Diarrhoeal Morbidity among Young Children in Eritrea: Environmental and Socioeconomic Determinants

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ABSTRACT

Diarrhoeal diseases are still a major cause of morbidity and mortality among children in many developing countries, particularly in sub-Saharan Africa. In Eritrea, diarrhoeal disease is one of the most frequent causes of illness and a major contributor to mortality among children. Yet, except for some descriptive reports by the National Statistics Office of Eritrea, no systematic study of the factors that influence the prevalence of diarrhoeal morbidity among young children in Eritrea was carried out. This study examined the effects of some environmental and socioeconomic factors that were associated with childhood diarrhoea in Eritrea. The study used data collected by the Demographic and Health Survey (DHS) in Eritrea in 1995. Results of the study showed that the environmental and socioeconomic conditions of the population were significant predictors of diarrhoeal morbidity. The study also found an important association of diarrheal morbidity with the age and the number of children, particularly with high prevalence of diarrhoea at the age of weaning and in households with a large number of children.

Key words: Diarrhoea, Infantile; Morbidity; Environment; Socioeconomic factors; Eritrea

INTRODUCTION

It is widely recognized that exposure to diarrhoeal pathogens in developing countries is conditioned by such factors as age of children, quality and quantity of water, availability of toilet facilities, housing conditions, level of education, economic status of households, place of residence, feeding practices, and general sanitary conditions (personal or domestic hygiene) surrounding houses. In Ethiopia, the incidence of diarrhoea is higher in the second half of an infant’s life, when inborn immunity is weaker and exposure to contaminated weaning foods is increased. Results of this study also showed that children living in households with some kind of toilet facility are less likely to be sick than children in households without any toilet facility. In Ghana, the risk of having diarrhoea is significantly associated with toilet facility, where children living in houses with toilet facilities are about 50% less likely to contact diarrhoea than children living in houses without such facilities. The same study indicates that the prevalence of diarrhoea varies...
according to education of mothers, being significantly lower among children of more educated mothers (secondary or higher) than among children of mothers with primary or no education. This is probably because more education provides knowledge of the rules of hygiene, feeding and weaning practices, and interpretation of symptoms, and enhances timely action to childhood illness (2,4).

Results of a comparative study, carried out in urban areas of Ghana, Egypt, Brazil, and Thailand by Timaeus and Lush, clearly indicate that children’s health is affected by environmental conditions and economic status of households (5). According to these authors, children from better-off households have lower diarrhoeal morbidity and mortality in Egypt, Thailand, and Brazil. Such differentials in diarrhoeal diseases by household economic status are probably due to the differences in childcare practices, for instance, preparation of weaning foods and personal hygiene (5).

In Eritrea, the health planners are, at present, greatly concerned about morbidity and mortality, especially among young children. The Ministry of Health has introduced a programme known as Participatory Hygiene and Sanitation Transformation (PHAST) by constructing community and school latrines and has undertaken national clean-up days yearly to reduce the prevalence of sanitary and hygiene-related diseases.

The success of any health policy or healthcare intervention depends on a correct understanding of the socioeconomic, environmental and cultural factors that determine the occurrence of diseases and deaths. Until 1995, any morbidity information available was derived from clinics and hospitals. Information on the incidence of diarrhoea obtained from hospitals represents only a small proportion of all illnesses, because many cases do not seek medical attention (8). Thus, the hospital records may not be appropriate for estimating the incidence of diarrhoea and are too sketchy to be used for programme developments.

The first attempt to obtain population-based morbidity data was the Eritrea Demographic and Health Survey (DHS) conducted in 1995. Although the Eritrea DHS data certainly do not allow one to attribute child morbidity to specific causes for all births, these probably are robust and could be useful, for example, in studying child morbidity for the last two weeks before the survey. This study was undertaken to assess the prevalence of diarrhoea among young children in Eritrea and to examine the environmental and socioeconomic characteristics that determine diarrhoeal morbidity, using the Eritrea DHS data. A description and categorization of the variables used in the analysis are provided in the annexure.

**MATERIALS AND METHODS**

Data for this study were drawn from the Eritrea DHS carried out in 1995 as part of the international programme of DHS. In the Eritrea DHS, data were collected during the harvesting season of the year, i.e. September to December 1995.

In the Eritrea DHS survey, diarrhoea was defined as passing of liquid, watery, or loose stools. For living children born three years prior to the survey, mothers were asked whether their children had experienced diarrhoea during the period of two weeks before the survey. Information on the presence of blood or mucus in stools and the number of bowel movements on the worst day was obtained from the mother of each child. Information was also sought on any treatment given at home, including the use of oral rehydration therapy, and on mode of feeding, specifically whether the child was on breast-feeding, bottle-feeding, weaning, or adult diet, or a combination of any of these.

Among others, information on diarrhoea and other health-related issues was collected from 5,054 women of reproductive age. Analysis was confined to children, aged 0-35 months, who were living with their mothers at the time of the survey. This produced a dataset comprising about 2,153 children.

Logistic regression was used for analyzing the data since a logistic regression method is appropriate when outcomes are dichotomous, and no observations are censored. For the ith individual, this model can be expressed as

\[ \ln(q/1-q) = \beta_0 + \sum \beta_m x_{mi} \]

where \( q_i \) is the probability of a child being ill with diarrhoea during the reference period, \( \beta_0 \) is the baseline constant, \( x_{mi} \) is an array of (m) independent variables, and \( \beta_m \) is the corresponding vector of unknown regression coefficients, which we estimated via a maximum likelihood procedure using the SPSS-PC logistic programme (9). The estimated coefficients (\( \hat{\beta}_m \)), when exponentiated, were interpreted as the odds of diarrhoeal morbidity (q/1-q) for individuals with certain characteristics relative to the odds of diarrhoeal morbidity in a reference (or baseline) group of individuals, that is, as relative odds or odds ratios. For
rare events, such as diarrhoeal diseases, q is small, and the odds ratio translates to a relative risk (10).

RESULTS

Table 1 presents the odds ratio from the univariate model, the prevalence rate of diarrhoea according to the demographic, environmental and socioeconomic variables. To examine the net effects of the variables included in the univariate model, we also estimated a series of nested multivariate models (Table 2). The patterns of the prevalence of diarrhoea showed some important variations by age (Table 1). The risk of having diarrhoea in the two-week reference period in Eritrea clearly indicates a peak at the age of 6-11 months. In this age group, the risk of having diarrhoea was more than three times higher than those children who were aged 0-5 months (reference group). After the age of 6-11 months, the risk of having diarrhoea in the two-week period decreased as the child got older. The significant effect of age was retained even after the other variables were controlled for (Table 2).

There was a significant association between the number of children living in the house and diarrhoeal morbidity in both univariate and multivariate models. Results of univariate analysis showed that the probability of having diarrhoea was about 60% higher if there were six or more children living in the house than if the number of children was less than three (Table 1). This difference remained the same even when the other environmental and socioeconomic variables were held constant.

In the univariate model, the availability of toilet facility in households was associated with a 27% reduction in risk of diarrhoea. However, this pattern of risk disappeared and increased positively after controlling for the type of floor material, maternal education, household economic status, and place of residence (rural or urban). Table 1 shows that the children living in the houses with non-dirt floor were 43% less likely to have diarrhoea than those living in the houses with dirt floor. Even after controlling for other variables, the difference in the risk of diarrhoea remained

<table>
<thead>
<tr>
<th>Variable</th>
<th>Diarrhoea odds ratio</th>
<th>Diarrhoea prevalence rate</th>
<th>Total no. of children (n=2,153)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of child (months)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-5</td>
<td>1</td>
<td>11.7</td>
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<tr>
<td>6-11</td>
<td>3.27*</td>
<td>30.1</td>
<td>372</td>
</tr>
<tr>
<td>12-23</td>
<td>2.79*</td>
<td>26.9</td>
<td>662</td>
</tr>
<tr>
<td>24-35</td>
<td>2.15*</td>
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<td>724</td>
</tr>
<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>&lt;3</td>
<td>1</td>
<td>19.1</td>
<td>780</td>
</tr>
<tr>
<td>3-5</td>
<td>1.30†</td>
<td>23.5</td>
<td>806</td>
</tr>
<tr>
<td>6+</td>
<td>1.64†</td>
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<td>1</td>
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<td>Facility</td>
<td>0.73†</td>
<td>18.8</td>
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</tr>
<tr>
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<td></td>
</tr>
<tr>
<td>Dirt</td>
<td>1</td>
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<td>1673</td>
</tr>
<tr>
<td>Non-dirt</td>
<td>0.57*</td>
<td>16.0</td>
<td>480</td>
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<td>25.2</td>
<td>1508</td>
</tr>
<tr>
<td>Education</td>
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<td>18.0</td>
<td>645</td>
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<tr>
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<td>1137</td>
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<tr>
<td>Medium</td>
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<td>18.4</td>
<td>777</td>
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<tr>
<td>High</td>
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<tr>
<td>Urban</td>
<td>0.54*</td>
<td>15.3</td>
<td>439</td>
</tr>
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</table>

* Factor level significant at <1%
† Significant at <5%
significant, although it was weakened after the addition of household economic status and place of residence. Education of the mothers showed a significant negative association with the risk of diarrhoea in the univariate model, but did not show any significant effect after adjusting for the influences of other variables. The results also indicated that the household economic status was an important predictor of childhood diarrhoea in Eritrea. The probability of having diarrhoea was 33-38% lower for children from the medium- and high-economic groups than the children from the low-economic group (Table 1). However, after controlling for other variables, the significant effect of high economic status disappeared. In the multivariate model, only children from the households with medium economic status had a significantly lower risk of diarrhoea. The place of current residence was strongly associated with the prevalence of diarrhoea in both univariate and multivariate models. In the univariate analysis, the children living in the urban areas were 46% less likely to have diarrhoea compared to the children living in the rural areas. When the other variables were taken into account, the difference in the risk of diarrhoea still remained significant.

**DISCUSSION**

While it is widely recognized that diarrhoea is a major cause of morbidity and mortality among children and is affected by several socioeconomic, environmental and behavioural factors, this has rarely been confirmed by longitudinal studies or clinical diagnosis, especially in sub-Saharan Africa. There are a number of studies on
diarrhoeal morbidity based on cross-sectional surveys (2). However, the assessment of diarrhoeal mortality and morbidity from such surveys is complicated, and the comparison across different background characteristics is difficult. There are both conceptual and technical problems associated with information on the prevalence of diarrhoea obtained retrospectively from cross-sectional studies. Firstly, the seasonal differences in occurrence in diarrhoea are difficult to be taken into account in such studies. Longitudinal studies may be more appropriate to provide data in different seasons (11). Secondly, during the survey, neither the children were examined nor the mothers were given a precise definition of what constitutes an episode of diarrhoea. These questions measure the mother’s perception of her child’s health rather than morbidity according to clinical examination. This may create variations among different socioeconomic groups, because perception of illness is not the same across different social groups. Thirdly, loss of memory of events and misinterpretation of the reference period can also contribute to the problems associated with the prevalence of diarrhoea (12,13). In this case, properly-designed longitudinal or clinical studies are ideal tools for the collection of information. However, diarhoeal morbidity among children and on other factors that are related to diarrhoea. Nonetheless, in the absence of longitudinal or clinical information, cross-sectional surveys, such as Eritrea DHS, offer the opportunity to examine the patterns and determinants of childhood diarrhoea during two weeks prior to the survey. Such estimates may be of relevance to health-development programmes in Eritrea.

In general, the results of our study show that the risk of having diarrhoea in the two-week reference period reached its peak at 6-11 months and then began to fall with increasing age of children. This pattern resembles to those found in many studies of sub-Saharan Africa. In Ethiopia, for instance, the peak occurs among infants aged 6-11 months and those between 12 and 23 months (14), with 24-59 months old at the lowest risk. In Nigeria, the prevalence of diarrhoea was found to be highest among children aged 6-12 months, the period when most children are weaned (15). The low risk of diarrhoea during the age of 0-5 months observed in this study clearly indicates the protective effect of exclusive breastfeeding in the first six months of life (in Eritrea, supplementary foods start between age 4 and 6 months). In addition to breastmilk, inborn immunity and less exposure to contaminated agents during the early period contribute to the lower prevalence of diarrhoea. On the other hand, the prevalence peaks when the child has lost inborn immunity and when he/she is exposed to different types of infections from eating food prepared with unclean water and in unhealthy environment.

The number of children living in the house is another important demographic variable that influences the prevalence of diarrhoea, where the risk of having diarrhoea rises as the number of children living in the house increases. The risks of having diarrhoeal morbidity associated with the number of children remain highly significant after adjusting for all the socioeconomic and environmental variables in the model.

The availability of toilet facility showed a significant association with diarrhoeal morbidity when examined in the univariate model. In the multivariate model that includes two demographic variables and the toilet facility (Model 1), the toilet facility retained its negative significant effect and reduced the risk of diarrhoea by 26%. However, the addition of the environmental and socioeconomic variables to the model (Model 2 to 5) tends to push the estimated toilet facility effect away from the null value, suggesting that the protective effect (negative effect) of toilet facility shown in the univariate model or in Model 1 of Table 2 could be attributed to the other variables. Particularly, the excess risk of 39% associated with the toilet facility in Model 5 is largely due to greater confounding with the place of residence. A statistically significant negative association between the type of floor and the prevalence of diarrhoea was observed in the univariate model. This significant difference was retained even when all the other variables were introduced into the model.

As long as the socioeconomic variables were considered, all of them were statistically significant when the relationships with diarrhoeal morbidity were examined independently. However, when the effects of other variables were held constant, only the household economic status and the place of residence retained their statistical significance. The household economic status was significantly associated with the prevalence of diarrhoea. It should, however, be pointed out that it was only the medium economic group that was significantly associated with diarrhoea when other variables were held constant. The place of current residence emerged as a strong predictor of diarrhoeal disease. The children living in the urban areas were less likely to have diarrhoea compared to those in the rural areas. This holds
true in both univariate and multivariate models. This persistent effect of the place of residence (rural or urban) on diarrheal morbidity after controlling for the other variables may indicate the difference in diarrheal morbidity between the rural and the urban areas that cannot be explained by the factors included in the model.

In conclusion, the most strong explanatory covariates for variation in the level of diarrheal morbidity are the age and the number of children in the house, type of floor material, and the place of residence. These covariates, especially the last one, encompass many different elements, ranging from the attitudes of mothers to the availability of basic health services and clean household environment, a few of which are easily accessible to interventions. This may include the fundamental impact of basic personal and domestic hygiene, particularly in the preparation of child’s food, feeding practices, e.g. breast-feeding and the importance of conveying these ideas to mothers.

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REFERENCES


ANNEXURE

Description and categorization of variables

For the purpose of this analysis, whether a child had had diarrhea in the two weeks before the survey was used as a dichotomous dependent variable (ill or not ill during the two weeks prior to the survey). Explanatory variables included in the analysis can be categorized under the following classes: (1) demographic variables, (2) household environmental variables, and (3) socioeconomic variables. The demographic variables were the age and the number of children living in houses. The environmental variables considered were availability of toilet facility in houses and whether the floor material of houses was dirt or non-dirt. Finally, the socioeconomic variables included education of mothers, household economic status, and place of residence (rural or urban). The description and categorization of each of these variables is given below.

Age of children: Age is one of the most important factors in morbidity analysis because both feeding and the incidence of disease are largely dependent on it. The level of exposure of children to disease organisms and the type of immune response to infections vary with the age of children. Infectious diseases, such as diarrhoea, are less frequent when the child is small because of the immunity acquired and the level of care and breastmilk he/she receives from the mother as well as less exposure to contaminated agents. When the child has lost inborn immunity and becomes more vulnerable to different infections, the prevalence of diarrhoea becomes high. Thus, assessing the prevalence of diarrhoea by the age of children will give an important information about the age pattern of diarrhoeal prevalence. The age of children was categorized as 0-5, 6-11, 12-23, and 24-35 months.

Number of children: The number of children living in a house may have some impacts on the incidence of childhood diarrhea. A large number of children in a household may be more likely of having diarrhoea because of crowding and competition for mother’s time and attention and other resources. Thus, the number of children living in a house was included as an indicator of crowding. Three categories are distinguished according to the number of children living in a house: less than 3, 3-5, and 6, or more children.

Availability of toilet facility: The respondents were asked whether the dwelling had some kind of toilet facility. Responses to the question on current excreta disposal were divided into two: no toilet facility and toilet facility.

Type of floor material: An indicator of environmental contamination is whether the floor material of the house where the child lives in is dirt or non-dirt. Since dirt floors cannot be washed, they are more likely to provide a breeding ground for various diarrhoea-causing agents than non-dirt floors (7). The materials with which the dwelling floor is constructed were classified into two categories. The first classification is ‘dirt’ where a floor is composed of soft floor—earth, sand, or dung. The second group, ‘non-dirt’, has a hard floor—concrete or cement.

Maternal education: The Eritrea DHS collected information on the highest educational level of respondents at the time of interview. The six categories identified by the Eritrea DHS were: no education, primary incomplete, primary complete, secondary incomplete, secondary complete, and higher education. The distribution of mothers over these six levels was respectively 77.6, 13.3, 1.4, 5.5, 1.7, and 0.5%. Given the small numbers of mothers who had been to school, education was measured as a simple dichotomy in this analysis: none or some education.

Household economic status: Most surveys do not collect direct information on parental income but seek information on the number of consumer durables possessed by households, such as radio, bicycle, etc. Like most DHSs, the Eritrea DHS did not collect information on income directly. Instead, the respondents were asked about ownership of household goods, such as radio, bicycle, television, car, and the like. Ownership of radio, bicycle, and car are here regarded as a proxy for general household wealth, which may affect infant and child health but for which information was not directly available. These items were used for constructing a new household economic status variable with three categories which were defined as: (1) low—if the household did not own any of the items: radio, bicycle, or car, (2) medium—if the household owned only a radio, and (3) high—if the household owned a bicycle or a car, or both. This variable avoids the problem of income measurement in rural areas and might be a reasonable indicator of relative economic status.

Place of residence: Whether a mother resides in an urban or rural locality may affect her exposure to education and the extent to which proper sanitation, clean water, and healthcare facilities are available. It may, therefore,
be expected that children in an urban area where proper sanitation and health facilities are available and where modern treatment is more frequent will have a lower prevalence of diarrhoea. Thus, a distinction was made between rural and urban areas in this study.

Unfortunately, there are some other factors that may influence diarrhoeal morbidity which we were not able to take into account in our analysis. Perhaps the most important ones are water supply and breast-feeding practices.

The health benefits of improved water supply have been established in several previous studies (16). Clean water prevents the spread of water-related diseases, such as diarrhoeas and cholera (12). However, since piped water was limited to the urban areas only, we were unable to consider this variable in our analysis.

Breastmilk has a protective effect on various infections. Some studies suggest that the anti-infective and protective effects of breastmilk are reflected in milder illnesses from various infections and lower risks of death (17,18). Exclusively breastfed babies are much less likely to get diarrhoea or to die of it than babies who are not breastfed or are partially breastfed (19). However, there are some problems in the breast-feeding data in the Eritrea DHS. First, there are severe heaping of reported durations of breast-feeding. Most reported durations fall on 6-month multiples, especially on 12, 18, and 24 months. Another problem is that we were unable to distinguish periods in which the child was in the process of being weaned. The introduction of supplementation with other liquids or foods marks the beginning of a child’s exposure to possibly contaminated foods and liquids.