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Research Article

Determinants of Oral Rehydration Solution and Zinc Use Among Under-Five Children for The Management of Diarrhea in Abeokuta, Nigeria

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Abstract

Diarrhea is the second leading cause of death in children under age five worldwide. There is little evidence on determinants of oral rehydration solution (ORS) and zinc use among under-five children in Nigeria. Therefore, the main aim of this study was to identify determinants of ORS and zinc use among under-five children in Abeokuta, Nigeria. A community-based, descriptive cross-sectional study was conducted, wherein mothers of under-five children were selected using a two-stage sampling technique. A pre-tested, interviewer-administered questionnaire was used to collect data. Average marginal effect (AME) from multiple probit regression was used as a measure of association. A 2-tailed p-value < 0.05 was considered statistically significant. A total of 280 respondents participated in the study. About 86% of the respondents were aware of ORS, and 82.9% had knowledge about ORS. Less than half (46.1%) of the respondents were aware of zinc, and 37.5% had knowledge about zinc. Usage rates of ORS and zinc were 66.4% and 22.1%, respectively. Determinants of ORS use were ORS awareness (AME = 0.47, p-value = 0.001), ORS knowledge (AME = 0.43, p-value = 0.001), and ORS availability (AME = 0.21, p-value = 0.004). Zinc knowledge (AME = 0.49, p-value < 0.001) was the only independent predictor of zinc use. There is need to intensify health education on the management of childhood diarrhea among mothers of under-five children in Nigeria. Furthermore, availability of high-quality and affordable supply of ORS and zinc should be improved in health facilities.

Key Words: Diarrhea; Under-five children; Oral rehydration solution; Zinc

INTRODUCTION

Diarrhea is a disease of public health importance. Worldwide, there are about 1.7 billion cases of childhood diarrheal disease every year (World Health Organization [WHO], 2017). Diarrhea is the second leading cause of death in under-five children, as it kills nearly 525 000 children every year; it is also a leading cause of malnutrition under-five children (WHO, 2017). South Asia and sub-Saharan Africa bear the greatest burden of diarrheal disease (Centers for Disease Control and Prevention [CDC], 2013). The prevalence of diarrhea among under-five children in Nigeria is 10% (National Population Commission and ICF International [NPC and ICF], 2014). Diarrhea is the 6th leading cause of death among under-five children in Nigeria, accounting for about 10% of mortality (WHO, 2015).

Diarrhea is defined as the passage of three or more loose or watery stools within a 24-hour period (WHO, 2017). Diarrhea is caused by a wide range of pathogens, including bacteria, viruses and protozoa, most of which are spread by faeces-contaminated water. Rotavirus and Escherichia coli are the two most common causative agents of diarrhea in developing countries (WHO, 2005). Risk factors for diarrhea include lack of safe drinking water, poor sanitation, poor hygiene, and poor nutritional status (WHO, 2005). Signs and symptoms of diarrhea include nausea, vomiting, abdominal pain, headache, fever, chills, and malaise; in chronic diarrhea, clinical presentation includes bouts, weight loss, anorexia, and weakness (Dipiro et al., 2008). Diarrhea can retard childhood growth and cognitive development in children (CDC, 2013).

The mainstay of diarrhea management is the use of oral rehydration solution (ORS) and zinc supplement (WHO, 2005). Diarrhea causes death by depleting body fluids resulting in substantial dehydration. Thus, oral rehydration therapy is the cornerstone of fluid replacement. Zinc can reduce the duration of illness by 25% and prevent recurrence of diarrhea for 2-3 months (Bhandari et al., 2005; Alam et al., 2010). Although most deaths caused by diarrhea in children are preventable using ORS and zinc, studies have reported their under-utilization (Ogunrinde et al., 2011; Ogbo et al., 2014; Agbolade et al., 2015). For example, the 2013 Nigeria Demographic and Health Survey (NDHS) demonstrated that 10% of children under the age of 5 with diarrhea received rehydrating fluids, and about 2% received zinc supplements (NPC and ICF, 2014).

Previous studies have investigated factors that influence ORS use for the management of diarrhea among under-five children in Nigeria. Ogunrinde et al. (2011) carried out a cross-sectional study among caregivers of under-five children in Kastina, Kebbi and Zamfara; they found that female caregivers were more likely to utilize ORS than male caregivers. A study from Nigeria among nursing mothers in Ibadan identified

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parity (number of births) as a determinant of ORS use in under-five children (Agbolade et al., 2015). In a study conducted among nursing mothers in Cross River State, Nigeria, Osonwa et al. (2016) reported that lack of knowledge on diarrhea and poor ORS knowledge were barriers to the utilization of ORS in the management of diarrhea in children. However, none of these studies used multivariate method of analysis in investigating determinants of ORS and zinc use; as such, the findings might be spurious due to confounding variables. Moreover, studies on determinants of zinc use among under-five children in Nigeria are very few. Therefore, the aim of this study was to identify determinants of ORS and zinc use among under-five children during diarrhea. Also, knowledge and awareness of ORS and zinc were assessed among mothers of under-five children.

MATERIALS AND METHODS

Study design, setting and population

A descriptive, community-based, cross-sectional study was carried out in Abeokuta among mothers of under-five children. Abeokuta is the largest city and state capital of Ogun State, Nigeria. Abeokuta North and Abeokuta South are the two major Local Government Areas in Abeokuta, with 16 and 15 political wards, respectively.

Sampling technique, sample size determination and inclusion criteria

A two-stage sampling technique was utilized. In the first stage, study setting (Abeokuta North Local Government) was divided into 2 strata – rural and urban areas (primary sampling units). Two political wards (secondary sampling units) were selected from each stratum by simple random sampling technique: Iberekodo/Ilugun and Ago Ika from the rural stratum, and Elega Housing Estate/Imala and Ita Oshin from the urban stratum. Osiele was purposively added to the rural stratum. In the second stage, households and eligible participants were consecutively recruited into the study.

The sample size was calculated using the ORS usage rate of 10% (p) as indicated in the 2013 NDHS report (NPC and ICF, 2014), Z_α statistic for 95% level of confidence (1.96) and precision of 5% (d).

The sample size was computed using the following formula:

$$n \geq \frac{Z_\alpha^2 * p * (1-p)}{d^2}$$

The effective sample size computed was 230 respondents, after adjusting for the design effect of 1.5, and non-response rate of 10%.

To be included in the study, the respondent must be a mother of at least one under-five child, and the child must have diarrhea not later than 2 months before the survey in order to minimize recall bias.

Data collection and instrument

Data were collected using a pre-tested, interviewer-administered, structured questionnaire. The questionnaire contained items on respondents' socio-demographic characteristics, health-related characteristics, and awareness, knowledge and utilization of ORS and zinc in under-five children.

Risk perception was assessed using an open-ended one item scale: What can happen to a child with diarrhea if not treated? Respondents who indicated 'death' were classified as having high perception. ORS awareness was assessed using 'Have you ever heard of ORS?' ORS knowledge was measured using 'ORS helps replace the water lost in the stools during diarrhea.' ORS use was assessed using 'The last time my child had diarrhea I gave him/her ORS.' Zinc awareness was assessed using 'Have you ever heard of zinc tablets?' Zinc knowledge was measured using 'Zinc tablets can make diarrhea less severe in children.' Zinc use was evaluated using 'The last time my child had diarrhea I gave him/her zinc tablets.' The above items had Yes/No response format.

Data management and statistical analyses

Data obtained were coded and entered in Statistical Package for Social Sciences (SPSS), version 20.0 (IBM, Chicago, USA) and analyzed in R, version 3.4.4 (R Core Team, Vienna, Austria). Descriptive statistics were computed for the variables: frequency distribution for categorical variables, and mean with standard deviation for continuous variables. Bivariate analysis was performed using chi-square test, and multivariate analysis using probit regression. The multivariate model included independent variables with p-value < 0.2 upon bivariate analysis (Hosmer et al., 2013). Average marginal effect (AME) was used as a measure of association. A 2-tailed p-value < 0.05 was considered statistically significant.

Ethical consideration

This study was approved by Ogun State Health Research Ethics Committee, Abeokuta. The respondents were fully informed about the research and their consent to participate in the study was obtained.

RESULTS

Characteristics of respondents

A total of 280 respondents were included in the study. The mean age of the respondents was 27.7 ± 6.0 years. Most of the respondents were married (88.6%), and had more than primary school education (79.6%). More than half (54.6%) of the respondents have had more than one birth. One hundred and fifty-one (53.9%) respondents resided in rural areas. Less than half (42.1%) of the respondents had high risk perception about diarrhea. Most (82.9%) of the respondents indicated that ORS was readily available in their surroundings. The mean ORS price was ₦74.82 ± 26.39, and most (93.6%) respondents perceived that the price of ORS was appropriate. The mean zinc price was ₦116.29 ± 39.04, and about fifty-seven percent of the respondents perceived that the price of zinc was appropriate. Table 1 shows the respondents' characteristics

Awareness and knowledge of ORS and zinc

Two hundred and forty (85.7%) respondents were aware of ORS. Two hundred and thirty-two (82.9%) respondents knew that ORS solution helps replace the water lost in the stools during diarrhea. Less than half (46.1%) of the respondents had awareness of zinc tablets. One hundred and five (37.5%) respondents knew that zinc tablets can make diarrhea less severe in children.

Table 1:
Characteristics of the respondents

Characteristic		Frequency	%
Age group (yrs)	<21	28	10.0
	21-30	169	60.4
	>30	83	29.6
Education	None	17	6.1
	Primary	40	14.3
	Higher	223	79.6
Ethnicity	Yoruba	233	83.2
	Hausa	11	3.9
	Igbo	21	7.5
	Others	15	5.4
Religion	Christianity	168	60.0
	Islam	109	38.9
	Traditional	3	1.1
Marital status	Never	32	11.4
	Married	248	88.6
Number of births	1	131	46.8
	1+	149	53.2
Employment	No	31	11.1
	Yes	249	88.9
Residence	Rural	151	53.9
	Urban	129	46.1
Risk perception	Low	162	57.9
	High	118	42.1
Place where treatment was sought			
	None	21	7.5
	Patent/ Traditional	92	32.9
Pharmacy/Clinic		167	59.6
ORS availability	No	48	17.1
	Yes	232	82.9
Perceived ORS price			
	Expensive	18	6.4
	Appropriat	262	93.6
Perceived zinc price			
	Expensive	120	42.9
	Appropriat	160	57.1
Zinc availability	No	60	21.4
	Yes	220	78.6

Determinants of ORS and Zinc Use

Usage rates of ORS and zinc among under-five children during diarrhea were 66.4% and 22.1%, respectively.

Bivariate analyses revealed that maternal age, maternal education, marital status, employment status, place of residence, place where treatment was sought, ORS awareness, ORS knowledge, ORS availability, and perceived ORS price were significantly associated with ORS use (Table 2). After multivariate adjustment, ORS awareness, ORS knowledge, and ORS availability were the independent predictors of ORS use (Table 3). On average, the probability of ORS use was 0.47 greater for respondents who had ORS awareness than those who did not (AME = 0.47, p-value = 0.001). Also, respondents who indicated that ORS was easily available to buy in their surroundings had higher probability of ORS use than those who did not (AME = 0.21, p-value = 0.004).

In bivariate analyses, age, number of births, place of residence, zinc awareness, and zinc knowledge were significantly associated with zinc use (Table 4). However, after adjusting for confounding factors in multivariate analysis, zinc knowledge was the only significant determinant of zinc use (Table 5). The probability of zinc use was 0.49 greater for respondents who had zinc knowledge than those who did not (AME = 0.49, p-value < 0.001).

Table 2:
Bivariate analyses of factors associated with ORS use

Variable	ORS use, n (%)		X^2	P-value
	No	**Yes**		
Age group (years)			13.473	0.001
<21	18 (64.3)	10 (35.7)		
21-30	49 (29)	120 (71)		
>30	27 (32.5)	56 (67.5)		
Education			11.66	0.003
None	9 (52.9)	8 (47.1)		
Primary	21 (52.5)	19 (47.5)		
Higher	64 (28.7)	159 (71.3)		
Marital status			16.645	< 0.001
Never married	21 (65.6)	11 (34.4)		
Married	73 (29.4)	175 (70.6)		
Number of births			1.622	0.203
1	49 (37.4)	82 (62.6)		
1+	45 (30.2)	104 (69.8)		
Employment			9.377	0.002
No	18 (58.1)	13 (41.9)		
Yes	76 (30.5)	173 (69.5)		
Residence			19.307	< 0.001
Rural	68 (45)	83 (55)		
Urban	26 (20.2)	103 (79.8)		
Risk perception			0.449	0.503
Low	57 (35.2)	105 (64.8)		
High	37 (31.4)	81 (68.6)		
ORS awareness			78.963	< 0.001
No	38 (95)	2 (5)		
Yes	56 (23.3)	184 (76.7)		
ORS knowledge			87.673	< 0.001
No	44 (91.7)	4 (8.3)		
Yes	50 (21.6)	182 (78.4)		
Place where treatment was sought			21.803	< 0.001
None	11 (52.4)	10 (47.6)		
Patent/Traditional medicine	45 (48.9)	47 (51.1)		
Pharmacy/Clinic	38 (22.8)	129 (77.2)		
ORS availability			11.018	< 0.001
No	26 (54.2)	22 (45.8)		
Yes	68 (29.3)	164 (70.7)		
Perceived ORS price			4.169	0.041
Expensive	10 (55.6)	8 (44.4)		
Appropriate	84 (32.1)	178 (67.9)		

DISCUSSION

The main focus of this study was to identify determinants of ORS and zinc use among under-five children during diarrhea. Also, knowledge and awareness of ORS and zinc supplement were assessed among mothers of under-five children.

Table 3:
Multivariate analysis of factors associated with ORS use

Variable	AME	95% CI	P-value
Age group (years)			
<21	Ref	-	-
21-30	0.18	-0.09−0.45	0.189
>30	0.18	-0.09−0.46	0.191
Education			
None	Ref	-	-
Primary	-0.06	-0.24−0.12	0.518
Higher	-0.12	-0.27−0.04	0.144
Marital status			
Never married	Ref	-	-
Married	0.20	-0.04−0.44	0.106
Employment			
No	Ref	-	-
Yes	-0.11	-0.27−0.05	0.166
Residence			
Rural	Ref	-	-
Urban	0.07	-0.04−0.17	0.210
ORS awareness			
No	Ref	-	-
Yes	0.47	0.20−0.74	0.001
ORS knowledge			
No	Ref	-	-
Yes	0.43	0.18−0.69	0.001
Place where treatment was sought			
None	Ref	-	-
Patent/Traditional medicine	-0.14	-0.29−0.01	0.064
Pharmacy/Clinic	-0.10	-0.24−0.04	0.157
ORS availability			
No	Ref	-	-
Yes	0.21	0.07−0.36	0.004
Perceived ORS price			
Expensive	Ref	-	-
Appropriate	0.07	-0.14−0.28	0.531

This study observed high awareness (85.7%) and knowledge ((82.9%)) rates for ORS, but low awareness (46.1%) and knowledge (37.5%) rates for zinc. Our finding on ORS awareness rate is similar to Digre et al.'s (2016) finding from Burkina Faso, where the ORS awareness rate was 82.0%. In contrast, Agbolade and co-investigators reported ORS awareness rate of 98.3% among mothers of under-five children from Ibadan, Nigeria (Agbolade et al., 2015); and Osanwa et al. (2016) reported awareness rate of 62.0% from Cross River State, Nigeria. Our result on zinc awareness rate was higher than Ogunrinde et al.'s (2012) result from northwestern Nigeria, where 32.0% of caregivers of under-five children were aware of zinc. Our finding on ORS knowledge rate disagrees with Agbolade et al.'s (2015) finding, in which 23.0% of mothers of under-five children had good knowledge of ORS. These variations may be due to differences in study settings, sample characteristics, and measures of awareness and knowledge.

Table 4:
Bivariate analyses of factors associated with zinc use

Variable	Zinc use, n (%)		X^2	P-value
	No	**Yes**		
Age group (years)				
<21	26 (92.9)	2 (7.1)	9.520	0.009
21-30	136 (80.5)	33 (19.5)		
>30	56 (67.5)	27 (32.5)		
Marital status				
Never	26 (81.2)	6 (18.8)	0.241	0.623
Married	192 (77.4)	56 (22.6)		
Number of births				
1	110 (84)	21 (16)	5.335	0.021
1+	108 (72.5)	41 (27.5)		
Employment				
No	28 (90.3)	3 (9.7)	3.142	0.076
Yes	190 (76.3)	59 (23.7)		
Residence				
Rural	136 (90.1)	15 (9.9)	28.339	< 0.001
Urban	82 (63.6)	47 (36.4)		
Zinc awareness				
No	147 (97.4)	4 (2.6)	72.245	< 0.00
Yes	71 (55)	58 (45)		
Zinc knowledge				
No	173 (98.9)	2 (1.1)	119.370	< 0.001
Yes	45 (42.9)	60 (57.1)		
ORS use				
No	88 (93.6)	6 (6.4)	20.387	< 0.00
Yes	130 (69.9)	56 (30.1)		

We found that ORS and zinc usage rates were 66.4 and 22.1%, respectively. Our finding on ORS usage rate is similar to that of Agbolade et al. However, many studies have reported lower usage rates of ORS. For example, Ogunrinde et al. (2011) reported 8.8% from northwestern Nigeria; Osonwa et al. (2016) reported 43.5% from Cross River State, Nigeria; Digre et al. (2016) reported ORS usage rate of 44.0% from Burkina Faso; and Gao et al. (2013) reported 34.6% from China. In contrast to our finding on zinc usage rate, the 2013 NDHS reported a zinc usage rate of 2% (NPC and ICF, 2014). However, DHS data in Nigeria are at least four years old and thus may not reflect the most recent national zinc usage rate.

We found that ORS awareness, ORS knowledge, ORS availability were positively associated with ORS use. The observed association of ORS availability with ORS use supports the finding of Gao et al. (2013) from China. Unlike

Agbolade et al.'s (2015) finding, ORS knowledge was an independent predictor of ORS use in this study. We identified zinc knowledge as the only significant determinant of zinc use. However, our results on determinants of zinc use could not be compared to findings from similar studies, because there is paucity of evidence on determinants of zinc use among under-five children in the literature.

Table 5:
Multivariate analysis of factors associated with zinc use

Variable	AME	95% CI	P-value
Age group (years)			
<21	Ref	-	-
21-30	-0.15	-0.36−0.05	0.150
>30	-0.07	-0.29−0.15	0.539
Number of births			
1	Ref	-	-
1+	-0.01	-0.09−0.07	0.838
Marital status			
Never married	Ref	-	-
Married	-0.09	-0.27−0.08	0.283
Employment			
No	Ref	-	-
Yes	0.14	0.01−0.27	0.034
Residence			
Rural	Ref	-	-
Urban	-0.03	-0.12−0.05	0.430
Zinc awareness			
No	Ref	-	-
Yes	0.07	-0.08−0.22	0.374
Zinc knowledge			
No	Ref	-	-
Yes	0.49	0.30−0.68	< 0.001
ORS use			
No	Ref	-	-
Yes	0.08	-0.02−0.17	0.105

This study had some limitations. First, it utilized self-reported measures to assess awareness, knowledge, and usage rates of ORS and zinc. As such, the results may be affected by recall and social desirability biases. Moreover, this study is cross-sectional; thus, temporal sequence of association cannot be established. In spite of these limitations, this study is one of the few studies that adjusted for potential confounding variables using multivariate analysis. Also, it provides evidence on factors associated with zinc use in under-five children, of which there is a dearth of information in the literatuIn conclusion, Diarrhea remains a leading cause of death among under-five children. Most deaths caused by diarrhea in children are preventable using ORS and zinc. This study showed that awareness, knowledge, and usage rate of ORS were high. In contrast, awareness, knowledge, and usage rate of zinc were low. Determinants of ORS use were ORS awareness, ORS knowledge, and ORS availability. Zinc knowledge was the only independent predictor of zinc use. There is need to intensify health education on the management of childhood diarrhea among mothers of under-five children in Nigeria. Furthermore, availability of high-quality and affordable supply of ORS and zinc should be improved in health facilities..

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