–23% and 11–20%, respectively (Tables 2 and 3). For the diarrhoea regression, the coefficients are statistically significant at 1% level (p<0.01) and for ARI regression they are statistically significant at 1% level (p<0.01) for younger children and at 10% level (p<0.1) for older children. Being wasted increases the probability of occurrence of diarrhoea by 14% compared to well-nourished counterparts (Table 2). The coefficient is statistically significant at 1% level (p<0.01).

Discussion

This paper set out to investigate the factors associated with the occurrence of diarrhoea and ARI incidence for children under five years. Using the UDHS 2006 data set, we employed both bivariate and multivariate analysis. It was revealed that, on average, 32% and 48% of children in the survey suffered from diarrhoea and ARI, respectively, in the two weeks prior to the survey date. These percentages seem to be very high and hence the need to gain insights into the factors associated with their occurrence in order to design policies than can reverse the situation. Various factors were found to be significantly associated with the probability of occurrence of diarrhoea and ARI. Mother's education, especially at post-secondary level, reduced the probability of diarrhoea occurrence but had no effect on ARI occurrence. These findings corroborate those of a study conducted in Egypt.[8] Government effort to educate girls beyond secondary level is therefore called for. The government's free primary and secondary education programme is very relevant in addressing this cause and hence should be strengthened and be propelled to higher levels.

There are also significant regional and location differentials with the northern region and the rural areas being more susceptible to the occurrence of both diarrhoea and ARI. The northern region is particularly vulnerable because it has suffered civil war for over two decades since 1986 and many people were forced to live in camps where poor sanitation and overcrowding increased the chances of disease occurrence. This result corroborates a study conducted in Egypt.[8] There is need for government effort to reach the areas at risk with the appropriate health services. Village outreach clinics should be established country-wide in order to eliminate the regional or location imbalance. Being in a higher wealth status, compared to the lowest (poorest), was revealed to reduce the probability of occurrence of diarrhoea and ARI. This finding is in line with what was found in rural India.[5] Therefore, the government effort to

raise the incomes of the poor by implementing the targets set out in the National Development Plan (2010-2015) is an important vehicle for the attainment of MDG 4. The government should also earmark funds that can facilitate individual access to healthcare irrespective of the ability to pay.

Table 3: Determinants of ARI among under-fives (marginal effects after a probit estimation)

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
Mother's education: primary	0.0	-0.00	-0.00		0.01
	(0.96)	(0.66)	(0.71)		(0.59)
Secondary	0.04	0.03	0.03		0.06
	(0.21)	(0.33)	(0.23)		(0.22)
Post-secondary	0.08	0.09	0.10*		0.13
	(0.12)	(0.10)	(0.07)		(0.20)
Location: Rural	0.07***	0.07***	0.09***	0.06	0.09*
	(0.00)	(0.0)	(0.00)	(0.11)	(0.06)
Region: East	0.01	0.02	0.01	0.01	-0.07
	(0.44)	(0.36)	(0.53)	(0.69)	(0.10)
North	0.04*	0.06**	0.05**	0.05**	-0.03
	(0.07)	(0.01)	(0.02)	(0.02)	(0.43)
West	0.05**	0.05**	0.02	0.02	0.05
	(0.02)	(0.01)	(0.37)	(0.31)	(0.23)
Father's education: primary	0.02	0.02	0.00		0.01
	(0.278)	(0.33)	(0.77)		(0.72)
Secondary	0.01	0.01	0.00		0.04
	(0.529)	(0.63)	(0.83)		(0.35)
Post-secondary	-0.04	-0.05	-0.04		-0.02
	(0.22)	(0.22)	(0.27)		(0.75)
Religion: Protestant	-0.01	-0.00	-0.01	-0.01	0.01
	(0.57)	(0.60)	(0.46)	(0.49)	(0.65)
Muslim	-0.02	-0.02	-0.02	-0.03	-0.00
	(0.44)	(0.29)	(0.41)	(0.27)	(0.98)
Other	0.03	0.04	0.03	0.02	0.05
	(0.16)	(0.12)	(0.17)	(0.35)	(0.261)
Wealth status: Poor	-0.05**	-0.05**			-0.08**
	(0.03)	(0.02)			(0.04)
Middle	-0.09***	-0.10***			-0.17***
	(0.00)	(0.00)			(0.00)
Rich	-0.04	-0.04			-0.07
	(0.12)	(0.12)			(0.12)
Richest	-0.08**	-0.08**			-0.18***
	(0.01)	(0.01)			(0.00)
Exclusive breastfeeding		-0.04***	-0.03**	-0.04**	
		(0.00)	(0.01)	(0.01)	
Mother age cohorts: 20-24		0.01	0.00	-0.02	
		(0.72)	(0.80)	(0.47)	
25-29		-0.03	-0.04	-0.07*	
		(0.26)	(0.25)	(0.05)	
30-34		-0.06*	-0.06*	-0.10***	
		(0.08)	(0.07)	(0.0)	
35-39		-0.10***	-0.10***	-0.13***	
		(0.00)	(0.00)	(0.002)	
40-44		-0.07*	-0.08*	-0.1**	
		(0.06)	(0.06)	(0.01)	
45-49		-0.06	-0.07	-0.10*	
		(0.22)	(0.16)	(0.08)	
Child sex: Male	0.00	0.00	0.01	0.01	-0.00
	(0.58)	(0.55)	(0.49)	(0.36)	(0.95)
Breastfeeding in the 1st half of an hour	-0.03**				
	(0.01)				
Birth order: 2	-0.03				
	(0.23)				
3	-0.06**				
	(0.02)				
4+	-0.07***				
	(0.00)				
Wall material: bricks			-0.07***		
			(0.00)		
Radio			-0.03*	-0.03**	
			(0.05)	(0.04)	
Cooking fuel: Charcoal			-0.00	-0.08	
			(0.99)	(0.68)	
Wood			-0.01	-0.10	
			(0.94)	(0.62)	
Floor material: cement				-0.06**	
				(0.01)	
Mother's occupation: Agriculture				-0.02	
				(0.49)	
Services				-0.02	
				(0.60)	
Blue collar jobs				-0.07*	
				(0.06)	
Father's occupation: Agriculture				0.00	
				(0.91)	
Services				0.08*	
				(0.06)	
Blue collar jobs				0.04*	
				(0.08)	
Child age in months: 13-24					-0.11***
					(0.00)
25-36					-0.19***
					(4.33e-06)
37-48					-0.13**
					(0.01)
49-59					-0.11*
					(0.07)
Breastfeeding up to six months					0.24***
					(1.35e-08)
Nutritional status: wasted					0.03
					(0.30)
Observations	4,40	4,38	4,22	3,87	1,47
p-value in parentheses; *** p<0.01, ** p<0.05, * p<0.1					

Breastfeeding practices are also important factors associated with the occurrence of both diseases. Mothers who initiated breastfeeding in the first hour after birth and those who practiced exclusive breastfeeding reduced the probability of their children suffering from diarrhoea and ARI. These results emphasise the protective effect of breastfeeding practices as recommended by WHO. These findings are similar to those found in Greenland.[9] There is therefore a need to sensitise mothers to adhere to the WHO breastfeeding recommendations in order to increase the resilience of children against diseases. Our findings also revealed that being a Muslim increases the probability of diarrhoea occurrence. This finding is rather unique because it has not been seen in the literature surveyed. However, this can probably be attributed to differences in traits and beliefs in different religions where Muslims are more likely to have larger families which are associated difficulties of providing proper sanitation and feeding compared to their counterparts.

Our findings revealed that women in a higher age cohorts, compared to those in the 15-19 age cohort, and those with a higher birth order, compared to the first, reduce the probability of occurrence of diarrhoea and ARI. This can be attributed to the knowledge and experience concerning childcare accumulated by older women over time which unambiguously gives them an edge over younger women. Surprisingly, the source of cooking fuel did not have any effect on the prevalence of ARI. We expected it to have no effect on diarrhoea but to have a strong effect on ARI, but the reverse is true. The effect of cooking fuel on diarrhoea occurrence was also observed in Nigeria.[14] This can be attributed to the fact that some households using firewood or charcoal, compared to counterparts using electricity or gas, are in some cases associated with a poor household environment that makes children vulnerable to diseases like diarrhoea.

Child age and their nutritional status are imperatively associated with the incidence of diseases. This can be attributed to the fact that very young children and those that are poorly nourished are highly susceptible to disease occurrence. These findings are corroborated by those conducted in rural India and Egypt.[5,8] Fathers with primary education, compared to counterparts with no education, increase the probability of diarrhoea occurrence by 6–8% (Table 2). This result is counter-intuitive and hence surprising. It might be the case that primary education is too low to yield favourable health outcomes. These findings contradict those found in Turkey where father's education was revealed as particularly important.[11]

Building materials; wall and floor, are significantly associated with the probability of disease occurrence. Children who lived in a brick wall and cemented floor had a lower probability of disease occurrence. These findings underscore the importance of household wealth in averting the incidence of diseases. Occupational engagement was important, with those in agriculture associated with a higher probability of disease occurrence. A similar scenario was observed in Egypt.[8] Our analysis has also yielded surprising results. It is surprising that the source of drinking water and toilet type did not matter for both diarrhoea and ARI incidences and hence were dropped out of our models. This is contrary to the findings in a study conducted in Ethiopia. [6]

Conclusion

Female education should be enhanced by appropriate government policy in order to attain favourable child health outcomes in the future. Government effort should be geared to eliminate location and regional disparities in the enjoyment of good health by the population. Therefore, the masses should be universally sensitised about the causes of diarrhoea and ARI and how to guard against the occurrence of these diseases. Additionally, the masses should be sensitised about the benefits of breastfeeding practices recommended by the WHO for favourable health outcomes. The government should also ensure proper dwelling places for the population in order to ensure favourable health outcomes. Other proper feeding practices, together with

breastfeeding, should be made known to the masses so as to reduce the numbers of children that are stunted and wasted.

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CONFLICTS OF INTEREST

I declare that there are no conflicts of interest

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Accessibility and use of data was approved by Macro International, the custodian of Demographic and Health Surveys.