FACTORS ASSOCIATED WITH DIARRHEA AMONG CHILDREN LESS THAN 5 YEARS OLD IN SUDAN: A SECONDARY ANALYSIS OF SUDAN MULTIPLE INDICATOR CLUSTER SURVEY 2014

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ABSTRACT:

Background: Diarrhea is the passage of three or more loose or liquid stools per day (or feces are discharged frequently from the bowl than the normal for the person). It is a leading cause of mortality and morbidity in children under the age of five in developing countries especially in the Sub-Sahara Africa including Sudan. The aim of the study was to explore the factors associated with diarrhea among children aged under 5 years in Sudan using the 2014 Multiple Indicator Cluster Survey (MICS).

Methods: A total of 14081 children under 5 years who had completed the survey questionnaire were considered for this study. Data was entered and cleaned using SPSS version 17. Bivariate analysis was done using Pearson's Chi square test while multivariate analysis was done using binary logistic regression with 95% CI to examine the association between the dependent and independent variables. All variables with p-value <0.2 using the bivariate analysis was included in multivariate analysis.

Results: The prevalence of diarrhea among children was 26.9% (3785 children with diarrhea out of 14081). Factors associated with diarrhea were weight for height z-score, weight for age z-score, wealth index quintile and child age in months. In multivariate analysis, children from the fourth wealth index quintile were 1.21 times more likely to develop diarrhea, (OR: 1.21, p=0.016) than those children from the richest wealth index quintile. Children who were severely underweighted were 1.59 times more likely to develop diarrhea (OR: 1.59, p<0.001) than children who were normal. The risk of diarrhea was 32% lower in severely wasted children (OR: 0.68, p=0.047) than those children who were obese. Children aged 6-11 and 12-23 months were about 2.5 times more at risk of getting diarrhea (OR: 2.49, p<0.001; OR: 2.45, p<0.001 respectively) in comparison to children aged 48-59 months.

Conclusions: Nutritional factors were found to be associated with diarrhea. Continuous governmental efforts to eradicate malnutrition and hunger are recommended. The MICS 2014 of Sudan has produced much of great value; but there are some questions about certain kinds of information. Unexpected results were found regarding main source, treatment of drinking water and toilet facilities. Further studies in the form of longitudinal studies are needed as one cannot infer causality using this kind of study.

Keywords: Diarrhea; Multiple indicator cluster survey 2014; Risk factors; Sudan

DOI: 10.14456/jhr.2017.86 *Received: June 2017; Accepted: February 2018*

INTRODUCTION

According to WHO reports, nearly 1.7 billion cases of diarrheal disease occur worldwide. The disease kills about 760,000 children yearly, contributing equal percentile with pneumonia. Diarrhea is regarded as the main contributor of mortality in the population [1]. The 1.7 billion episodes of diarrhea costs the health system about 7 billion US dollars yearly. Diarrhea remains a high

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Cite this article as: Netsereab TB, Xenos P. Factors associated with diarrhea among children less than 5 years old in Sudan: a secondary analysis of Sudan multiple indicator cluster survey 2014. J Health Res. 2017; 31(Suppl.2): S209-15. DOI: 10.14456/jhr.2017.86

burden disease despite the availability of simple, affordable, and effective treatments. The Sub-Saharan Africa and Southeast Asia are the regions with the highest rates child mortality from diarrhea [2].

Globally in 2015 alone, there were a total death of 5.9 million children under the age of 5 years old. Majority of the causes of death in children are due to the conditions that can be prevented or treated by getting access to a simple and easily affordable intervention. More than 45% of deaths in children are associated with malnutrition. This is an underlying cause of diarrhea which makes the disease among the main causes of death in children less than five years old. The sub-Sahara African children are 14 times more at risk of dying before they reach the age of five in comparison to children in the developed world [3].

Being one of the Sub-Saharan Africa countries, Sudan is among the countries with the highest prevalence rates of diarrhea and Malnutrition. In the 2000 MICS report of Sudan, it was reported that the prevalence of diarrhea among under five years old children was 28% just two weeks before the survey [4].

Diarrhea is the passage of three or more loose or liquid stools per day (or feces are discharged frequently from the bowl than the normal for the person). Diarrhea can be prevented and treated. Usually it is a symptom of an infection in the intestinal tract that can be caused by a variety of bacteria, virus and parasitic organisms [1].

Like all the sub-Sahara Africa countries, Sudan has high burden of both morbidity and mortality rates of diarrhea in children under 5 years of age compared to other age groups as reported by the MICS surveys. In a national level there is limited information regarding the causes/risk factors of diarrhea in children aged less than 5 years old. The reports of Sudan Multiple Indicator Cluster Survey (MICS) are usually based on limited analysis of collected data, usually done by a cross sectional studies at hospital based or a smaller community based, which leaves out a lot of important information existing in the data [4].

In this study further analysis of the MICS data was done to explore the factors associated with diarrhea in children aged less than 5 years in Sudan. This study addresses the issue of diarrhoea among children less than 5 years old in order to generate the relevant scientific approaches toward the reduction of diarrhoea morbidity and mortality and the achievement of Millennium Development Goal in Sudan.

METHODS

The Multiple Indicator Cluster Survey (MICS) was conducted across the 18 states of Sudan by the Central Bureau of Statistics (CBS) Sudan in collaboration with the Ministry of Health with support from United Nations Children's Fund (UNICEF) and other partners from August 2014 to November 2014. Data was collected from 14081 children aged less than 5 years. Three MICS Sudan Statistical Package for the Social Sciences (SPSS) datasets of women, children and household were obtained from UNICEF; and they were merged into the child dataset using the line number, household number, child line number and mother/caretaker line number by creating a unique identification number in order to have variables of interest in one dataset. Bivariate analysis was done using Pearson's chi square test. Multivariate analysis was done using binary logistic regression. Variables, which had *p*-value of less than 0.2, were included in multivariate analysis as module predictors of diarrhea in children less than 5 years old in Sudan. Level of significance was set at 0.05.

RESULTS

Bivariate analysis of factors associated with diarrhea in children less than 5 years old in Sudan

Household socio-demographic factors

A statistically significant association between the number of children under 5 years in the household and diarrhea among children was demonstrated. The overall prevalence of diarrhea among children less than five years old in Sudan was found to be 26.9%. The rate of diarrhea in the households with one under five years old child was slightly higher (28 %) in comparison with the rate of diarrhea in households with more than one children less than 5 years (26.4%). A significant association between the household head educational level and occurrence of diarrhea in children aged less than 5 years was demonstrated. Another factor that was significantly associated with diarrhea in children under five years was household wealth index quintile. Households with the fourth wealth index quintile were shown to have the highest proportion of diarrhea (30.7%) while households in the poorest wealth index quintile category showed 26.6% prevalence of diarrhea in children less than

Table 1 Association between household and caretakers' socio-demographic factors and diarrhea in children less than 5 years old in Sudan

Factors	Diarrhea in the past 2 weeks		$\chi 2$	*p*-value
	Yes	No		
	N (%)	N (%)		
Children < 5 years in the household (N=14081)			3.927	0.048
1	1218 (28)	3134 (72)		
>1	2567 (26.4)	7162 (73.6)		
Household head's education level (N=13951)			8.568	0.014
None	1619 (25.9)	4637 (74.1)		
Primary	1252 (28.4)	3157 (71.6)		
Secondary and above	871 (26.5)	2415 (73.5)		
Household wealth index quintile (N=14081)			21.522	<0.001
Poorest	865(26.6)	2383(73.4)		
Second	996 (26.7)	2738 (73.3)		
Middle	776 (25.1)	2312 (74.9)		
Fourth	678 (30.7)	1534 (69.3)		
Richest	470 (26.1)	1329 (73.9)		
Kind of toilet facility (14060)			4.526	0.033
Improved	1277 (28.0)	3277 (72.0)		
Unimproved	2504 (26.3)	7002 (73.7)		
Age in years (N=13706)			20.068	0.003
15-19	184 (32.1)	389 (67.9)		
20-24	651 (27.7)	1696 (72.3)		
25-29	1109 (28.0)	2845 (72.0)		
30-34	791 (26.2)	2232(73.8)		
35-39	665 (26.7)	1826 (73.3)		
40-44	244 (25.4)	715 (74.6)		
45-49	74 (20.6)	285 (79.4)		

five years in Sudan. The kind of toilet facilities used by the households was significantly associated with diarrhea in children under the age of five years in Sudan, Table 1.

Caretakers' socio-demographic factors

Age of mother/caretaker was significantly associated with diarrhea in children under 5 years in Sudan. The highest episodes of diarrhea (32.1%) were among those children whose mothers or caretakers fall in the age group of 15-19 years. The lowest rate of diarrhea (20.6%) was in children whose mothers or caretakers were in the age group of 45-49 years. Maternal/caretakers mean age was 29.76 years (SD 6.75) (not shown).

Child factors

In this study the total number of male children under five years were slightly higher (51.1%) in comparison with their female counterparts. There was no significant association between the child gender and episode of diarrhea.

There was a strong significant association between the children age in months and the existence of diarrhea among the study population.

There was a significant association between the height for age child nutrition assessment parameter and episodes of diarrhea in those children. Both parameters of Weight for age Z-score and Weight for height Z-score had a strong statistical significant association with diarrhea in children below five years in Sudan, Table 2.

Multivariate analysis of factors associated with diarrhea

Table 3, the variables included in this analysis were: number of children < 5 years in the household, household head educational level, mother's/caretaker's education level, household wealth index quintile, kind of toilet facility, age of mother/caretaker, sex of the child, Age of child in months, height for age z-score, weight for age z-score and weight for height z-score.

Education level of household head, maternal/ caretakers educational level, mother's/female caretaker's age, toilet facility, number of children in the household, gender of the child and height for age z-score were not significantly associated with diarrhea in children under five years old in Sudan

Table 2 Association between children's social and nutritional factors and diarrhea in children less than 5 years old in Sudan

Factors	Diarrhea in the past 2 weeks		$\chi 2$	*p*-value
	Yes	No		
	N (%)	N (%)		
Age in months (N=14081)			341.321	<0.001
0-5	347 (22.5)	1196 (77.5)		
6-11	508 (35.7)	915 (64.3)		
12-23	954 (36.1)	1687 (63.9)		
24-35	798 (30.1)	1849 (69.9)		
36-47	701 (21.8)	2516 (78.2)		
48-59	477 (18.3)	2133 (81.7)		
Height for age Z-score (N=11011)			12.434	0.002
<-3	667 (31.2)	1469 (68.8)		
-3 to -2.01	652 (29.4)	1569 (70.6)		
≥ -2	1824 (27.4)	4830 (72.6)		
Weight for age Z-score (N=11367)			41.814	< 0.001
<-3	488 (34.0)	947 (66.0)		
-3 to -2.01	748 (30.8)	1683 (69.2)		
≥ -2	1990 (26.5)	5511 (73.5)		
Weight for height Z-score (N=12402)			22.051	< 0.001
<-3	162 (29.8)	382 (70.2)		
-3 to -2.01	466 (32.8)	955 (67.2)		
-2 to 2	2739 (27.2)	7347 (72.8)		
> 2	88 (25.1)	263 (74.9)		

Table 3 Multivariate analysis of factors associated with diarrhea in children

Variables	B	Adjusted 95% CI			*p*-value
		OR	Lower	Upper	
Weight for height Z-score					0.012
< -3	-0.382	0.683	0.468	0.995	0.047
-3 to -2.01	0.040	1.041	0.758	1.431	0.803
-2 to 2	-0.049	0.952	0.723	1.254	0.728
> 2®		1			
Weight for age Z-score					<0.001
< -3	0.465	1.592	1.301	1.948	<0.001
-3 to -2.01	0.247	1.28	1.125	1.458	<0.001
≥ -2®		1			
Wealth index quintile					0.001
Poorest	0.126	1.134	0.927	1.387	0.22
Second	0.077	1.08	0.892	1.307	0.43
Middle	-0.074	0.929	0.78	1.107	0.41
Fourth	0.194	1.215	1.037	1.423	0.016
Richest®		1			
Child age in months					<0.001
< 6	0.324	1.382	1.148	1.665	0.001
6-11	0.912	2.489	2.105	2.944	<0.001
12-23	0.896	2.449	2.114	2.838	<0.001
24-35	0.579	1.784	1.535	2.074	<0.001
36-47	0.126	1.135	0.974	1.322	0.105
48-59		1			
Constant	-1.342	0.261			<0.001

® Reference group

using the multivariate analysis while controlling for other factors.

Weight for height Z-score, weight for age Z-score, household wealth index quintile and child's age in months were all significantly associated with diarrhea in children less than five years of age using the multivariate analysis as predictors for diarrhea after controlling for other factors.

Weight for height Z-score was significantly associated with diarrhea (p=0.012). Children, who were severely wasted (Z-score <-3), were about 0.7 times more likely to develop diarrhea than those children who were obese (Z-score > 2).

Weight for age Z-score had a strong significant association (p<0.001) with diarrhea in children under 5 years. In multivariate analysis children, who were severely underweight (Z-score <-3), were about 1.6 times more likely to develop diarrhea than children who had a normal weight for age Z-score (Z-score ≥-2).

Wealth index quintile was highly significantly associated with diarrhea (p=0.001). Children, whose households were from the fourth wealth index quintile, were 1.2 times more likely to develop diarrhea than those children whose households were from the richest wealth index quintile.

Child's age had a highly significant association with diarrhea (p<0.001). Children aged 6-11 and 12-23 months were about 2.5 times more likely to develop diarrhea than children aged 48-59 months while those aged less than 6 months were only 1.4 times more likely to develop diarrhea than children aged 48-59 months.

DISCUSSION

The overall prevalence of diarrhea among children less than five years old in Sudan was 26.9 %. The prevalence of diarrhea in Sudan had shown only a slight decrease from the previous reports of Multiple Indicator Cluster Survey 2000 which were 28% of children under the age of five in Sudan [4]. This periodic prevalence is higher than the prevalence of diarrhea among children reported from the study done in Latin America using a pooled data from 12 Demographic and Health Surveys (DHS), which reported that 16.9% of the children under five years old had developed diarrhea during the two weeks preceding the surveys [5] .

In bivariate analysis the percentage of diarrhea was higher in children in the fourth wealth index quintile in comparison to the poorest household. This could be due to lack of personal sanitation and low awareness of the caretakers towards their children. Wealth index quintile had a significant association with diarrhea after adjusting for other factors. Though the relation was not linear, children living in poor households can have higher diarrhea rates than their wealthier counterparts. This is probably due to inadequate access to sanitary facilities, unclean/unsanitary environment in their home, poor child hygiene practices and prone to diarrhea infection due to lack of food for their normal growth patterns. This finding is consistent with several other studies which have found a significant association between household economic status and diarrhea among children [5].

Although a study done in Egypt found that children from rural areas were at a higher risk of developing diarrhea than their urban counterparts [6], this study did not show a significant association between diarrhea and area.

Educational level of head of household was significantly associated with diarrhea in the bivariate analysis before it completely lost its significant margin in the multivariate. In the bivariate analysis children with their mothers having primary or secondary and above level of education were found to have higher diarrhea episodes in comparison to mothers with no education. This could be due to unclean environment. This contradicts with the findings from three East African countries; they have reported an association between household head's education and diarrhea in children [7].

Number of children less than five years in the household was found to have a significant association with diarrhea by bivariate analysis in this study. After adjusting for other factors, the significance was lost.

This study did not show a significant association in both main source and treatment of drinking water with diarrhea in children aged less than five years. With 61.3% of households get access to safe drinking water, only 25.8% of the households treat water to make it safe for drinking. Previous study done in Tanzania which was a case control study showed no association between different water sources and diarrhea in children [8]. Another similar study done in the developing world also have shown the increase in diarrheal cases in children denied of safe drinking water which greatly contributes to their mortality rate [9].

Kind of toilet facility had a significant association with diarrhea in bivariate analysis,

before it lost its significance in multivariate analysis once the other variables were under control. A study done in Ethiopia showed that children from those households who had no toilet facility were found to be about six times more likelihood to have diarrhea than children from households who had toilet facility [10].

Child caretaker age was significantly associated with diarrhea in bivariate analysis; but it failed to maintain its significance in multivariate analysis after controlling for other variables. The finding in this study is similar to a previous study which reported high incidence of diarrhea in children with young mothers in a cohort study done in Brazil [11].

Maternal/caretaker educational level did not show an association with diarrhea in children, as it did not maintained its significance in the multivariate analysis similar to the household head education level. The findings from this study were in contrary to studies done in other countries which have shown that mother education is associated with diarrhea in children [11].

Mother's marital status did not show significant association with diarrhea in children under five years in bivariate analysis. This finding was similar to a study done in Philippines [12].

Male children were 51.1% of the survey children. Child's gender was not significantly associated with diarrhea; it had lost its significance after adjusting for confounders. The findings of this study contradicts with other studies. A MICS study done in Thailand found out that male children were more likely to suffer from diarrhea in comparison to their female counterparts [13]. Male children were shown to have more diarrheal episodes than their female counterparts [14].

The finding of this study showed a higher risk of the illness among children aged 6-23 months. Under nutrition as a risk factor for diarrhea has been shown in many cohort studies [15]. This study have shown association between the two anthropometric measurements of nutrition in children (weight for height Z-score and weight for age Z-score) and diarrhea in both the bivariate analysis and also after controlling for other factors in multivariate analysis. Only one indicator of nutrition (height for age Z score) did not show significant association with diarrhea in children less than five years old. The rough estimation of Under nutrition as an underlying cause of diarrhea is about 61% [16].

The findings from this study are important as they provide knowledge of factors associated with diarrhea in children less than five years old at a national level; and therefore it be helpful for policy making in a national level in Sudan. As diarrhea morbidity information was collected for the period two weeks preceding the survey as reported by the children under 5 questionnaires respondents, there is a potential for recall bias.

CONCLUSIONS

The MICS 2014 survey of Sudan has produced much of great value; but there are some questions about certain kinds of information. Unexpected results were found regarding main source of drinking water, treatment of drinking water and kind of toilet facilities. Special attention in prevention and care should be given to children 6-23 months as they are having the highest risk of diarrhea. The government of Sudan should be involved in a continuous efforts in eradicating the disease. Further studies including longitudinal studies design are needed to understand the complete dynamics of diarrhea morbidity and associated factors in children. Nutritional factors were found to be associated with diarrhea. Continuous governmental efforts to eradicate malnutrition and hunger are recommended.

ACKNOWLEDGEMENTS

Many thanks to the MICS, UNICEF for allowing me to use their data for my study. Special thanks goes to my scholarship agent Thailand International Cooperation Agency (TICA) for giving me such a golden opportunity.

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