

# Determinants of oral rehydration salt utilization among under-five children with diarrhea in Ethiopia: A multilevel mixed-effect analysis

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## Abstract

**Background:** Oral rehydration salt therapy is a critical intervention to reduce mortality and morbidity of children with diarrheal diseases. However, it remains underused in low- and middle-income countries. In Ethiopia, only less than half of children with diarrheal diseases were treated with oral rehydration salt solution. Therefore, the objective of this study was to identify the determinants of oral rehydration salt utilization among children with diarrhea in Ethiopia.

**Method:** A secondary data analysis was done using the 2016 Ethiopian Demographic and Health Survey. A weighted sample of 1227 children who had diarrhea in the last 2 weeks with their index mothers during the 5 years survey was included in the study. A multilevel mixed logistic regression model was fitted to identify factors associated with oral rehydration salt utilization. Finally, statistical significance was declared at  $p$ -value  $< 0.05$ .

**Result:** The overall prevalence of oral rehydration salt utilization for children with diarrhea was 29.5%. In this study, age of mother  $\geq 35$  (adjusted odds ratio = 1.66, 95% confidence interval = 1.05, 2.64), mothers with formal education (adjusted odds ratio = 1.52, 95% confidence interval = 1.09, 2.11), media exposure (adjusted odds ratio = 1.72, 95% confidence interval = 1.25, 2.38), living in Metropolitan regions (Addis Ababa and Dire Dawa (adjusted odds ratio = 1.76, 95% confidence interval = 1.14, 2.69)), and small peripheral regions (Afar, Gambela, Somalia, Benishangul-Gumuz (adjusted odds ratio = 1.69, 95% confidence interval = 1.22, 2.34)) were associated with higher odd of oral rehydration salt utilization for children with diarrhea.

**Conclusion:** The study concludes that the age of mothers, educational status of the mother, media exposure, and regions of mothers were determinants of oral rehydration salt utilization for children with diarrhea. Therefore, media advertising regarding diarrhea management should be scaled up to increase oral rehydration salt utilization for children with diarrhea. Special attention to socio-cultural constraints or beliefs regarding diarrhea management should be given to mothers from large to center (Tigray, Amhara, Oromia, Southern Nations Nationalities, and People's Region, and Harari) regions.

## Keywords

Oral rehydration salt, diarrhea, under-five children, multilevel analysis, Ethiopia

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## Introduction

Globally, diarrheal disease is the second leading cause of under-five mortality, and it contributes about 480,000 under-five death per year.<sup>1</sup> Most deaths from diarrhea are due to dehydration. Dehydration leads to the loss of water and electrolytes (sodium, chloride, potassium, and bicarbonate) needed for survival.<sup>2</sup>

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Many countries have been working to end preventable deaths of children, including deaths from diarrheal illness. In 2013, the World Health Organization (WHO) had developed a platform called “Integrated Global Action Plan for Pneumonia and Diarrhea (GAPPD),” mainly to decrease under-five death due to Pneumonia and Diarrhea to less than 3 per 1000 live births and 1 per 1000 live births by 2025, respectively.<sup>3</sup> Moreover, as part of the sustainable development goal (SDG), countries have also been striving to reduce newborn and under-five deaths in countries to less than 12 deaths per 1000 live births and less than 25 deaths per 1000 live births by 2030, respectively.<sup>4</sup> To achieve these targets, oral rehydration salt (ORS) utilization for children with diarrhea is one of the recommended strategies to reduce diarrheal deaths.<sup>3,5</sup>

ORS was first introduced at the end of the 1960s to replace water and electrolyte losses in diarrheal diseases.<sup>6</sup> It is a combination of sugar and electrolyte solutions. ORS is simple, inexpensive, and used to treat fluid lost as a result of diarrhea and can be given at home by mothers or caregivers during episodes of diarrhea.<sup>2,7</sup> Previous studies indicated that the deaths from diarrheal diseases have significantly declined following the introduction of ORS.<sup>8–10</sup> For the last two decades, evidence shows that under-five mortality due to diarrheal diseases has declined from 2.7 million in 2000 to 0.5 million in 2015<sup>8</sup> and 480,000 in 2020.<sup>1</sup>

Despite the crucial role of ORS in managing children with diarrhea, its utilization and coverage are still low, particularly in low- and middle-income countries. In 2017, in low- and middle-income countries, from the total of 13.34 million children with diarrhea, about 6.52 million children were not treated with any form of oral rehydration therapy, and the overall coverage of oral rehydration therapy is remained below 50% in the majority of the countries.<sup>11</sup> Similarly, a study conducted in Sub-Saharan countries revealed that the correct management of diarrhea (treating with ORS and zinc) was low, ranging from 17% in Cote d’Ivoire to 38% in Niger.<sup>12</sup>

Despite an effort made by the Ethiopian government to increase the utilization of ORS for children with diarrheal diseases, only 46% and 17% of children with diarrhea were received oral rehydration therapy and ORS plus zinc, respectively.<sup>13</sup> Moreover, according to the International Vaccine Access Center (IVAC) reports, Ethiopia is one of the highest-burden countries for diarrheal deaths, and only achieved 30% of ORS treatment targets from 90% treatment targets of 2020.<sup>14</sup> This indicates that the presence of factors that needs further investigation.

Previous studies conducted in Ethiopia found that maternal educational status,<sup>15,16</sup> monthly income,<sup>15</sup> previous experience,<sup>15,17</sup> perception of tooth eruption,<sup>17,18</sup> knowing the severe sign of dehydration,<sup>18</sup> seeking advice from health facilities,<sup>15,17</sup> and knowledge of oral rehydration therapy<sup>15,17</sup> have an association with ORS utilization. However, those

studies were conducted in specific areas of Ethiopia and were not nationally representative.<sup>15–18</sup> Even there is one study conducted nationally in Ethiopia, which is only focused primarily on individual-level factors<sup>19</sup> without considering the community-level factors. But, ORS utilization can be affected by community-level factors, such as the recommended water source for preparation of ORS,<sup>20</sup> enumeration area (region), distance from health institution,<sup>21</sup> and residence.<sup>22–24</sup> Moreover, while the multilevel modeling that controls the nesting effect of clusters at different levels is appropriate, the earlier study used the traditional logistic regression model that could not adequately handle hierarchical constructs of data like the Demographic and Health Survey. This study had used multilevel mixed logistic regression analysis to overcome these limitations and to further estimate the significant impact of individual-level and community-level factors.<sup>25</sup> Therefore, the study was aimed to identify the individual- and community-level factors associated with ORS utilization for the management of diarrhea in under-five children using nationally representative data of Ethiopia.

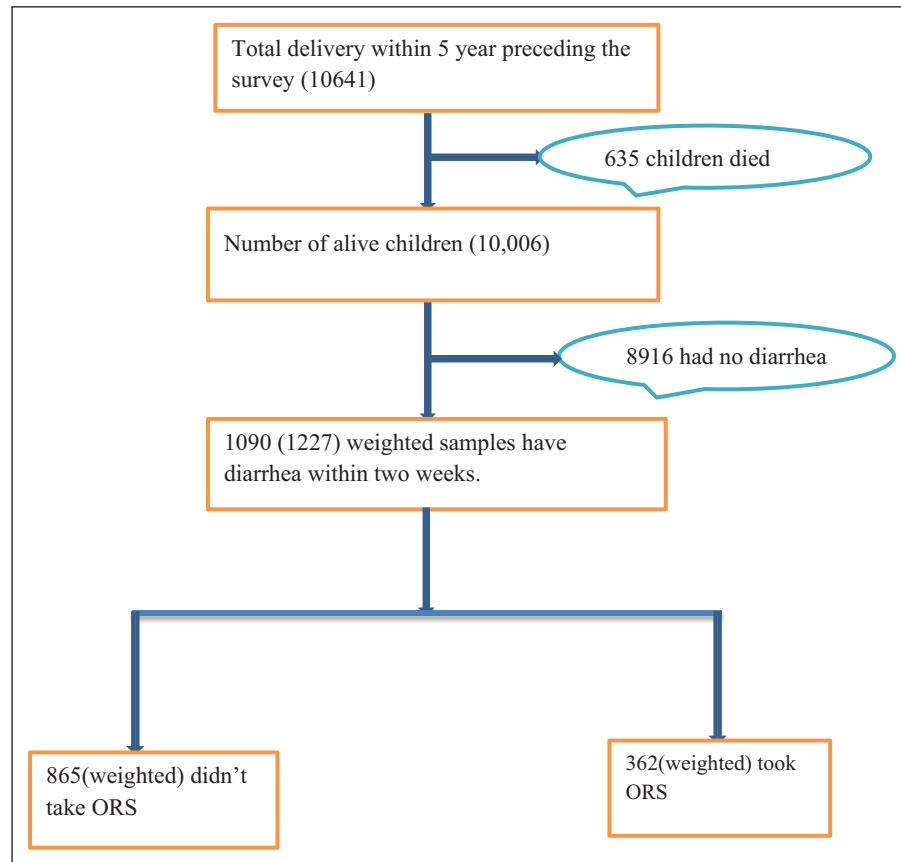
## Methods

### *Data source and study population*

The study used data from Ethiopian Demographic and Health Survey (EDHS 2016). This was the fourth survey employed from 18 January to 27 June 2016. The data were collected using a cross-sectional study design. The two-stage stratified sampling technique was used to select study participants. About 645 enumeration areas were selected in the first stage, including 202 urban areas and 443 rural areas. In the second stage, 28 households per cluster were selected. The overall sampling procedures were described in EDHS 2016 report.<sup>13</sup> A total of 10,641 births before the 5 years survey were used as a target population. All children who developed diarrhea in the last 2 weeks during the data collection period and with their index mothers were used as the study population. All children who did not have diarrhea were excluded from the study. Based on this, a total of 1227 (weighted samples) children with diarrhea and with their index mothers were incorporated in this study (Figure 1).

### *Variables of the study*

**Dependent variables.** The dependent variable was the utilization of ORS for children with diarrhea which was a binary outcome variable coded as “0” for No, and “1” for Yes. The original questions of EDHS have asked the respondents to answer the question “did you give oral rehydration salt for your children with diarrhea during the last 2 weeks?” The respondents responded as “Yes” if the child had given ORS and “No” if the child had not given ORS.



**Figure 1.** Schematic presentation of children with diarrhea incorporated in the final analysis.

**Independent variables.** Maternal age, maternal education status, maternal working status, paternal education status, sex of household head, family size, number of under-five children, age of children, wealth index, women participation in making health care decisions, health insurance, parity, and media exposure and toilet facility were considered as individual-level factors. Media exposure was measured from three variables; frequency of watching TV, reading a newspaper, and listening to the radio, and coded as “Yes” if an individual was exposed to all or either of the three and “No” if an individual was not exposed to at least one of these. Factors such as residence, distance from health facilities, water source, and region were considered as community-level factors.

### Operational definition

In Ethiopia, there are nine regions (Afar, Amhara, Benishangul-Gumuz, Gambela, Oromia, Somali, Southern Nations Nationalities, and People’s Region (SNNPR), Harari, and Tigray) and two city administrations (Addis Ababa and Dire Dawa). In this study, these regions were recoded into three categories based on the development and population characteristics: (1) small peripheral regions are emerging regions, including Afar, Somali, Benishangul, and Gambela, (2) large central regions are developed regions,

including Tigray, Amhara, Oromia, and SNNPR, and Harari, and (3) metropolitans include Dire Dawa and Addis Ababa.<sup>26</sup>

### Statistical analysis

The data were extracted using SPSS version 21 software and further analyzed using the R version 3.5.3. Data were edited, coded, and cleaned. Descriptive statistics were summarized using frequencies, percentages and presented by tables. In this study, a two levels hierarchy of data was considered due to the sampling techniques used in the EDHS data (multi-stage stratified cluster). Level one units were individual children in households and level two units were enumeration areas (community). Level one (children in the households) was nested at the next higher level of enumeration areas (community). Therefore, the multilevel mixed logistic regression model was fitted to identify the contributing factors of ORS utilization for children with diarrhea at each level (individual level and community level). Both bivariable and multivariable analyses were employed. In bivariable two-level binary logistic regression, variables with  $p$ -value  $\leq 0.25$  were a candidate for multivariable multilevel logistic regression analysis. Finally, in multivariable multilevel logistic regression, variables with a  $p$ -value  $\leq 0.05$  were declared as statistically significant factors associated with oral rehydration utilization for children with diarrhea.

Four models were fitted, with the hypothesis of varying intercepts across clusters but fixed coefficients. The first was the null model (Model I) adjusted without independent variables. The second model (Model II) was adjusted for individual-level factors and employed to explore the contribution to the variation of ORS utilization for children with diarrhea. The third model (Model III) was fitted for community-level factors and employed to explore the contribution for the variation of ORS utilization across the cluster. Finally, the fourth model (Model IV) was developed by combining the individual- and community-level factors. The model goodness of fit was checked using deviance information criteria (DIC) and Akaike's information criterion (AIC), the model with the lowest value was selected as the best fit model. The random effects measure the variation of ORS utilization across clusters and are determined by the intraclass correlation coefficient (ICC), median odds ratio (MOR), and proportional change in variance (PCV) statistics. The ICC measures the variation within-cluster and between-cluster differences. The PCV measures the total variation of ORS utilization at individual- and community-level factors in each model. The MOR measures the MOR of ORS utilization at the high-risk cluster (clusters did not use ORS during diarrhea illness) and low-risk cluster (clusters have used ORS during diarrheal illness) when we select randomly two children with diarrhea in the last 2 weeks during data collection from two clusters. The formulas for these three measurements are as follows

$$ICC = \frac{v_i}{\left(v_i + \frac{\pi^2}{3}\right)} \sim \frac{V_i}{V_i + 3.29}$$

where  $V_i$  is the between-cluster (community) variances, and  $\pi^2/3$  is the within-cluster (community) variance

$$PCV = \frac{V_i - V_y}{V_i}$$

where  $V_i$  is the variances of the null model, and  $V_y$  is the variance of the model with more terms

$$MOR = \exp\left[\sqrt{2 \times V_z} \times 0.6745\right] \sim \exp\left[0.95 \sqrt{V_z}\right]$$

where  $V_z$  is the variance at the community (cluster) level.

## Results

### Socio-demographic characteristics

A total of 1227 weighted samples of children who had diarrhea in the last 2 weeks before the survey were incorporated

into the study. The overall prevalence of ORS utilization for children with diarrhea was 29.5%. The median age of children was 20 months. The majority (89.7%) of the mothers were from rural residencies. More than half (54.7%) of the mothers were aged between 25 and 34 years. About 767 (62.5%) of mothers had no formal education. About 810 (66%) of mothers had no media exposure such as radio, TV, and newspaper. More than two-thirds (68.9%) of mothers had more than four household sizes and 1085 (88.4%) were male-headed households. More than half (52.4%) of mothers had a big problem of distance from health facilities (Table 1).

### Random effect and model comparison

The DIC and AIC values for each model were compared and the model with the lowest value of DIC and AIC was selected as a better explanatory model. Based on this, model four with a DIC value (1233.1) and AIC (1269.1) was selected as the best-fitted model to explain ORS utilization for children with diarrhea. The ICC in the null model was (0.14), which indicates that 14% of the variability of ORS utilization was due to differences between clusters or unobserved factors at the community level. This indicates that the multilevel logistic regression model is better to estimate ORS utilization for children with diarrhea than single-level logistic regression. The MOR in all models was greater than one indicating that there is variation in oral rehydration utilization among children with diarrhea between communities level (cluster). The value of MOR (1.98) in the null model indicates that there was a variation of ORS utilization between clusters when we randomly selected two children with diarrhea from two clusters, children from a low-risk cluster (clusters have used ORS during diarrhea illness) were 1.98 times more likely use ORS during diarrhea episode as compared to children from a high-risk cluster (clusters did not use ORS during diarrhea illness). The higher PCV value in the fourth model (0.56) indicates that about 56% of the variability of ORS utilization was explained by both the individual-level and community-level factors (Table 2).

### Factors associated with ORS utilization

In the bivariable multilevel logistic regression analysis, variables such as health insurance, number of under-five children, wealth index, parity, age of children, and toilet facility had  $p$ -value  $> 0.25$ , and they were not eligible for multivariable multilevel analysis. In multivariable multilevel analysis, maternal age (years), maternal education status, and media exposure were individual-level factors associated with ORS utilization. Whereas regions such as small peripheral (Afar, Somali, Benishangul, and Gambela) and metropolitan (Addis Ababa and Dire Dawa) and water sources were community-level factors associated with a higher odd of ORS utilization. Based on this, the odds of ORS utilization for children with diarrhea were 66% (adjusted odds ratio (AOR) = 1.66, 95%

**Table 1.** Socio-demographic characteristics of study participants.

Variable	Category	Weighted frequency (%)	Used ORS during diarrhea	
			No (%)	Yes (%)
Maternal age (years)	15–24	306 (25.0)	224 (25.9)	82 (22.8)
	25–34	672 (54.7)	492 (56.9)	180 (49.6)
	≥35	249 (20.3)	149 (17.2)	100 (27.7)
Residence	Urban	126 (10.3)	75 (8.7)	51 (14.1)
	Rural	1101 (89.7)	790 (91.3)	311 (85.9)
Maternal education status	No formal education	767 (62.5)	565 (65.3)	202 (55.8)
	Have formal education	460 (37.5)	300 (34.5)	160 (44.2)
Mother currently working	No	854 (69.6)	614 (71.0)	240 (66.2)
	Yes	373 (30.4)	250 (29.0)	123 (33.8)
Paternal education status	No formal education	498 (43.1)	360 (44.0)	138 (40.8)
	Have formal education	659 (56.9)	459 (56.0)	200 (59.2)
Sex of house hold	Male	1085 (88.4)	784 (90.7)	301 (83.0)
	Female	142 (11.6)	81 (9.3)	61 (17.0)
Family size	≤4	382 (31.1)	261 (30.2)	121 (33.3)
	>4	845 (68.9)	603 (69.8)	242 (66.7)
Number of under-five children	≤2	1076 (87.7)	757 (87.5)	319 (88.0)
	>2	151 (12.3)	108 (12.5)	43 (12.0)
Wealth index	Poor	538 (43.8)	391 (45.2)	147 (40.4)
	Medium	267 (21.8)	181 (20.9)	86 (23.9)
	Rich	422 (34.4)	293 (33.9)	129 (35.7)
Improved water source	No	481 (39.2)	369 (42.7)	111 (30.8)
	Yes	746 (60.8)	495 (57.3)	251 (69.2)
Improved toilet facility	No	482 (39.3)	340 (39.3)	142 (39.1)
	Yes	745 (60.7)	525 (60.7)	220 (60.9)
Exposed to media	No	810 (66.0)	609 (70.5)	201 (55.4)
	Yes	417 (34.0)	256 (29.5)	161 (44.6)
Age of children (N= 1209)	<6 months	109 (9)	96 (11.3)	13 (3.8)
	6–11 months	218 (18.1)	150 (17.6)	68 (19.1)
	12–23 months	353 (29.2)	226 (26.5)	126 (35.5)
	24–59 months	529 (43.8)	381 (44.6)	148 (41.6)
Women participating in making healthcare decisions	No	311 (25.3)	220 (25.5)	91 (25.0)
	Yes	916 (74.7)	644 (74.5)	272 (75.0)
Distance from health facilities	Not big problem	584 (47.6)	366 (42.3)	218 (60.2)
	Big problem	643 (52.4)	499 (57.7)	144 (39.8)
Covered with health insurance	No	1187 (96.7)	841 (97.2)	346 (97.2)
	Yes	40 (3.3)	24 (2.8)	16 (4.7)
Parity	1–3	598 (48.7)	416 (48.1)	182 (50.2)
	4–6	308 (25.1)	217 (25.1)	91 (25.1)
	≥6	321 (26.2)	231 (26.8)	90 (24.7)
Region	Large to center	1147 (93.5)	822 (95.0)	325 (89.7)
	small peripheral	55 (4.5)	31 (3.6)	24 (6.6)
	Metropolitan	25 (2.1)	12 (1.4)	13 (3.7)

ORS: oral rehydration salt.

confidence interval (CI)=1.05, 2.64) higher among mothers whose ages are ≥35 years as compared to mothers whose ages are between 15 and 24 years. The odd of ORS utilization for managing diarrhea was 52% higher (AOR=1.52, 95% CI=1.09, 2.11) among mothers who have formal education compared to their counterparts. The odd of ORS

utilization for managing diarrhea was 72% higher among mothers who have media exposure (AOR=1.72, 95% CI=1.25, 2.38) compared to mothers who did not have media exposure. The odd of ORS utilization for children with diarrhea was higher by 61% (AOR=1.61, 95% CI=1.18, 2.20) among mothers who have improved water

**Table 2.** The random effect and model comparison for predicting factors of oral rehydration salt utilization for the management of diarrhea in under-five children, Ethiopia, 2016.

Random effect	Null	Model II	Model III	Model IV
Variance	0.52	0.36	0.27	0.23
AIC	1417.2	1300.2	1360.8	1269.1
Log likelihood	-706.6	-637.1	-673.4	-616.6
DIC	1413.2	1274.2	1346.8	1233.1
ICC	14%	10%	8%	7%
MOR	1.98	1.77	1.64	1.58
PCV	Reference	31%	48%	56%

AIC: Akaike's information criterion; DIC: deviance information criterion; ICC: intraclass correlation coefficient; MOR: median odds ratio; PCV: proportional change in variance.

sources compared to their counterparts. The odd of ORS utilization for children with diarrhea was 1.69 (AOR=1.69, 95% CI=1.22, 2.34) and 1.76 (AOR=1.76, 95% CI=1.14,

2.69) times higher among mothers who are from small peripheral regions (Afar, Somali, Benishangul, and Gambela) and metropolitan (Addis Ababa and Dire Dawa) regions, respectively, as compared to the mothers who are from large to center (Tigray, Amhara, Oromia, SNNPR, and Harari) Regions (Table 3).

## Discussion

The study disclosed the determinants of ORS utilization for children with diarrhea using the multilevel mixed-effect analysis. Based on this, we found that the age of mothers, educational status of the mothers, media exposure, water source, and the regions of the mothers were determinants of ORS utilization for children with diarrhea.

The odd of ORS utilization for children with diarrhea was higher among mothers who have formal education as compared to their counterparts. The finding is supported by other studies.<sup>15,16,24,27-29</sup> The possible justification might be that

**Table 3.** The multivariable multilevel analysis of factors associated with oral rehydration salt utilization for the management of diarrhea in under-five children, Ethiopia, 2016.

Variable	Category	Null	Model II AOR (95% CI)	Model III AOR (95% CI)	Model IV AOR (95% CI)
Maternal age (years)	15-24	I			I
	25-34		0.91 (0.65, 1.29)		0.98 (0.68, 1.40)
	≥35		1.60 (1.03, 2.51)*		1.66 (1.05, 2.64)*
Mother currently working	No	I			I
	Yes		0.96 (0.71, 1.30)		0.90 (0.66, 1.23)
Maternal education status	No formal education	I			I
	Have formal education		1.86 (1.37, 2.53)*		1.52 (1.09, 2.11)*
Paternal education status	No formal education	I			I
	Have formal education		0.98 (0.73, 1.33)		1.00 (0.74, 1.37)
Sex of house hold	Male	I			I
	Female		1.49 (1.04, 2.14)*		1.31 (0.90, 1.90)
Family size	≤4	I			I
	>4		0.85 (0.61, 1.19)		0.87 (0.62, 1.22)
Wealth index	Poor	I			I
	Medium		1.26 (0.85, 1.85)		1.30 (0.86, 1.97)
	Rich		1.01 (0.71, 1.44)		0.93 (0.62, 1.39)
Women participating in making healthcare decisions	No	I			I
	Yes		1.08 (0.78, 1.51)		1.13 (0.81, 1.59)
Exposed to media	No	I			I
	Yes		1.85 (1.36, 2.52)*		1.72 (1.25, 2.38)*
Distance from health facilities	Not big problem			I	I
	Big problem			0.48 (0.37, 0.64)*	0.55 (0.41, 0.73)
Residence	Urban			I	I
	Rural			0.83 (0.58, 1.20)	1.24 (0.78, 1.97)
Region	Large to center			I	I
	Small peripheral			1.49 (1.12, 1.98)*	1.69 (1.22, 2.34)*
	Metropolitan			1.61 (1.08, 2.40)*	1.76 (1.14, 2.69)*
Improved water source	No			I	I
	Yes			1.76 (1.32, 2.37)*	1.61 (1.18, 2.20)*

AOR: adjusted odds ratio; CI: confidence interval; I: reference.

\* $p \leq 0.05$ .

educated mothers presume better about the complication of diarrheal disease and they may seek early health treatment during the episode of diarrhea.<sup>30–32</sup> This was a good opportunity for mothers to obtain health education from health professionals and give the appropriate treatment or medication, including ORS, to their sick children.

Unlike the study conducted in Bangladesh<sup>33</sup> and consistent with study,<sup>34</sup> in this study, the likelihood of ORS utilization for children with diarrhea was higher among mothers who have media exposure as compared to mothers who have no media exposure. The possible justification might be that those mothers who have media exposure are in advantage of getting information regarding the treatment option of diarrhea, including ORS and its importance for children with diarrheal disease.

Unlike the study conducted in Bangladesh,<sup>35</sup> in this study, the odd of ORS utilization for children with diarrheal diseases was higher among mothers whose ages are  $\geq 35$  years as compared to mothers whose ages are between 15 and 24 years. The possible justification might be due to that the older mothers may have previous information and experience on their older children regarding the importance of ORS in diarrheal diseases management.

In contrarily with a study conducted in rural Nigeria,<sup>28</sup> this study revealed that the odd of ORS utilization for children with diarrhea was higher among mothers who have improved water sources as compared to their counterparts. This might be the fact that clean water is required to prepare oral rehydration solution;<sup>36</sup> thus, access to improved water source may help the mothers for early initiation of ORS during diarrheal episodes. This implies that water source enhancement is an input for using ORS for children with diarrhea beyond its preventive effect of diarrheal diseases.

Unlike the study conducted in Nigeria,<sup>23</sup> in this study, the utilization of ORS for children with diarrhea was significantly different across regions in Ethiopia. Thus, the odd of ORS utilization for children with diarrhea was higher among mothers from metropolitan (Addis Ababa and Dire Dawa) and small peripheral (Somalia, Afar, Gambela, and Benishangul-Gumuz) regions as compared to mothers from large to center regions (Amhara, Oromia, SNNPR, Harari, and Tigray). The possible justification for the discrepancy might be due to the difference in socio-cultural characteristics or beliefs of the community regarding diarrhea disease. Thus, measures such as health education regarding the clinical importance of ORS for children with diarrhea should be emphasized especially for mothers from large to center (Amhara, Oromia, SNNPR, Harari, and Tigray) regions.

The clinical and public health implication of this study is to increase the utilization of ORS for children with diarrhea and to decrease under-five deaths. Therefore, giving special attention to younger mothers, mothers with no formal education, mothers who have no media exposure, mothers who have a poor water source, and to mothers from large to center

regions (Tigray, Amhara, Oromia, Harari, and SNNPR) could increase the utilization of ORS for children with diarrhea.

## Strength and limitation

The study has used nationality representative data of 2016 EDHS with large sample size and high-quality data which will reduce a bias related to sampling and measurement. Besides, we have employed an appropriate statistical approach (multilevel mixed analysis) to estimate the cluster effect on oral rehydration utilization. However, the study shares the limitation of a cross-sectional study that was impossible to establish the cause and effect relationship. Since this study is used secondary data analysis, other variables such as previous experience, perception of the mother and community regarding diarrhea, respondent's health-seeking behaviors, and knowledge of oral rehydration therapy are not explored. The study has also a limitation that the power analysis for the sample size calculation was not done.

## Conclusion

The study concludes that the age of mothers, educational status of mothers, media exposure, water source, and the regions of mothers were determinants of ORS utilization for children with diarrhea. Therefore, media advertising regarding diarrhea management should be scaled up to increase ORS utilization for children with diarrhea. Special attention to socio-cultural constraints or beliefs regarding diarrhea management should be given to mothers from large to center (Tigray, Amhara, Oromia, Harari, and SNNPR) regions. Strengthening health education regarding the importance of ORS utilization, giving special attention to mothers with no formal educations and younger mothers could increase the utilization of ORS for children with diarrhea.

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## Author contributions

All authors contributed to data analysis, drafting, or revising the article; have agreed on the journal to which the article will be submitted; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

## Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Ethical approval

The 2016 EDHS protocol has been reviewed and approved by the National Ethics Review Board of the Democratic Federal Republic of Ethiopia, the Ministry of Science and Technology, and the

Institutional Review Board of ICF International with ICF project number 132989.0.000.ET. DHS.01. Ethical approval for the study was waived off from the Mizan–Tepi University.

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### Informed consent

An informed consent statement was obtained before the data collection of 2016 EDHS. The confidentiality was maintained. The data were publicly available from the Measure DHS Program. For this study, we had requested DHS Program and permission was allowed to download to use the data from <https://www.dhsprogram.com/>. There are no names of household addresses or individuals in the data.

### ORCID iDs

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### Availability of data and materials

The data are available and may be provided upon request.

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