ORIGINAL RESEARCH

DIARRHOEA AND MALNUTRITION AMONG CHILDREN IN A KENYAN DISTRICT: A CORRELATIONAL STUDY

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ABSTRACT

Background: Diarrhoea is a leading cause of child morbidity and mortality in Kenya. Diarrhoea and malnutrition have been shown to be bi-directionally related. Methods: Monthly diarrhoeal outpatient morbidity among children under five years of age and anthropometric measurements carried out in the community among children under five years of age were analysed for 2009. This information was supplemented by data on latrine coverage and mean distance to water source. Results: Diarrhoea morbidity and being at risk for malnutrition were closely correlated (correlation coefficient = 0.8 after controlling for monthly latrine coverage and mean distance to a water source). A quarter of the children were found to be at risk for malnutrition and the mean monthly prevalence of diarrhoea was 8%. Diarrhoea and malnutrition also displayed a seasonal trend with the highest cases being reported during July, which was also the driest month. Latrine coverage is low with only 12.8% of households having access to a latrine at the end of 2009. Conclusion: In this resource constrained setting, the need to direct funds towards latrine coverage, improvements of nutritional status of children and the availability of potable water. Such a three pronged approach may help reducing diarrhoeal morbidity and malnutrition among children.

KEY WORDS: Diarrhoea; Malnutrition; Sanitation; Children; Water; Ecological study; Kenya.

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INTRODUCTION

The primary causes of many childhood illnesses in Kenya are water and sanitation-related. Amongst these illnesses, diarrhoea remains one of the most important environmental health problems. Diarrhoeal diseases cause 16 % of deaths among children below five years in Kenya and are second only to pneumonia as a cause of deaths in this cohort (Ministry of Public Health and Sanitation, 2010). Millions of dollars are spent on treatment of diarrhoea annually. In most rural public health facilities diarrhoea is ranked number three of the leading causes of outpatient attendance (Ministry of Public Health and Sanitation, 2010). In Kenya about 80% of hospital attendance is due to preventable diseases and 50% of these diseases are water, sanitation and hygiene related (Ministry of Health, 2007).

Diarrhoea and malnutrition are known to have a bi-directional relationship, that is, they are potentially causing each other. Diarrhoea may lead to malnutrition due to reduced dietary intake, mal-absorption and mal-digestion. On the other hand, malnutrition may cause and worsen diarrhoea and other infections due to a weakened immune system (Nel, 2010). It has been suggested that poor nutritional status is a risk factor of diarrhoea (Chowdhury et al., 1990; Chen et al., 1981; Schorling et al., 1990). A pooled analysis of nine cohort studies from different countries also indicated that a higher cumulative burden of diarrhoea prior to 24 months of life was associated with an increased prevalence of stunting at 24 months of age (Checkley et al. 2008).

METHODS

Ijara is one of the 11 districts of North-Eastern province of Kenya and it covers an area of 9,642 km^2 with a population density of 9 people per square kilometre. The district is sub-divided into seven administrative divisions and it is semi arid in nature, with high temperatures (15-38 ^{0}C) and a low altitude (0-90 meters above sea level). Ijara is predominantly inhabited by the Somali ethnic group. The main economic activity is livestock rearing. Pastoralists live in villages, with an average village comprising of 150 households. These are mainly concentrated in areas with water sources. According to the national census, Ijara had a population of 92,663 in 2009, comprising of 50,165 males and 42,498 females living in 13,180 households.

The river Tana runs along the western boundary of the district. The river has important influence over climate, settlement pattern, and economic potential within the district for it forms the single most important source of water. Seasonal rivers are found all over the district and provide water for both human and livestock consumption during the wet season. However, less than 10% of the population of Ijara has access to safe drinking water (Ministry of Public Health and Sanitation, 2008). The average distance to the nearest water is about 2 kilometres for domestic use and 2.5 kilometres for livestock (Ministry of Public Health and Sanitation, 2008). The present study looked at the trends between diarrhoeal morbidity and malnutrition, with a view of establishing if there is correlation at the aggregate level.

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Study Design

The design of the present study is ecological and retrospective using routinely available data collected by the Kenyan Government. Different data sources were used from the Ministry of Public Health and Sanitation and from the Ministry for the Development of Northern Kenya and other arid lands. The Ministry for the Development of Northern Kenya and other arid lands runs sentinel sites across the district as part of its early warning system. These gather data on a range of issues including the proportion of children under 5 years that are at risk for malnutrition as well as the mean distance to the nearest water source. At the end of every month, reports are produced and disseminated to the various stakeholders. It is from these reports that data on the proportion of children under 5 years that are at risk for malnutrition and the mean distance to the nearest water source in kilometres were extracted for 2009.

Children at risk for malnutrition are those with a mid upper arm circumference (MUAC) of less than 135 mm. This screening method has the advantage of being very simple and can be implemented at very low costs in terms of personnel and training. MUAC has also been shown to perform as well as weight for height z scores (Berkley et al. 2005).

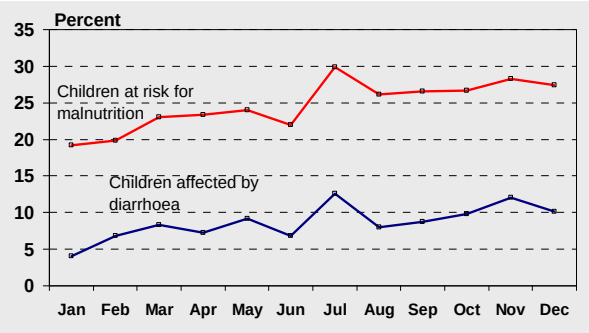
The Department of Environmental Health in the Ministry of Public Health and Sanitation maintains a database on latrine coverage beginning from July 2008, when a baseline survey had been conducted. Data on monthly latrine coverage in 2009 was extracted from this database. Data on outpatient diarrhoeal morbidity among children under 5 years for 2009 was provided by the district health records office. These records indicate the number of diarrhoeal cases treated per month in health facilities within the district.

The under 5 years age cohort was estimated to comprise 18% of the population (Ministry of Public Health and Sanitation, 2008). This was used to calculate the number of children under 5 years in the district. This figure formed the denominator and was used to calculate diarrhoea morbidity per 1000 children. These data was analysed for descriptive and correlation analysis. Analysis was done using SPSS version 16 (www.spss.com). The partial correlation analysis entailed controlling for latrine coverage and distance to nearest water source.

RESULTS

In 2009, the mean distance to the nearest water source was 4.3 kilometres; 24.7% of children were at risk for malnutrition and 8.7% of children had a bout of diarrhoea every month. Partial correlation was used to explore the relationship between diarrhoea morbidity among children and children at risk for malnutrition while controlling for latrine coverage and mean distance to a water body. There was a strong, positive correlation ($r=0.83$, $p<0.001$) between diarrhoea and malnutrition. Diarrh0ea and malnutrition showed a remarkable parallelism over time (Figure 1) with the highest prevalence of diarrhoea and vulnerability to malnutrition being recorded for July.

Figure 1: Percentages of children in Ijara, Kenya, affected by diarrhoea and at risk for malnutrition in 2009.



DISCUSSION

The present study provides some evidence that in this Kenyan district and at the aggregate level diarrhoea morbidity is correlated with malnutrition among young children. Though this correlation does not indicate causality, it may imply that addressing one issue may lead to an improvement in the other. A quarter of children in Ijara district are at risk of malnutrition. Kenya's North Eastern province has the highest proportion of moderate and severely underweight children, estimated to affect about 25% (KDHS, 2008). The district is characterized by frequent drought and unreliable rainfall, which do not favour the growth of food crops and pasture for livestock. These conditions create food insecurity and high poverty levels.

According to the present study every month almost 9 of every 100 children suffer a bout of diarrhoea in Ijara district. This may be an under-estimate given the fact that the health facilities may not be always accessed or accessible. This is a possibility given the vastness of the district and especially during the rainy season, when roads become impassable. A previous survey done in Kenya's North Eastern province found that 16% of children less than 5 years of age had diarrhoea in the two weeks preceding the survey (KDHS, 2008).

The seasonal calendar of Ijara is divided into a short dry spell between January and March. During this time milk yield drops due to decline in pasture and water scarcity. The rainy season usually commences between April and June bringing with it high milk yield as well as calving, kidding and lambing. July to October have long dry spells seeing again low milk yield and water scarcity. The short rains occur from November to December during which time milk yield increases again. The months of July and November showed the highest number of cases of diarrhoeal disease. These were also the driest and wettest months, respectively, in 2009. The occurrence of diarrhoea has been shown to display a seasonal variation. In temperate climates, bacterial diarrhoea occur more frequently during the summer (Siraj et al, 2008), whereas viral diarrhoea, particularly diarrhoea caused by rotavirus peak during the winter. In tropical areas, rotavirus diarrhoea occurs throughout the year, increasing in frequency during the drier, cool months, whereas bacterial diarrhoeas peak during the warmer, rainy season. This study was unable to delineate between viral and bacterial diarrhoea.

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In a previous study conducted in Fiji (Singh et al, 2001), high rainfall was associated with significant increase in diarrhoea in the same month, but decreased in the following month. A plausible reason given was that the initial high rainfall may have carried faecal contaminants from pastures into water supplies thus increasing the faecal load. The number of non-cholera diarrhoea cases has also been shown to increase with an increase in rainfall and temperature (Masahiro et al, 2007).

In July, the mean distance to the nearest water source was 7 kilometres and the water was of poor quality; while simultaneously food was scarce. In November, the mean distance to the nearest water was 1.1 kilometres. It is worth noting that 91% of diarrhoea cases in November were reported by the district hospital in the Masalani division. The water situation was stable in November for the entire district, including the Masalani sentinel site. In this area residents had to travel on average 5 kilometres in search of water due to the breakdown of the water pipeline (Ministry for the Development of Northern Kenya and other arid lands, 2009). This may explain the high number of cases of diarrhoea in November 2009, despite the improved water supply in other divisions.

Ijara district had mean latrine coverage of 11.9%, meaning only one in 9 households had a latrine. In Kenya's North Eastern province it is estimated that a household has an average of 5.4 persons (NASCOP, 2009). This translates to a total of 49 people sharing one latrine, leading to a high likelihood of open defecation. In Kenya's North Eastern province, poor disposal of children faeces has also been documented with only 45% of the stools of children under age 5 being disposed of safely (KDHS, 2008). This observation further predisposes children to diarrhoeal diseases. An estimated 224 million people in sub-Saharan Africa practised open defecation in 2008, and of this figure 5.6 million were in Kenya. Only four countries in sub-Saharan Africa are on track for meeting the Millennium Developmental Goal sanitation target and Kenya is not one of them (WHO/UNICEF Joint Monitoring Program for Water Supply and Sanitation, 2010). Latrine coverage in Kenya was estimated to be 53% in 2009, and Ijara district had the lowest coverage in the country. Latrine coverage in the district improved marginally from 11% to 12.8 %, an increase of 14%. This is an indication that there was little investment in sanitation. The Ministry of Public Health and Sanitation plans attaining a 10% increase in latrine coverage annually. Washing hands with soap has been shown to reduce the risk of diarrhoea by 48%; improving water quality will reduce the risk by 17%, and excreta disposal will reduce the risk by 36%. (Cairncross et al, 2010).

The present study showed a strong correlation between diarrhoea and malnutrition and policy makers should strive to reducing their prevalence. It may be imperative that investments in sanitation, provision of potable water and nutritional assistance programs be implemented or scaled up.

This study had some potential limitations. A key limitation is that a correlation study cannot show causality and it is unable to directly link diarrhoea and malnutrition in an individual child. Data gathered through the routine health care system is liable to missing values and under- reporting. Diarrhoea is caused by various pathogens, transmitted by various routes and is associated with various factors which are potentially confounding the correlation between diarrhoea and malnutrition (Cairncross et al, 2010). In addition, Ijara district lacks a meteorological station and data on rainfall would have been useful. Calculating estimates to give one figure for the entire district may be an over-simplification. This is because it was not possible to delineate figures for each division. This simplification was especially true for the mean distance to the nearest water source; which might have let to November despite being the wettest month, being the second leading in terms of diarrhoea morbidity.

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