SA Journal of Child Health

ARTICLE

Epidemiological factors in admissions for diarrhoea in 6 - 60-month-old children admitted to Morogoro Regional Hospital, Tanzania

Rebecca Oketcho, Esron D Karimuribo, Cornelio N M Nyaruhucha, Saifuddin Taybali

Department of Veterinary Medicine and Public Health, Sokoine University of Agriculture Morogoro, Tanzania
Rebecca Oketcho, BSc
Esron D Karimuribo, BVM, MVM, PhD

Department of Food Science and Technology, Sokoine University of Agriculture, Morogoro, Tanzania
Cornelio N M Nyaruhucha, BSc, MSc, PhD

Morogoro Regional Hospital, Morogoro, Tanzania
Saifuddin Taybali, MD

Corresponding author: *Rebecca Oketcho (rbccoketcho@yahoo.co.uk)*

Objectives. To describe the diarrhoea admissions and the influencing factors in 6 - 60-month-old children at Morogoro Regional Hospital.

Design. A retrospective descriptive study of the type of diarrhoea, patient age, home address, nutritional status, diagnosed infection, month of admission, admission duration and outcome.

Setting. A hospital-based study: paediatric admissions at Morogoro Regional Hospital.

Subjects. All children aged 6 - 60 months admitted to the infectious diseases ward over the 60-month period from May 2006 to April 2011.

Results. A total of 4 988 records were extracted, among which the prevalence of diarrhoea was 2 855 (57.2%). Among the 2 855 children with diarrhoea, the majority (2 536 (88.8%)), were 6 - 24 months old, with peak admissions at 7 months and 12 months. District of residence, season, undernutrition and infection were the factors significantly associated (p<0.001) with the age at which children were admitted with diarrhoea.

Conclusions. There were increased numbers of admissions for diarrhoea at the ages of 7 months and 12 months, during the dry season and together with diagnosed infection, particularly malaria. However, further study on causes of childhood diarrhoea, given the identified risk factors, may better explain the epidemiology of diarrhoea in Morogoro.

S Afr J CH 2012;6(3):81-84. DOI:10.7196/SAJCH.479

Diarrhoea is defined as the passage of loose or watery stools at least three times a day, characterised by increase in volume, fluidity or frequency of bowel movement relative to the usual pattern for a particular person.[1] Diarrhoea is a common symptom of gastrointestinal infections due to ingestion of many bacteria, viruses or parasites that may be transmitted by water, food, utensils, hands, and flies.[1] It is the mechanism by which the body rids itself of pathogenic organisms, with excessive stimulation of intestinal motility, leaving insufficient time for absorption of intestinal fluid.[2] There are three clinical syndromes of diarrhoea: (*i*) acute watery diarrhoea, lasting less than 14 days; (*ii*) bloody diarrhoea; and (*iii*) persistent diarrhoea, lasting at least 14 days. Diarrhoea results in electrolyte loss, dehydration, shock and sometimes death.[1]

The paediatric death toll due to diarrhoea exceeds that of acquired immunodeficiency syndrome (AIDS), malaria and measles combined, with Africa and South Asia accounting for 80%[1] and sub-Saharan Africa 37%. The prevalence of diarrhoea among children under 5 years in Tanzania is 15%,[3] with 23 900 annual deaths.[1] In Morogoro Region, the prevalence is 15.8%,[3] an increase from 12.1% in 2004.[4] The diarrhoea syndrome ranks second after malaria among causes of morbidity,[5] and third among the causes of mortalityin the region.[6]

Diarrhoea is more prevalent in the developing world due, in large part, to lack of safe drinking water, sanitation and hygiene, and poorer overall health and nutritional status.[1] Efforts to define the underlying biological mechanisms have identified nutritional, microbiological and immunological factors to be associated with specific patterns of diarrhoea morbidity and mortality.[2] Diarrhoea is a common symptom of gastrointestinal infections. Enteric pathogens stimulate partial immunity against repeated infection, leading to declining incidence of disease in older children and adults.[7] While protein-energy malnutrition, in association with micronutrient deficiencies, may predispose children to persistent diarrhoea and/or prolong the rate of recovery, each diarrhoea episode can cause weight loss and growth retardation. Studies on impact of infant feeding patterns on diarrhoea

have identified breast-feeding duration and age of complementary food introduction as important determinants of this relationship.[2]
The aim of this study was to describe the pattern of diarrhoea admissions of 6 - 60-month-old children at Morogoro Regional Hospital and factors influencing this pattern.

Materials and methods

Study site

The study was conducted at Morogoro Regional Hospital. The region covers 8.2% of the total Tanzania mainland area and lies between latitudes 5°58" and 10°0" South of the Equator and longitudes 35°25" and 35°30" East of the Greenwich meridian.[5] Administratively, the region is composed of six districts, namely Kilombero, Kilosa, Morogoro rural, Morogoro urban, Mvomero and Ulanga, further divided into 30 divisions and 141 wards. There are six public hospitals in the region – one in each of the Ulanga, Kilosa and Mvomero districts and the other three in Morogoro urban, one of which is the regional hospital, located in Morogoro town. The regional hospital is a referral hospital, receiving patients from both within and outside the region.[6] The paediatrics section of the hospital has three wards, and in this study data were retrieved from the ward responsible for management of infectious diseases, admitting children aged 1 month to 2 years. The other two wards, the one dealing with children without infectious diseases and the one admitting children under the age of 1 month, were excluded from this study.

Ethical clearance

The Medical Research Coordination Committee at the National Institute for Medical Research (NIMR), Dar es Salaam, Tanzania, granted the ethical clearance for conducting this study; Reference number: NIMR/HQ/R.8a/Vol. IX/1023.

Study design and sample size estimation

A retrospective study employing a survival analysis approach was adopted. This involved retrieval of child admission records from a paediatric ward responsible for management of infectious diseases, targeting children from 6 to 60 months old. All the children admitted at the ward over the 60-month period were included in the study, with the exception of those outside the age bracket 6 - 60 months.

Data collection

The inclusion criterion was the age of children at admission. Recorded information for the children, from 6 to 60 months old regardless of their ailments, was extracted, focusing on whether they had diarrhoea, the type of diarrhoea, age of the child, the home address, nutritional status, diagnosed infection, the month of admission, as well as the duration of stay at the ward and the outcome. The total number of admissions for this age group was 4 988. Additionally, rainfall and temperature data for Morogoro Region was obtained from the region profile.[6] The climate was categorised into two rainy seasons, namely long rains between November and May and short rains between January and February, and a dry season, from July to September.

Data analysis

The data were analysed using Epi info, version 3.4.3 and Statistical Package for Social Sciences (SPSS), version 16.0. Semi-parametric Cox proportional hazard models were used.[9] The age of children in months was compared with other factors to determine the effect of each on the age of admission with diarrhoea. Significance tests about the subsets of the parameters were derived by comparison of the hazard ratios (HR) and -2 log likelihoods achieved, according to the likelihood ratio test chi-square distribution.[10] Additionally, linear regression was done to find the association between diarrhoea admission and the seasons experienced in Morogoro Region. The mapping of the districts of residence of the children within Morogoro Region was performed using GIS software package (ArcView 3.2).

Results

Descriptive statistics

From May 2006 to April 2011, 4 988 children within the age bracket 6 - 60 months were admitted to the paediatric ward for management of infectious diseases at Morogoro Regional Hospital. There were some

Table 1. Characteristics of admissions to paediatric infectious diseases ward of Morogoro Regional Hospital

Factor	Total admissions	Diarrhoea cases (*n*)	Diarrhoea cases (%)
Total admissions	4 988	2 855	57.2
Season			
Long rains	1 933	957	49.5
Short rains	809	466	57.6
Dry season	2 246	1 432	63.8
Age (months)			
6 - 12	2 804	1692	60.3
13 - 24	1 501	844	56.2
25 - 36	388	184	47.4
37 - 60	295	135	45.8
Sex			
Female	2 096	1 195	57.0
Male	2 888	1 659	57.4
Missing	4	1	25.0
Residence			
Kilombero district	14	4	28.6
Kilosa district	130	67	51.5
Morogoro rural	671	297	44.3
Morogoro urban	3 859	2 310	59.8
Mvomero district	247	134	54.7
Ulanga district	7	4	57.1
Outside Morogoro	19	11	57.9
Missing	41	28	68.3
Infection			
HIV/AIDS	28	9	32.1
Malaria	3 098	1 800	58.1
Measles	43	5	11.6
Multiple infections	605	236	39.0
Pneumonia	221	85	38.5
Others	220	79	35.9
No infection	773	641	82.9
Undernutrition			
Anaemia	457	171	37.4
Kwashiorkor	26	8	30.8
Marasmus	48	21	43.8
Protein-energy malnutrition	125	34	27.2
Under-weight	16	10	62.5
Others	22	9	40.9
No undernutrition	4 294	2 602	60.6

cases of missing data: 41 for the residence and 4 for sex of children. Nearly all children (99.5%) resided in Morogoro and there were more male children (57.9%) than female (Table 1). The prevalence of diarrhoea was 57.2%, with 63.8% occurrence during the dry season, and among the 2 855 children admitted with diarrhoea, those less than 2 years old contributed 2 536 (88.8%). Also, among the 2 855 diarrhoea admissions, watery diarrhoea constituted 2 785 (97.5%), dysentery 66 (2.3%) and persistent diarrhoea 4 (0.2%). The female: male diarrhoea admission ratio was 1:1.4. Commonest forms of undernutrition were anaemia and protein energy malnutrition (PEM), but underweight had highest co-occurrence with diarrhoea (62.5%). Of infections diagnosed, malaria had the highest co-occurrence with diarrhoea (58.1%). Diarrhoea was most common among children admitted from Morogoro urban, Kilosa and Mvomero districts, where more than half of the children from these districts were admitted with diarrhoea: 59.8%, 51.5% and 54.7%, respectively.

Among the 4 988 children included in the study, 2 855 (57.2%) had diarrhoea and 2 133 (42.8%) other diseases. Among the 2 855 children admitted with diarrhoea, 2 598 (91.0%) were admitted for 7 days or less, compared with 1 765 (82.7%) of the 2 133 children with other diseases. Fewer diarrhoea cases than controls were admitted for 8 - 14 days (5.3% versus 7.6%) and for longer than 14 days (0.7% versus 1.3%). Among the 2 855 diarrhoea cases, 180 (6.3%) died, compared with 293 of 2 133 non-diarrhoea cases (13.7%).

Factors associated with variation in diarrhoea occurrence by age

Effect of seasons

Diarrhoea admissions were particularly high in July (Fig. 1). Seasons were significantly associated with admissions for diarrhoea, with the dry season having the highest likelihood (HR 1.308, p=0.000) and highest probability (Fig. 2) of diarrhoea admission at any age. July, August, October and December significantly influenced age of admission for diarrhoea, p=0.000, p=0.005, p=0.002 and p=0.011, respectively. The types of diarrhoea were relatively evenly distributed throughout the year except dysentery, of which 30% were admitted in October and November. Climate and diarrhoea occurrence were moderately associated and inversely proportional: correlation coefficient (r) 0.469, regression coefficient -13.762 for temperature and correlation (r) 0.648, regression coefficient -0.65 for rainfall. Temperature had 22% (r^2=0.22) effect on diarrhoea occurrence while rainfall had 42% (r^2=0.42).

Effect of infections

The commonest infection, malaria, also had the highest co-occurrence with diarrhoea (58.1%) (Table 1).

Effect of undernutrition

Undernutrition was significantly associated (p=0.000) with the age of occurrence of diarrhoea (Table 2). Protein-energy malnutrition had the highest risk for diarrhoea occurrence at any age. In comparison with anaemia, under-weight was also associated with high likelihood of diarrhoea occurrence (HR 2.064), (Fig. 2).

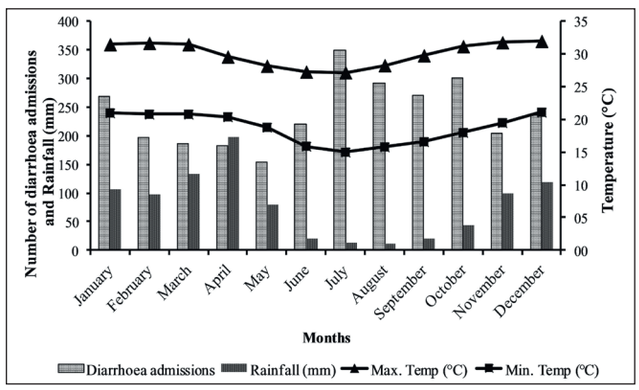

Fig. 1. Diarrhoea admission variation by the climate of Morogoro region.

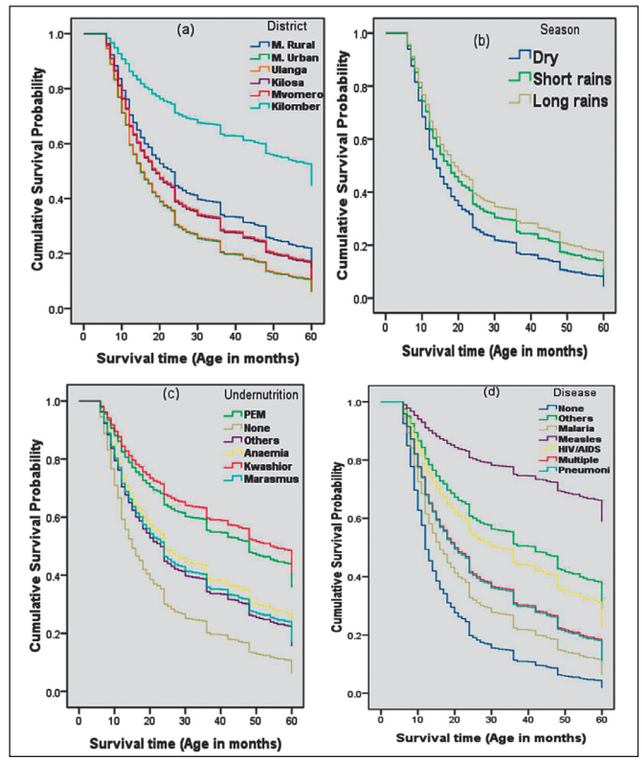

Fig. 2. Survival probability for time to diarrhoea admission by (a) residence, (b) seasons, (c) under-nutrition and (d) infections.

Effect of district of residence

The risk for admission for diarrhoea varied among districts, with the highest probability in Ulanga and Morogoro urban. The ordered comparative risk at any age was: Morogoro urban (HR 1.418), Ulanga (HR 1.364), Mvomero (HR 1.183), Kilosa (HR 1.177), Morogoro rural (HR 1.002), Kilombero (HR 0.554).

Effect of sex

Although the male child was more likely to get diarrhoea (HR 1.064) than the female, sex did not have a significant effect on the age at which children were admitted for diarrhoea (Table 2).

Discussion

Among the 6 - 60-month-old children admitted to Morogoro Regional Hospital from May 2006 to April 2011, diarrhoea was associated with 6.3% mortality, and prevalence was highest between the ages of 6 months and 15 months, with peaks at 7 and 12 months. Beyond 15 months of age, diarrhoea admissions reduced steadily. The World Health Organization attributes this trend to weak immune systems due to first exposure to enteric pathogens via contaminated complementary and/or weaning food or contact with faeces when crawling.[7] In Morogoro Region, the factors of residence, season, undernutrition and infection significantly influenced this trend of diarrhoea admission in children.

In Morogoro, temperatures range from 18 to 30°C and annual rainfall varies between 600 and 1 800 mm. The dry season is from July to September and the rainy season from November to May.[6] Significantly more children were admitted with diarrhoea in the dry period from July to December (Figs 1 and 2). Water scarcity has been associated with lower levels of hygiene, which in turn increase the risk of transmission of enteric pathogens. This suggests that climate indirectly affects the age at which children get diarrhoea by facilitating the impact of other risk factors.

Table 2. Factors influencing the likelihood of diarrhoea occurrence in children admitted to Morogoro Regional Hospital

Factor	Likelihood ratio	Chi-square	Degrees of freedom	*p*-value
Sex	2.112	2.098	1	0.350
District	60.694	55.005	5	0.000
Season	77.504	77.947	2	0.000
Nutritional status	113.820	95.274	5	0.000
Infection(s)	196.251	183.757	5	0.000

Although Morogoro Regional Hospital is a referral hospital, it is one of six public hospitals in the region, and is not centrally located. The total number of general child admissions was biased by distance of districts from the hospital. Morogoro urban, where the hospital is located, had the highest total admissions, while Ulanga and Kilosa districts, furthest from Morogoro urban, registered relatively lower numbers of diarrhoea admissions. These also happen to have a public hospital within each of them, hence the possibility of adequate management of diarrhoea and less need to refer children to Morogoro Regional Hospital. However, children residing in Kilombero district, which does not have a public hospital, generally had the lowest numbers of diarrhoea admissions (HR 0.554). Children admitted from Ulanga, on the other hand, were comparatively more likely (HR 1.364) to be admitted with diarrhoea than children living in other districts, despite the fact that Ulanga is furthest from the hospital, and also has a public hospital. North Kilosa is situated on the leeward side of the Uluguru Mountains and receives the least rainfall, compared with the other districts. Ulanga and Kilombero districts, in the southern part of Morogoro, have their climate greatly influenced by Mahenge and Udzungwa Mountains, some parts receiving more rainfall than others.[6] This may explain the geographical influence of these districts on diarrhoea admissions.

Poor nutritional status is associated with persistent diarrhoea, the least common type of diarrhoea.[2] The findings in Morogoro reflected a similar picture, undernutrition being 14% of admissions and persistent diarrhoea 0.2% of diarrhoea admissions. There was 37% undernutrition and diarrhoea co-occurrence and undernutrition significantly influenced (p=0.000) the age at which children were admitted with diarrhoea (Fig. 2). Either one of the two conditions, diarrhoea or undernutrition, can predispose children to the other;[11] however, it was beyond the scope of this study to establish which preceded the other.

There is an association between infections and diarrhoea occurrence in children.[12] In Morogoro, infections were significantly associated (p=0.000) with age at which children with diarrhoea were admitted to hospital. Of the infections diagnosed, malaria exposed children to the highest probability of suffering from diarrhoea. This may be so because malaria was the commonest infection in hospitalised children. It is especially interesting to note that malaria had more influence on diarrhoea admissions than HIV/AIDS did, yet the latter is more widely associated with diarrhoea occurrence in adults.[13] However, most children with diarrhoea were not diagnosed with any infection, indicating how frequently gastroenteritis patients were admitted. There were similar findings in Nigeria.[14]

In Morogoro the likelihood of diarrhoea admission does not appear to be influenced by sex of children, and this was also reported in Uganda.[15]

Conclusion

The risk factors for diarrhoea admission in children included, but may not have been limited to, residence, seasons, undernutrition and infections. Children appeared to be particularly vulnerable to diarrhoea before their second birthday, with an increased admission rate around the ages of 7 months and 12 months. Those living in Ulanga and Morogoro urban appeared to be at increased risk, and more so during the dry season. When children were admitted with diarrhoea, they were also likely to have an infection, most likely malaria. Undernutrition was also associated with diarrhoea. However, further study on the possible causes of diarrhoea may better explain the epidemiology of diarrhoea in Morogoro.

Acknowledgements. The study was funded by Dr V O Oketcho, the sponsor of the corresponding author. The authors express gratitude to the staff of Morogoro Regional Hospital for their cooperation and support in conducting the study.

Conflict of interest. Neither the sponsor nor the authors of this work has had any affiliations that could inappropriately influence or bias the content of the manuscript.

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