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Journal:	*BMJ Open*
Manuscript ID	bmjopen-2022-070203
Article Type:	Original research
Date Submitted by the Author:	16-Nov-2022
Complete List of Authors:	Terefa, Dufera; Wallaga University, Public Health Shama, Adisu; Wallaga University, Public Health Kenea, Abdi Kebede; East Wallaga Zonal Health Department
Keywords:	NEONATOLOGY, PAEDIATRICS, NUTRITION & DIETETICS

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Socio-demographic and Institutional Determinants of Zinc Bundled with Oral Rehydration Salt Utilization among Under-Five Children with Diarrheal Diseases in East Wallaga Zone, western Ethiopia: A Community-based Cross-sectional Study

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Abstract

Objective: Aimed to assess socio-demographic and institutional determinants of zinc bundled with oral rehydration salt utilization among under-five children with diarrheal diseases in East Wallaga Zone, western Ethiopia, 2022.

Methods: A community-based cross-sectional study was conducted among 560 randomly selected participants from April 1 to 30, 2022. Data was entered into Epi-data version 3.1,then exported to the Statistical Package for Social Science (SPSS) version 25 for analysis. An AOR along with a 95% confidence level and a P value < 0.05 was considered to declare the statistical significance .

Results: About 39.6% (of the participants had utilized zinc bundled with ORS for their children with diarrhea at least once in the last 12 months. Being aged from 40–49 years [AOR and 95% CI= 3.48 (1.41, 8.53)]; merchant [AOR and 95% CI =5.06 (1.92, 13.34)]; able to read and write [AOR and 95% CI = 5.64 (1.18, 12.88)]; visited secondary [AOR and 95% CI= 2.82 (1.30, 6.10)] and tertiary level health facilities [AOR and 95% CI= 0.016 (.03, .97)]; degree and above [AOR and 95% CI= 0.06 (0.03, 0.12)] and doctor [AOR and 95% CI= 0.13 (0.04, 0.44)] holders health care professionals and had no fear of COVID-19 during facility visit [AOR and 95% CI = 2.71 (1.13,6.48)] were statistically associated utilization zinc bundled with ORS.

Conclusion: The study found that about two in five of the participants had utilized zinc bundled with ORS for their under-five children with diarrheal diseases. Age, occupation, educational status, level of health facilities visited, level of health professionals provided care, and fear of COVID-19 during a health facility visit were determinants of zinc bundled with ORS utilization. So, health professionals at different levels of the health system have to enhance the maximization of its bundled uptake.

Key Words: Bundling; Diarrhea; Socio-demographic and institutional factors; Utilization; Zinc and ORS; Ethiopia

1. Background

Globally, diarrhea is both a disease and an economic burden each and every year, with Sub-Saharan African countries disproportionately affected by the illness and disease .[1]

Now a day, nearly 1.7 billion cases of childhood diarrheal diseases account for one in nine child deaths, making diarrhea the second leading cause of death and leading cause of malnutrition in children under five years old across the globe. [2] It kills more than 5.2 million under-five children globally, and around 800,000 children die of diarrhea and dehydration each year in Africa.[3] Of all child deaths from diarrhea, 78% occur in the African and South-East Asian regions, which are also disproportionately burdened with infant and childhood HIV infections.[4] Sub-Saharan African countries share a significant proportion (42%), of which Ethiopia ranks fifth globally as diarrhea causes about one fourth (20–27%) of child deaths .[3]

Sub-Saharan Africa has made the least progress in the reduction of infant and child mortality. The two leading causes of mortality among children under five years of age in sub-Saharan Africa are pneumonia and diarrhea, accounting for 18% and 15%, respectively. [5]

Although Ethiopia has already achieved remarkable progress in reducing under-five mortality in recent decades, studies done in different parts of Ethiopia have shown that diarrhea is still a major public health problem. [1] According to Ethiopia

Demographic and Health Surveys (EDHS) of 2016, 12% of children under age five had diarrhea .[6]

Different countries have incorporated zinc and ORS as an effective treatment combination in their policies since July 2019, when WHO added ORS bundled zinc to its core Model List of Essential Medicines for Children (EMLC) and encouraged countries to prioritize the bundle in their expenditures, procurement and supply, and training of healthcare providers. [7] This recommended regimen of zinc bundled with ORS, along with continued feeding, is a safe, effective, and inexpensive treatment for children, and 50% of diarrhea deaths can be prevented .[8] Also, the health policy of Ethiopia indicated that Federal Ministry of Health (FMOH) includes zinc as an essential drug that should be available at local health facilities and prescribed free of charge at health post level in order to be easily accessible and given to the community since 2013. [9]

Despite these important benefits, access to ORS and zinc remains a challenge in low-resource settings, and the rate of bundling of both products is extremely low. Eleven of the 15 highest-burden countries, 6 (~55%) had ORS and zinc coverage levels of 2% or less.[10]

It is recommended that under-five children should receive 10–14 days of zinc treatment for diarrhea, and full coverage and utilization of Oral Rehydration Salt (ORS) and adjunct zinc supplementation could avert over 75% of all diarrhea deaths. However, an increasing number of studies are showing that adherence to zinc is unsatisfactory. [2]

Bundling (co-packaging) of zinc with ORS may encourage their combined use, and enhance access to and utilization of the treatment to under five children, but different studies across the globe indicated that low utilization has been observed. Hence, a study conducted on oral rehydration salt use and its correlates in low-level care of diarrhea among children under 36 months old in rural Western China, indicated that the therapy rate of ORS was 34.62%.[11]

Of East African countries, studies conducted on zinc utilization and associated factors indicated that Uganda had the highest prevalence of zinc utilization (40.51%), whereas the Comoros had the lowest (0.44%). This study also revealed that utilization of zinc was 18% in Tanzania, 10% in Nigeria, 15% in Sudan, and 21.5% in Ethiopia.[4] This indicates that much needs to be done to increase its utilization and reduce the impact of diarrhea, a preventable cause of under-five mortality in the region.

Also, another study conducted in Ethiopia's Addis Ababa city showed that slightly over two-thirds (67.1%) of caretakers used zinc bundles with ORS during the recent diarrheal attack. This was higher than a study conducted in Nigeria (8.3 %) and comparable to the Kenyan findings (67%). [12] The proportion of children under the age of five who received treatment for diarrhea has risen from 13% in 2000 to 22% in 2005, 32% in 2011, and 44% in 2016. Whereas the percentage of children who received no treatment has decreased from 42% in 2011 to 38% in 2016. According to the Ethiopian EDHS-2016 report, one in three children (33%) under age 5 with diarrhea received zinc, and 17% received a combination of

ORS and zinc. Antibiotics were given to 9% of children with diarrhea, and two in five (38%) of children with diarrhea did not receive any treatment. [6]

In general, age, occupation, caregiver relationship with child, type and level of health facilities visited, distance from health facilities, and community-based health insurance membership were some of the determinants of zinc bundled with ORS utilization among under five children with diarrheal diseases studied [2,12–14]

However, to the best of the author's knowledge, no prior studies have been conducted on socio-demographics and institutional determinants of utilization of zinc bundled oral rehydration salt among under-five children with diarrheal diseases in East Wallaga Zone, western Ethiopia. Also, studies that have been conducted elsewhere mostly reviled specific interventions, either on zinc or ORS only [4] rather than focusing on the recently implemented co-packaged zinc and ORS and particularly giving attention to its socio-demographics and institutional determinants. Therefore, to fill these gaps, this study aimed to assess socio-demographics and institutional determinants of zinc bundled with oral rehydration salt utilization among under-five children with diarrheal diseases in East Wallaga Zone, western Ethiopia, in 2022.

2. Methods and Materials

2.1. Study Setting and Period

The study was conducted in East Wallaga Zone, Western Ethiopia from April 1st to April 30th, 2022.

2.2. Study Design and Population

2.2.1. Study Design

A community-based cross-sectional study design was employed on socio-demographic and institutional determinants of zinc bundled with oral rehydration salt utilization among under-five children with diarrheal diseases in East Wallaga Zone, Western Ethiopia.

2.2.2. Population

2.2.2.1. Source population

All households among selected districts whose under five children had diarrhea in the last one-year period were the source population.

2.2.2.2. Study population

All selected households whose under five children had diarrhea in the last one year period were the study population.

2.3. Eligibility Criteria

2.3.1. Inclusion Criteria

All households whose under five children had diarrhea in the last one year and who had stayed for more than one year in the area were included in the study.

2.3.2. Exclusion Criteria

Under-five children's mothers or caregivers who were sick at the time of data collection were excluded in the study.

2.4. Sample Size and Sampling Technique

2.4.1. Sample Size Determination

The sample size was determined using a single population proportion formula by considering the following assumptions: where the proportion of zinc bundled with oral rehydration salt utilization among under five children was 67.1% [12] was taken. Also, by considering 5% margins of error, a design effect of 1.5 and a 10% potential non-response rate, the final sample size became 560.

2.4.2. Sampling Techniques and Procedures

A multi-stage sampling procedure was carried out. In the first stage, four districts (40%) were randomly selected using a lottery method from nine nutrition international project-supported districts in the zone. [15] In the second stage, all Keble's were listed for each selected district, and among them, a total of 12 kebles (3 kebles per district) were selected for the study as representative of the Keble's using a simple random sampling technique for each district based on the WHO health facility assessment tool. [16,17] Then, after the selection of the Keble's to be included in the study, records of diarrheal diseases from each health facility in the catchments for each Keble's and diarrheal disease data for under-five children were obtained from health extension workers. Households who can fulfill the inclusion criteria from these records were listed from the Master Family Index (MFI) and family folders of Community Health Information System (CHIS) registration books, and the households' numbers were obtained and used as a

sampling frame. The sample size was then distributed to each Keble's in proportion to the size of their household in each district. Finally, to obtain the final sample size, simple random sampling techniques were used to select households based on the allocated sample size of each kebele, and the data was collected from mothers or caregivers.

2.5. Study Variables

Utilization of Zinc Bundled with Oral Rehydration Salt was the outcome variable and the independent variables were: socio-demographic and economic related variables (age of the caregivers or mothers, sex of caregivers or mothers, marital status, family size, educational status, occupation, residence, age of the child, sex of the child, caregiver relationship with child, and household's monthly income); and institutional related variables (place of treatment, types of health facility visited, level of health facilities, perceived quality of care by health professional, status of health professionals, availability of drugs or supplies in the facilities, perceived affordability of drugs, distance from nearby health facilities, health insurance membership status, and fear of COVID-19 during facility visit).

2.6. Operational Definitions

Zinc and ORS Bundling: is a bundle containing zinc sulfate and oral rehydration salt which can be prepared in different forms for supplementation, such as;

- **Central bundling**: Pre-bundled zinc and ORS using a pouch that had an instructional message intended for improving the rational use of zinc-ORS treatment, distributed to health facilities;

- **Facility level bundling:** Zinc, ORS bundling pouch that had instructional messages distributed to the health facilities; bundling was made by the health workers while administering the treatment and
- **Status quo:** Zinc and ORS are co-administered without bundling. [2]

Utilizations of Zinc Bundled with ORS: is the use of services by under-five children, at least one child in the household at least once, for the purpose of preventing and curing health problems, promoting maintenance of health and well-being or obtaining information about one's health status and prognosis, from health facilities regarding diarrheal diseases treatment with Zinc and ORS co-pack in the last one year, which was answered by a close-ended binary question (Yes/NO). Based on this, if they had received the drugs from health facilities, it was answered as "Yes" and if not, it was answered as "No". [12]

Level of health facilities: are facilities that provide health services at various levels of care according to Ethiopia's current health tier system (three tier system) (health posts, health centers, hospitals).[18]

2.7. Data Collection Instrument and Procedures

Data was collected using a semi-structured interviewer administered pre-tested questionnaire by face-to-face interviewing of mothers or a care giver of children was used. It was adapted by a review of different literates [8,12] and modified to fit the local context. The tool was first prepared in English and translated to Afan Oromo, and then back translated to English by Afan Oromo and English language Bachelor degree holders to check for consistency. It consists of socio-demographic and institutional-related factors.

2.8. Data Quality Management

To maintain the quality of the data, different measures were undertaken before, during, and after data collection. A preliminary translation and re-translation of the questionnaire was made to check for its consistency before the actual data collection. Training was given for all data collectors and supervisors on the objective of the study, contents of the questionnaire, and issues of maintaining confidentiality, informed verbal consent, and interview techniques.

2.9. Data Analysis Procedure

Data was entered into Epi-Data version 3.1 and exported to SPSS version 25 for statistical analysis. A descriptive analysis was used to describe the percentages and number of distributions of the respondents. Binary logistic regression analysis was performed on the independent variables and their proportions, and a crude odds ratio was computed against the outcome variable. Finally, independent variables with a P-value less than 0.25 were entered into the final multivariable logistic regression model to control for potential confounders and to identify significant factors associated with the outcome variable. The adequacy of the model to fit the outcome variable with the predictors was checked using the Hosmer and Lemeshow Test for goodness of fit. Finally, the adjusted odds ratio along with a 95% confidence interval was estimated to assess the strength of the association, and a P value < 0.05 was considered to declare the statistical significance in the multivariable analysis.

2.10. Patient and public involvement

No patient involved.

3. Results

3.1. Socio-demographic and economic characteristics

In this study, a total of five hundred forty respondents participated. Most of the participants were within the age range of 18–29 years, 260(48.1%); with the mean age of (30.88±SD=5.29). Females constituted 457 (84.6%) of the study participants. Majority of them were belonged to Oromo, 520(96.3%); Protestant, 439(81.3%) and married, 494(91.5%) and rural residents, 454(84.1%). In terms of educational attainment, approximately 244 (45.2%) had completed their primary education (1-8), followed by Grade 9-12 (122, 22.6%).

Of the studied participants, 227(42.0%) of them had greater than or equal to five people per household. About 447(82.8%) of the households had 1-2 children per household, and 270(50.0%) of them were aged 12–23 months old. Regarding their income, about 317(58.7%) of them had a monthly income of 1651 to 3200 Ethiopian Birr (ETB) with a mean monthly income of (3509.13ETB± SD = 2219.61) (Table 1).

Table 1.Socio-demographic and economic characteristics of the participants on socio-demographic and institutional determinants of zinc bundled with ORS utilization among under-five children with diarrheal diseases in East Wallaga Zone, western Ethiopia, 2022 (N=540)

Variables	Categories	Frequency (%)
Age of respondents	18–29	260(48.1%)
	30–39	232(43.0%
	40–49	48(8.9%)
Sex	Male	83(15.4%)

	Female	457(84.6%)
Religion	Orthodox	60(11.1%)
	Protestant	439(81.3%)
	Muslim	38(7.0%)
	Others [a]	3(0.6%)
Ethnicity	Oromo	520(96.3%)
	Amhara	11(2.0%)
	Tigre	2(0.4%
	Gurage	7(1.3%)
Marital status	Single	11(2.05%)
	Married	494(91.5%)
	Divorced	23(4.3%)
	Widowed	12(2.2%)
Occupation	Farmer	190(35.2%)
	Housewife	230(42.6%)
	Merchant	87(16.1%)
	Laborer	11(2.0%)
	Others [b]	22(4.1%)
Educational Status	Unable to read and write	88(16.3%)
	Read and write	54(10.0%)
	Primary education(1-8)	244(45.2%)
	Grade 9-12	122(22.6%)
	Diploma	22(4.1%)
	Degree and above	10(1.9%)
Family size	<5	313(58.0%)
	≥5	227(42.0%)
Number of under five children in household	1-2	447(82.8%)
	3-4	76(14.1%)
	5-6	15(2.8%)

	>6	2(0.4%)
Age of children in months	6-11 months	162(30.0%)
	12-23 months	270(50.0%)
	24-59 months	108(20.0%)
Sex of child	Male	335(62%)
	Female	205(38%)
Relationship with child	Mother	452(83.7%)
	Father	16(3%)
	Grand mother	11(2%)
	Grand Father	16(3%)
	Auntie	16(3%)
	Sister/Brother	29(5.4%)
Household's head	Male headed	506(93.7%)
	Female headed	34(6.3%)
Place of residence	Urban	86(15.9%)
	Rural	454(84.1%)
Monthly income(ETB)	1651–3200	317(58.7%)
	3201–5250	149(27.6%)
	5251–7800	52(9.6%)
	7801–10,900	10(1.9%)
	>10900	12(2.2%)

Note: [a]: Catholic, Wakefata; [b]: students, government employee; ETB: Ethiopian Birr

3.2. Institutional Related factors

Regarding the place of treatment during child illness, about 195(36.1%), 262 (48.5%), and 83(15.4%) of them received treatment during their illness in the last 12 months at home, public health facilities, and private health facilities, respectively.

In terms of facilities visited, approximately 187 (34.6%), 319 (59.1%), and 34 (6.3%) of them had visited a health post, health center, and hospital, respectively. Also, the majority (84.3%) of the facilities they have visited were primary-level health facilities. Most of the studied households, 277 (51.3%), had a distance of greater than or equal to 10 kilometers from the nearby health facilities.

About 356(65.9%) of the respondents were satisfied with the quality of care provided by healthcare professionals (HCP). Also, about 171(31.7%) and 430(79.6%) of them perceived that drugs were always available and affordable, respectively.

Additionally, about 464(85.9%) and 413(76.5%) of the participants had a fear of COVID-19 during the facility visit and were CBHI members, respectively (Table 2).

Table 2.Institutional related factors for the study on socio-demographic and institutional determinants of zinc bundled with ORS utilization among under-five children with diarrheal diseases in East Wallaga Zone, western Ethiopia, 2022 (N = 540)

Variables	Categories	Frequency (%)
Place of treatment during child illness	At home	195(36.1%)
	At public health facility	262(48.5%)
	At private health facility	83(15.4%)
Distance from health facilities	<10KM	263(48.7%)

	≥10KM	277(51.3%)
Types of health facilities visited during recent episode	Health Post	187(34.6%)
	Health center	319(59.1%)
	Hospital	34(6.3%)
Level of health facilities visited during recent episode	Primary Level	455(84.3%)
	Secondary level	69(12.8%)
	Tertiary level	16(3.0%)
Perceived quality of health care by health care professionals	Good	390(72.2%)
	Poor	150(27.8%)
Level of health care professionals provided care	Diploma	133(24.6%)
	Degree and above	340(63.0%)
	Doctor(GP)	31(5.7%)
	Pediatrician(specialist)	36(6.7%)
Perceived satisfaction from quality of care by HCPs	Satisfied	356(65.9%)
	Not satisfied	184(34.1%)
Perceived availability of drugs during facility visit	Always available	171(31.7%)
	Sometimes available	270(50.0%)
	Write prescription to outside	99(18.3%)
Perceived affordability of drugs for treatment	Affordable	430(79.6%)
	Not affordable	110(20.4%)
Fear of COVID-19 during health facility visit	Yes	464(85.9%)
	No	76(14.1%)

Status of CBHI membership	Member	413(76.5%)
	Not member	127(23.5%)

3.3. Utilization of Zinc Bundled with ORS

The study showed that about 214(39.6%) of the participant's households had utilized zinc bundled with ORS for their under five children with diarrhea at least once in the last 12 months (Table 1). Regarding duration of treatment or utilization of the drugs, about 10(4.7%), 54 (25.2%) and 150(70.1%) of them supplement co-pack for less than 7 days, 7-10 days, and 10-14 days, respectively. This implies that only 150(70.1%) of them had received full doses of the co-pack or bundle and the majority of them, 50 (78.2%), reported that diarrhea was stopped as the reason for not taking the full dose.

Concerning the form of supplementation of zinc bundled with ORS, about 152(71.0%), 27(12.6%) and 35(16.4%) were received from central bundling, facility level bundling, and status quo, respectively (Figure 1). Duration of diarrhea stopped after bundled supplementation was reported as immediately, 65(28.8%), after 1-3 days, 138 (61.1%), and after 4-6 days, 23(10.2%) (Table 3).

Table 3. Utilization of Zinc Bundled with ORS among under-five children with diarrheal diseases in East Wallaga Zone, western Ethiopia, 2022 (N=540)

Variables	Categories	Frequency (%)
Received zinc bundled with ORS at least once in the last 12months	Yes	214(39.6%)
	No	326(60.4%)
Reason for not receiving Bundle	Don't know where to obtain	56(17.3%)

	Don't know it should be given together	232(71.8%)
	Unsure how to administer	24(7.4%)
	Do not think it is effective	11(3.4%)
Duration of supplementation	Less than 7 days	10(4.7%)
	7-10 days	54(25.2%)
	10-14 days	150(70.1%)
Bundled utilization for your child	Not full dose	64(29.9%)
	Full dose	150(70.1%)
Reason for not giving full dose	Vomiting	14(21.8%)
	Diarrhea stopped	50(78.2%)
Duration of diarrhea after bundled supplementation?	Immediately	65(28.8%)
	After 1-3 days	138(61.1%)
	After 4-6 days	23(10.2%)

3.4. Determinants of Zinc Bundled with ORS Utilization

Some socio-demographic variables, such as respondents' age, occupation, educational status, family size, child's age in months, and residence, as well as institutional variables, such as distance from nearby health facility, level of health facility visited, level of health care professionals provided care, fear of COVID-19 during facility visit, and status of CBHI membership, were associated with zinc bundled with ORS use among children with diarrhea in the study.

After controlling for confounders, a multivariable logistic regression analysis revealed that respondents' age, occupation, educational status, level of health facility visited, level of health professionals provided care, and fear of COVID-19 during facility visit were significantly associated.

From this multivariable logistic regression analysis, age was associated with the utilization of zinc bundled with ORS [AOR and 95% CI = 3.48 (1.41, 8.53)]. This implied that the probability of utilizing zinc bundled with ORS among respondents' households whose age ranged from 40–49 years old was almost 3 times more likely to utilize it than those whose age ranged from 18–29 years old.

Regarding the occupation of the respondents, being a merchant was statistically strongly associated with zinc bundled with ORS [AOR and 95% CI = 5.06 (1.92, 13.34)]. This indicated that those who were merchants were 5 times more likely to utilize zinc bundled with ORS for their children than those who were farmers.

The educational status of the respondents was also strongly associated with zinc bundled with ORS for those who were able to read and write [AOR and 95% CI = 5.64 (1.18, 12.88)]. This showed that the probability of utilizing zinc and ORS bundling among respondents' households whose educational status was able to read and write was 5.6 times more likely to utilize it than those whose educational status was unable to read and write.

The study indicated that respondents who had visited secondary level health facilities were 2.8 times [AOR and 95% CI = 2.82 (1.30, 6.10)] more likely to utilize zinc bundled with ORS than those who had visited primary level health facilities, but the probability of utilizing zinc bundled with ORS among

respondents who had visited tertiary level health facilities was reduced by 98.4% [AOR and 95% CI = 0.016 (0.03, 0.97)] as compared to their counterparts.

This study also showed that the level of health professionals providing care was statistically strongly associated with the utilization of zinc bundled with ORS for degree and above [AOR and 95% CI = 0.06 (0.03, 0.12)] and doctor (general practitioners) [AOR and 95% CI = 0.13 (0.04, 0.44)] holders. This indicated that the probability of utilizing zinc bundled with ORS among respondents who had been treated by bachelor's degree and above and doctor-holder health professionals was reduced by 40% and 87% as compared to diploma-holder health professionals, respectively.

Finally, the study finding showed that respondents' households who had no fear of COVID-19 during facility visits were 2.7 times [AOR and 95% CI = 2.71 (1.13, 6.48)] more likely to utilize zinc bundled with ORS than their counterparts (Table 4).

Table 4 shows the factors that influence zinc combined with ORS utilization among under-five children with diarrheal diseases in the East Wallaga Zone of western Ethiopia in 2022 (N = 540)

Variables		Zinc Bundled with ORS Utilization		OR[95% CI] And P value	
		Non-Utilized N (%)	Utilized N (%)	COR	AOR
Age of the respondent	18–29	162(49.7%)	98(45.8%)	1	1
	30–39	142(43.6%)	90(42.1%)	1.04(.72,1.50)	1.46(.81, 2.63)
	40–49	22(6.7%)	26(12.1%)	1.9(1.05,3.63)	3.48(1.41, 8.53)**
Occupation	Farmer	148(45.4%)	42(19.6%)	1	1
	Housewife	136(41.7%)	94(43.9%)	2.43(1.581,3.75)	2.49(0.27,4.87)
	Merchant	21(6.4%)	66(30.8%)	11.07(6.08,20.15)	5.06(1.92,13.34)***
	Laborer	5(1.5%)	6(2.8%)	4.22(1.22,14.54)	3.42(1.12,26.17)
	Others [b]	16(4.9%)	6(2.8%)	2.11(.72,6.15)	4.80(1.37,16.74)
Educational status	Unable to read and write	49(15.0%)	39(18.2%)	1	1
	Read and write	20(6.1%)	34(15.9%)	2.13(1.06, 4.276)	5.64 (1.18, 12.88)*
	Primary education (1-8)	163(50.0%)	81(37.9%)	.62(.37, 1.02)	.29(.08, 1.04)
	Grade 9-12	79(24.2%)	43(20.1%)	.68(.39, 1.199)	.14(.032, .65)
	Diploma	10(3.1%)	12(5.6%)	1.50(.59, 3.85)	.32(.03, 3.33)
	Degree and above	5(1.5%)	5(2.3%)	1.25(.339, 4.65)	.02(.00, .06)
Family Size	<5	152(46.6%)	161(75.2%)	3.47(2.38, 5.08)	1.75(0.08, 6.76)

	≥5	174(53.4%)	53(24.8%)	1	1
Age of children in months	6-11 months	91(27.9%)	71(33.2%)	4.48(2.42,8.29)	1.91(0.33, 13.87)
	12-23 months	143(43.9%)	127(59.3%)	5.10(2.85,9.14)	2.07(0.24, 19.72)
	24-59 months	92(28.2%)	16(7.5%)	1	1
Place of residence	Urban	41(12.6%)	45(21.0%)	1	1
	Rural	285(87.4%)	169(79.0%)	1.85(1.16, 2.94)	1.28(.38, 4.34)
Level of health facility visited	Primary Level	290(89.0%)	165(77.1%)	1	1
	Secondary level	31(9.5%)	38(17.8%)	2.15(1.29, 3.59)	2.82 (1.30 , 6.10)**
	Tertiary level	5(1.5%)	11(5.1%)	0.44(0.32,0.86)	.016(.03, .97)*
Level of health professionals provided care	Diploma	27(8.3%)	106(49.5%)	1	1
	Degree and above	264(81.0%)	76(35.5%)	.07 (.04, .12)	.06(.03,.12)***
	Medical Doctor	15(4.6%)	16(7.5%)	.27(.11, .61)	.13(.04,.44)***
	Pediatrician	20(6.1%)	16(7.5%)	.20(.09,.44)	.40(.13, 1.24)
Fear of COVID-19 during facility visit	Yes	300(92.0%)	164(76.6%)	1	1
	No	26(8.0%)	50(23.4%)	3.28(1.17,7.47)	2.71(1.13, 6.48)*
CBHI membership status	Member	295(90.5%)	118(55.1%)	1	1
	Non-Member	31(9.5%)	96(44.9%)	3.03(4.89,12.23)	2.24(.43,11.71)

353 Note: *P-value <0.05, **P-value <0.01, ***P-value <0.001 and 1=reference, [b]:
354 Students, government workers

4. Discussion

This study aimed to address socio-demographic and institutional determinants of zinc bundles with ORS utilization among under-five children with diarrheal diseases. Based on this, the study showed that 39.6% (35.6-43.9%) of the studied participant's household had utilized zinc bundled with ORS at least once in the last 12 months. This finding was higher than the study findings from different corners of the world as; in Nigeria, 8.3% [19], among 15 highest-burden countries where ORS and zinc coverage levels were accounted as 2% or less [10] ; in Sudan, where only 18.9% and 14.8% of the children had received ORS and zinc supplements, respectively [20]; and Ethiopian EDHS 2016 reported that 17% of them received a combination of zinc and ORS. [6] The discrepancy might be due to socio-cultural differences, study area differences and time of study considered for those of the studies and surveys conducted even in the study area. Also, for the current study, we have considered majorly rural and semi-urban households, whereas these studies have assessed majorly urban residences, and they were institutional-based studies.

However, it was lower than the studies conducted in other countries, such as; in Kenya on the study occurrence of diarrhea and utilization of zinc bundled with ORS among caregivers of children less than five-years old, in which it revealed 75% [12] and also in both studies conducted in our country, Ethiopia, like studies conducted on the effectiveness of bundling of zinc with ORS for improving adherence to acute watery diarrhea treatment, which reported the magnitude of zinc and ORS co-pack utilization as 67% [2] and on the occurrence of diarrhea and

utilization of zinc bundled with ORS among caregivers of children less than five-years in Addis Ababa, Ethiopia, where it was accounted for two-thirds. [12] The probable differences might be due to differences in the study design used, in which some of them have used randomized controlled trials and differences in the study settings.

Also, it was in line with the study conducted in rural China, at 34.6%. [11] . This similarity might be due to the fact that in both of the studies, the majority of them were considered low-level care for diarrhea among children under five years old.

Variables such as age of the respondent, occupation, educational status, level of health facility visited, level of health professionals provided care, and fear of COVID-19 during a health facility visit were statistically associated with zinc bundled with ORS utilization.

The age of the mothers or caregivers was an important variable significantly associated with the utilization of zinc bundled with ORS. This finding was in contradiction with a study conducted on oral rehydration salt use and its correlates in low-level care of diarrhea among children under 36 months old in rural Western China that indicated that children in families with several pre-school-aged children or those of the smaller age groups were less likely to receive ORS therapy against diarrhea [11]. This might be due to socio-cultural differences and in study settings as well as the ages considered, in which the Chinese study considered those less than 36 months old.

Regarding the occupation of the respondents, merchants were more likely to utilize zinc bundled with ORS for their children with diarrhea than those who were

farmers. This could be explained by the fact that merchants might have more exposure to any sanitation and hygienic problems as they have an opportunity to move from one place to another and could share the fact that merchants might have more exposure to any sanitation and hygienic problems as they have an opportunity to move from one place to another and could share experiences more readily than farmers. The educational status of the respondents was also strongly associated with the bundled utilization. This showed that the probability of utilizing zinc bundled with ORS among those whose educational status was able to read and write was six times greater for those whose educational status was not able to read and write. This finding was supported by a study done in Kebri-Dehar Town, Somali Region, of Ethiopia [21] and also, the higher the educational level, the more likelihood of utilization of zinc was reported according to a study conducted in East Africa. [22] This could be due to the fact that education is the way of gaining knowledge, which could lead to an understanding of the utilization of health services.

The level of health facility visited played a vital role in the utilization of zinc with bundled ORS. A study conducted in Addis Ababa, Ethiopia revealed that 56.6% of the respondents visited health facilities and nearly all (93.9%) of the mothers or caregivers using public health facilities used health centers (i.e., primary level health facilities). However, only 11.9% of them obtained ORS plus zinc supplementation.[5] This indicated that at primary level health facilities, utilization of zinc bundled with ORS was low, which was in line with our study findings, which indicated that respondents who had visited secondary level health facilities

utilized zinc and ORS bundle by three fold more than those who had visited primary level health facilities. This might be due to similarity in the health system and the higher the level of the health facility, the greater the capacity and skill of health care professionals to understand and determine healthcare needs. However, in our study finding, at the tertiary level, health facility utilization of zinc with ORS bundled showed a reduction. This might be due to low referral cases associated with the specified disease.

In this study, a greater reduction in the utilization of zinc bundled with ORS was observed among respondents who had been treated by bachelor's degree and above and doctorate-holding health professionals than diploma-holding health professionals. This could be due to alignment, utilization, and ability to follow clinical treatment guidelines that might prevent higher-level healthcare professionals from providing services to service seekers.

Finally, this study showed that respondents who had no fear of COVID-19 during health facility visits were associated with the utilization of zinc bundled with ORS. This implied that participants who had no fear of COVID-19 were three times more likely to utilize it than their counterparts. This might be due to those who had visited health facilities being confident in the utilization of COVID-19 prevention measures. Generally, this study has some limitations. Firstly, the cross-sectional nature of the study made it difficult to show the cause and effect, and secondly, there might be a probability of recall bias.

Conclusion and Recommendation

The study found that about two in five of the respondents had utilized zinc bundled with ORS for their under-five children with diarrheal diseases. Age of the respondents, occupation, educational status, level of health facilities visited, level of health professionals provided care, and fear of COVID-19 during a health facility visit were the variables statistically associated with utilization of zinc bundled with ORS. So, health professionals at different levels of the health system have to enhance the maximization of its bundled uptake. Additionally, health education and information dissemination services and awareness on what the community has feared like COVID-19 to improve its utilization should have to be strengthened at different levels of health facilities across different levels of health care professionals. Finally, the authors recommend that further studies are required to assess the economic evaluation of an intervention.

Declarations

Ethical Approval and Consent to Participate

An appropriate ethical approval was obtained from the Institutional Review Board of Wallaga University, institute of health sciences (Reference number: IRB/205/2022) and a permission letter from East Wallaga zonal health department. It was conducted in accordance with the Declaration of Helsinki. The tool was designed to be anonymous, and the result did not identify the personality of the respondents; rather it was presented as aggregated statistics. The data was kept in a protected and safe location.

Consent to Participate

Not Applicable

Availability of Data and Materials

All the data supporting the study's findings are within the manuscript. Additional detailed information and raw data will be shared upon request addressed to the corresponding author.

Competing Interest

All authors declared that they have no conflicts of interest related to this work.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Authors Contribution

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; gave final approval of the version to be published; and agreed to be accountable for all aspects of the work.

Acknowledgments

The authors would like to acknowledge all the study participants and Wallaga University for their due cooperation and involvement during the survey.

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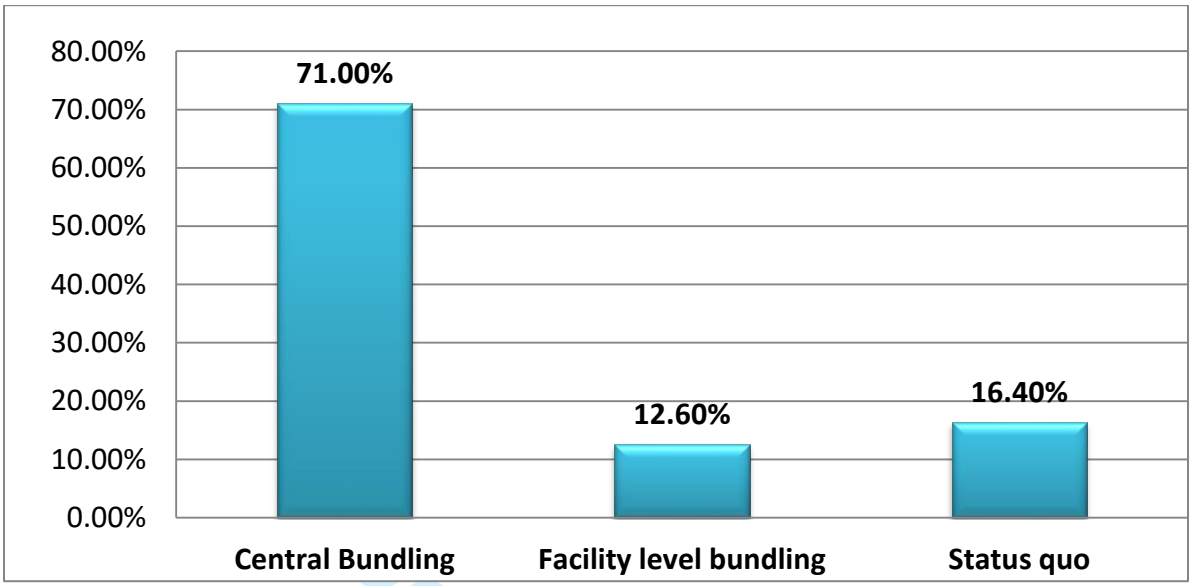

Figure 1. Forms of bundle supplementation among under-five children with diarrheal diseases in East Wallaga Zone, western Ethiopia, 2022(N = 540).

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-7
Objectives	3	State specific objectives, including any prespecified hypotheses	7
Methods			
Study design	4	Present key elements of study design early in the paper	7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	-
Bias	9	Describe any efforts to address potential sources of bias	-
Study size	10	Explain how the study size was arrived at	8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	11
		(*b*) Describe any methods used to examine subgroups and interactions	-
		(*c*) Explain how missing data were addressed	10
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	-
		(*e*) Describe any sensitivity analyses	-
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	-
		(b) Give reasons for non-participation at each stage	-
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	11
		(b) Indicate number of participants with missing data for each variable of interest	-
Outcome data	15*	Report numbers of outcome events or summary measures	-
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	-
		(*b*) Report category boundaries when continuous variables were categorized	-
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	15-19
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	-
Generalisability	21	Discuss the generalisability (external validity) of the study results	-
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	18

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Journal:	*BMJ Open*
Manuscript ID	bmjopen-2022-070203.R1
Article Type:	Original research
Date Submitted by the Author:	27-Feb-2023
Complete List of Authors:	Terefa, Dufera; Wallaga University, Public Health Shama, Adisu; Wallaga University, Public Health Kenea, Abdi Kebede; East Wallaga Zonal Health Department
Primary Subject Heading:	Nutrition and metabolism
Secondary Subject Heading:	Global health, Health services research, Medical management, Nutrition and metabolism, Paediatrics
Keywords:	Public health < INFECTIOUS DISEASES, Nutritional support < ONCOLOGY, Community child health < PAEDIATRICS, PUBLIC HEALTH, Risk Factors

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Socio-demographic and Institutional Determinants of Zinc Bundled with Oral Rehydration Salt Utilization among Under-Five Children with Diarrheal Diseases in East Wallaga Zone, western Ethiopia: A Community-based Cross-sectional Study

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Abstract

Objective: Aimed to assess socio-demographic and institutional determinants of zinc bundled with oral rehydration salt utilization among under-five children with diarrheal diseases in East Wallaga Zone, western Ethiopia, 2022.

Methods: A community-based cross-sectional study was conducted among 560 randomly selected participants from April 1 to 30, 2022. Data was entered into Epi-data version 3.1,then exported to the Statistical Package for Social Science (SPSS) version 25 for analysis. An AOR along with a 95% confidence level and a P value < 0.05 was considered to declare the statistical significance.

Results: About 39.6% of the participants had utilized zinc bundled with ORS for their children with diarrhea at least once in the last 12 months. Being aged from 40–49 years for mothers or care givers [AOR and 95% CI= 3.48 (1.41, 8.53)]; merchant [AOR and 95% CI = 4.11 (1.73,8.12)]; mothers or care givers able to read and write [AOR and 95% CI = 5.77 (1.22, 11.67)]; visited secondary [AOR and 95% CI= 2.82 (1.30, 6.10)] and tertiary level health facilities [AOR and 95% CI= 0.016 (.03, .97)]; degree and above [AOR and 95% CI= 0.06 (0.03, 0.12)] and doctor [AOR and 95% CI= 0.13 (0.04, 0.44)] holders health care professionals were statistically associated utilization zinc bundled with ORS.

Conclusion: The study found that about two in five of the participants had utilized zinc bundled with ORS for their under-five children with diarrheal diseases. Age, occupation, educational status, level of health facilities visited, and level of health professionals provided care were determinants of zinc bundled with ORS utilization. So, health professionals at different levels of the health system have to enhance the maximization of its bundled uptake.

Key Words: Bundling; Diarrhea; Socio-demographic and institutional factors; Utilization; Zinc and ORS; Ethiopia

Strengths and limitations

- This is the first study in the study setting and even in Ethiopia to assess the socio-demographic and institutional determinants of zinc bundles with oral rehydration salt utilization among under-five children with diarrhea at the community level as strength. However, this study was not with without limitation;
- The cross-sectional nature of the study made it difficult to show the cause-and-effect relationship.
- There might be a probability of recall bias.
- Unable to generalize these findings to the whole under-five children with diarrheal disease treatment with zinc and ORS bundling because there might be patients admitted at health facilities.
- It is difficult to compare these findings with those of other studies due to lack of literatures.

1. Background

Globally, diarrhea is both a disease and an economic burden each and every year, with Sub-Saharan African countries disproportionately affected by the illness and disease .[1]

Currently, nearly 1.7 billion cases of childhood diarrheal diseases account for one in nine child deaths, making diarrhea the second leading cause of death and the leading cause of malnutrition in children under five years old across the globe.[2] It kills more than 5.2 million under-five children globally, and around 800,000 children die of diarrhea and dehydration each year in Africa.[3] Of all child deaths from diarrhea, 78% occur in the African and South-East Asian regions, which are

also disproportionately burdened with infant and childhood HIV infections.[4] Sub-Saharan African countries share a significant proportion (42%), of which Ethiopia ranks fifth globally, as diarrhea causes about one-fourth (20–27%) of child deaths.[3]

Sub-Saharan African countries have made the least progress in the reduction of infant and child mortality. The two leading causes of mortality among children under five years of age in sub-Saharan Africa are pneumonia and diarrhea, which accounted for 18% and 15% of deaths, respectively. [5]

Although Ethiopia has already achieved remarkable progress in reducing under-five mortality in recent decades, studies done in different parts of Ethiopia have shown that diarrhea is still a major public health problem. [6] According to the Ethiopian Demographic and Health Surveys (EDHS) of 2016, 12% of children under age five had diarrhea .[7]

Different countries have incorporated zinc and ORS as an effective treatment combination in their policies since July 2019, when WHO added ORS bundled zinc to its core Model List of Essential Medicines for Children (EMLC) and encouraged countries to prioritize the bundle in their expenditures, procurement and supply, and training of healthcare providers.[8] This recommended regimen of zinc bundled with ORS, along with continued feeding, is a safe, effective, and inexpensive treatment for children, and 50% of diarrhea deaths can be prevented. [9] In addition, Ethiopia's health policy stated that the Federal Ministry of Health (FMOH) included zinc as an essential drug that should be available at

local health facilities and prescribed free of charge at the health post level in order to be easily accessible and given to the community since 2013. [10]

Despite these important benefits, access to ORS and zinc remains a challenge in low-resource settings, and the rate of bundling of both products was extremely low. Globally, about 55% of the highest-burden countries had ORS and zinc coverage levels of 2% or less.[11]

It is recommended that under-five children should receive 10–14 days of zinc treatment for diarrhea, and full coverage and utilization of oral rehydration salts (ORS) and adjunct zinc supplementation could avert over 75% of all diarrhea-related deaths. However, the study showed that the level of adherence to zinc supplementation was low.[12]

Bundling (co-packaging) zinc with ORS may encourage their combined use and improve access to and utilization of the treatment in children under the age of five, but different studies around the world have found low utilization. Hence, a study conducted on oral rehydration salt use and its correlates in low-level care of diarrhea among children under 36 months old in rural Western China indicated that the therapy rate of ORS was 34.62%.[13]

Of East African countries, studies conducted on zinc utilization and associated factors indicated that Uganda had the highest prevalence of zinc utilization (40.51%), whereas the Comoros had the lowest (0.44%). This study also revealed that utilization of zinc was 18% in Tanzania, 10% in Nigeria, 15% in Sudan, and 21.5% in Ethiopia. [14] This indicates that much needs to be done to

increase its utilization and reduce the impact of diarrhea, a preventable cause of under-five mortality in the region.

Also, another study conducted in Ethiopia's Addis Ababa city showed that slightly over two-thirds (67.1%) of caretakers used zinc bundles with ORS during the recent diarrheal attack. This was higher than a study conducted in Nigeria (8.3%) and comparable to the Kenyan findings (67%). [15] The proportion of children under the age of five who received treatment for diarrhea has risen from 13% in 2000 to 22% in 2005, 32% in 2011, and 44% in 2016. Whereas the percentage of children who received no treatment has decreased from 42% in 2011 to 38% in 2016. According to the Ethiopian EDHS-2016 report, one in three children (33%) under age 5 with diarrhea received zinc, and 17% received a combination of ORS and zinc. Antibiotics were given to 9% of children with diarrhea, and two in five (38%) children with diarrhea did not receive any treatment. [7]

In general, age, occupation, caregiver relationship with the child, type and level of health facilities visited, distance from health facilities, and community-based health insurance membership were some of the determinants of zinc bundles with ORS utilization among under-five children with diarrheal diseases studied.[12,15-16] Although these studies showed some variations, there were gaps in identifying socio-demographic and institutional determinants in this area specifically because these determinants are more vital in assessing utilization of these bundled products than assessing these variables with other determinant factors together.

Moreover, to the best of the author's knowledge, no prior studies have been conducted on the socio-demographics and institutional determinants of the utilization of zinc-bundled oral rehydration salt among under-five children with diarrheal diseases in the East Wallaga Zone, western Ethiopia. Also, studies that have been conducted elsewhere have mostly revealed specific interventions, either on zinc or ORS only [14] rather than focusing on the recently implemented co-packaged zinc and ORS and particularly giving attention to its socio-demographics and institutional determinants. Therefore, to fill these gaps, this study aimed to assess the socio-demographics and institutional determinants of zinc bundles with oral rehydration salt utilization among under-five children with diarrheal diseases in the East Wallaga Zone, western Ethiopia, in 2022.

2. Methods and Materials

2.1. Study Setting and Period

The study was conducted in East Wallaga Zone, Oromia region, Western Ethiopia from April 1st to April 30th, 2022. The zonal town, Nekemte, is located 333 km west of Addis Ababa, which is the capital city of Ethiopia. East Wallaga zone has an area of 21,980 million sq. km. and is geographically bounded in the east by West Shewa and Jimma zones, in the west by West Wallaga zone, in the north by Horo Guduru Wallaga zone and Amahara Regional State, and in the south west by Buno Bedele zone. Administratively, the zone has a total of seventeen districts, and the total population of the zone in 2021/22, as projected from 2007, was 1,585,215 with a male to female ratio of 1.1:1.

2.2. Study Design and Population

2.2.1. Study Design

A community-based cross-sectional study design was employed to assess the socio-demographic and institutional determinants of zinc bundles with oral rehydration salt utilization among under-five children with diarrheal diseases in East Wallaga Zone, Western Ethiopia.

2.2.2. Population

2.2.2.1. Source population

All households among selected districts whose under-five children had diarrhea in the last one-year period were the source population.

2.2.2.2. Study population

All selected under-five children who had diarrhea in the last 12 months and their caregivers were the study population.

2.3. Eligibility Criteria

2.3.1. Inclusion Criteria

All households whose under-five children had diarrhea in the last year and who had stayed for more than one year in the area were included in the study.

2.3.2. Exclusion Criteria

Under-five children's mothers or caregivers who were sick at the time of data collection were excluded from the study.

2.4. Sample Size and Sampling Technique

2.4.1. Sample Size Determination

The sample size was determined using a single population proportion formula by considering the following assumptions: where the proportion of zinc bundled with oral rehydration salt utilization among under-five children was 67.1% [15] was taken. Also, by considering 5% margins of error, a design effect of 1.5, and a 10% potential non-response rate, the final sample size became 560.

2.4.2. Sampling Techniques and Procedures

A multi-stage sampling procedure was carried out. In the first stage, four districts (40%) were randomly selected using a lottery method from nine nutrition international project-supported districts in the zone. [17] In the second stage, all Kebles were listed for each selected district, and among them, a total of 12 Kebles (3 Kebles per district) were selected for the study as representative of the Kebles using a simple random sampling technique for each district based on the WHO health facility assessment tool. [18,19] Then, after the selection of the Kebles to be included in the study, records of diarrheal diseases from each health facility in the catchments for each Keble and diarrheal disease data for under-five children were obtained from health extension workers. Where, Keble is Ethiopia's smallest administrative division or unit, which is a sub-section of the district. Households that could fulfill the inclusion criteria from these records were listed from the Master Family Index (MFI) and family folders of the Community Health Information System (CHIS) registration books, and the households' numbers were obtained and used as a sampling frame. The sample size was then distributed to each Keble in proportion to the size of their household in each district. Finally, to obtain the final sample size, simple random sampling

techniques were used to select households based on the allocated sample size of each keble, and the data was collected from mothers or caregivers.

2.5. Study Variables

Utilization of Zinc Bundled with Oral Rehydration Salt was the outcome variable and the independent variables were: socio-demographic and economic related variables (age of the caregivers or mothers, sex of caregivers or mothers, marital status, family size, educational status, occupation, residence, age of the child, sex of the child, caregiver relationship with child, and household's monthly income); and institutional related variables (place of treatment, types of health facility visited, level of health facilities, perceived quality of care by health professional, status of health professionals, availability of drugs or supplies in the facilities, perceived affordability of drugs, distance from nearby health facilities and health insurance membership status).

2.6. Operational Definitions

Zinc and ORS Bundling: is a bundle containing zinc sulfate and oral rehydration salt which can be prepared in different forms for supplementation, such as;

- **Central bundling**: Pre-bundled zinc and ORS using a pouch that had an instructional message intended for improving the rational use of zinc-ORS treatment, distributed to health facilities;
- **Facility level bundling:** Zinc, ORS bundling pouch that had instructional messages distributed to the health facilities; bundling was made by the health workers while administering the treatment and
- **Status quo:** Zinc and ORS are co-administered without bundling. [12]

Utilizations of Zinc Bundled with ORS: is the use of services by under-five children, at least one child in the household, at least once, from health facilities for the purpose of preventing and curing health problems, promoting health and well-being, or obtaining information about one's health status and prognosis, regarding diarrheal diseases treatment with zinc and ORS co-pack in the previous year, which was answered by a closed-ended binary question (Yes/No). Based on this, if they had received the drugs from health facilities, it was answered as "yes," and if not, it was answered as "no." [15]

Level of health facilities: are health-care facilities that provide various levels of care in accordance with Ethiopia's current health-tier system (three-tier system) (health posts, health centers, hospitals). [20]

2.7. Data Collection Instrument and Procedures

Data were gathered through face-to-face interviews with mothers or child caregivers using a semi-structured, interviewer-administered, pre-tested questionnaire. It was adapted from a review of different literature. [9,15] and modified to fit the local context. The tool was first prepared in English, translated to Afan Oromo, and then back translated to English by Afan Oromo and English-language Bachelor degree holders to check for consistency. It consists of socio-demographic and institutional-related factors.

2.8. Data Quality Management

To maintain the quality of the data, different measures were undertaken before, during, and after data collection. A preliminary translation and re-translation of the questionnaire was made to check for its consistency before the actual data collection. Training was given for all data collectors and supervisors on the

objective of the study, the contents of the questionnaire, issues of maintaining confidentiality, informed verbal consent, and interview techniques.

2.9. Data Analysis Procedure

Data was entered into Epi-Data version 3.1 and exported to SPSS version 25 for statistical analysis. A descriptive analysis was used to describe the percentages and number of distributions of the respondents. A binary logistic regression analysis was performed on the independent variables and their proportions, and a crude odds ratio was computed against the outcome variable. Finally, independent variables with a P-value less than 0.25 were entered into the final multivariable logistic regression model to control for potential confounders and identify significant factors associated with the outcome variable. The adequacy of the model to fit the outcome variable with the predictors was checked using the Hosmer and Lemeshow Test for goodness of fit. Finally, the adjusted odds ratios along with a 95% confidence interval were estimated to assess the strength of the association, and a P value < 0.05 was considered to declare the statistical significance in the multivariable analysis.

2.10. Patient and public involvement

No patient involved.

3. Results

3.1.Socio-demographic and economic characteristics

In this study, a total of five hundred forty respondents participated, resulting in a 96.4% response rate. Most of the participants were within the age range of 18–29 years, 260(48.1%); with a mean age of (30.88±SD=5.29). Females constituted 457 (84.6%) of the study participants. Majority of them were belonged

to Oromo, 520(96.3%); Protestant, 439(81.3%) and married, 494(91.5%) and rural residents, 454(84.1%). In terms of educational attainment, approximately 244 (45.2%) had completed their primary education (1-8), followed by Grades 9-12 (122, 22.6%).

Of the studied participants, 227 (42.0%) had greater than or equal to five people per household. About 447 (82.8%) of the households had 1-2 children per household, and 270 (50.0%) of them were aged 12–23 months. Regarding their income, about 317 (58.7%) of them had a monthly income of 1651–3200 Ethiopian Birr (ETB), with a mean monthly income of (3509.13 ETB ± SD = 2219.61) (Table 1).

Table 1. Socio-demographic and economic characteristics of the participants on socio-demographic and institutional determinants of zinc bundles with ORS utilization among under-five children with diarrheal diseases in the East Wallaga Zone, western Ethiopia, 2022 (N = 540)

Variables	Categories	Frequency (%)
Age of respondents	18–29	260(48.1%)
	30–39	232(43.0%
	40–49	48(8.9%)
Sex	Male	83(15.4%)
	Female	457(84.6%)
Religion	Orthodox	60(11.1%)
	Protestant	439(81.3%)
	Muslim	38(7.0%)
	Others [a]	3(0.6%)
Ethnicity	Oromo	520(96.3%)
	Amhara	11(2.0%)
	Tigre	2(0.4%
	Gurage	7(1.3%)
Marital status	Single	11(2.05%)
	Married	494(91.5%)
	Divorced	23(4.3%)
	Widowed	12(2.2%)
Occupation	Farmer	190(35.2%)
	Housewife	230(42.6%)
	Merchant	87(16.1%)
	Laborer	11(2.0%)
	Others [b]	22(4.1%)
Educational Status	Unable to read and write	88(16.3%)
	Read and write	54(10.0%)
	Primary education(1-8)	244(45.2%)
	Grade 9-12	122(22.6%)
	Diploma	22(4.1%)
	Degree and above	10(1.9%)
Family size	<5	313(58.0%)

	≥5	227(42.0%)
Number of under five children in household	1-2	447(82.8%)
	3-4	76(14.1%)
	5-6	15(2.8%)
	>6	2(0.4%)
Age of children in months	6-11 months	162(30.0%)
	12-23 months	270(50.0%)
	24-59 months	108(20.0%)
Sex of child	Male	335(62%)
	Female	205(38%)
Relationship with child	Mother	452(83.7%)
	Father	16(3%)
	Grand mother	11(2%)
	Grand Father	16(3%)
	Auntie	16(3%)
	Sister/Brother	29(5.4%)
Household's head	Male headed	506(93.7%)
	Female headed	34(6.3%)
Place of residence	Urban	86(15.9%)
	Rural	454(84.1%)
Monthly income(ETB)	1651–3200	317(58.7%)
	3201–5250	149(27.6%)
	5251–7800	52(9.6%)
	7801–10,900	10(1.9%)
	>10900	12(2.2%)

Note: [a]: Catholic, Wakefata; [b]: students, government employee; ETB: Ethiopian Birr

3.2. Institutional Related factors

In the previous 12 months, 195 (36.1%), 262 (48.5%), and 83 (15.4%) of them received treatment during their illness at home, public health facilities, and private health facilities, respectively.

In terms of facilities visited, approximately 187 (34.6%), 319 (59.1%), and 34 (6.3%) of them had visited a health post, health center, and hospital, respectively. Also, the majority (84.3%) of the facilities they have visited were primary-level health facilities. Most of the studied households, 277 (51.3%), had a distance greater than or equal to 10 kilometers from the nearby health facilities. About 356 (65.9%) of the respondents were satisfied with the quality of care provided by healthcare professionals (HCP). Also, about 171 (31.7%) and 430 (79.5%) of them perceived that drugs were always available and affordable, respectively (Table 2).

Table 2. Institutional related factors for the study on socio-demographic and institutional determinants of zinc bundles with ORS utilization among under-five children with diarrheal diseases in the East Wallaga Zone, western Ethiopia, 2022 (N = 540)

Variables	Categories	Frequency (%)
Place of treatment during child illness	At home	195(36.1%)
	At public health facility	262(48.5%)
	At private health facility	83(15.4%)
Distance from health facilities	<10KM	263(48.7%)
	≥10KM	277(51.3%)
Types of health facilities visited	Health Post	187(34.6%)

during recent episode		
	Health center	319(59.1%)
	Hospital	34(6.3%)
Level of health facilities visited during recent episode	Primary Level	455(84.3%)
	Secondary level	69(12.8%)
	Tertiary level	16(3.0%)
Perceived quality of health care by health care professionals	Good	390(72.2%)
	Poor	150(27.8%)
Level of health care professionals provided care	Diploma	133(24.6%)
	Degree and above	340(63.0%)
	Doctor(GP)	31(5.7%)
	Pediatrician(specialist)	36(6.7%)
Perceived satisfaction from quality of care by HCPs	Satisfied	356(65.9%)
	Not satisfied	184(34.1%)
Perceived availability of drugs during facility visit	Always available	171(31.7%)
	Sometimes available	270(50.0%)
	Write prescription to outside	99(18.3%)
Perceived affordability of drugs for treatment	Affordable	430(79.6%)
	Not affordable	110(20.4%)
Status of CBHI membership	Member	413(76.5%)
	Not member	127(23.5%)

3.3. Utilization of Zinc Bundled with ORS

The study showed that about 214 households (39.5%) of the participants had utilized zinc bundled with ORS for their under-five children with diarrhea at least once in the last 12 months (Table 1). Regarding duration of treatment or utilization of the drugs, about 10 (4.7%), 54 (25.2%), and 150 (70.1%) of them supplement co-packs for less than 7 days, 7–10 days, and 10–14 days, respectively. This implies that only 150 (70.1%) of them had received full doses of the co-pack or bundle, and the majority of them, 50 (78.2%), reported that diarrhea had been stopped as the reason for not taking the full dose.

Concerning the form of supplementation of zinc bundled with ORS, about 152(71.0%), 27(12.6%) and 35(16.4%) were received from central bundling, facility level bundling, and status quo, respectively (Figure 1). The duration of diarrhea stopped after bundled supplementation was reported as immediately, 65(28.8%), after 1-3 days, 138 (61.1%), and after 4-6 days, 23(10.2%) (Table 3).

Table 3. Utilization of zinc bundled with ORS among under-five children with diarrheal diseases in the East Wallaga Zone, western Ethiopia, 2022 (N = 540)

Variables	Categories	Frequency (%)
Received zinc bundled with ORS at least once in the last 12months	Yes	214(39.6%)
	No	326(60.4%)
Reason for not receiving Bundle	Don't know where to obtain	56(17.3%)
	Don't know it should be given together	232(71.8%)

	Unsure how to administer	24(7.4%)
	Do not think it is effective	11(3.4%)
Duration of supplementation	Less than 7 days	10(4.7%)
	7-10 days	54(25.2%)
	10-14 days	150(70.1%)
Bundled utilization for your child	Not full dose	64(29.9%)
	Full dose	150(70.1%)
Reason for not giving full dose	Vomiting	14(21.8%)
	Diarrhea stopped	50(78.2%)
Duration of diarrhea after bundled supplementation?	Immediately	65(28.8%)
	After 1-3 days	138(61.1%)
	After 4-6 days	23(10.2%)

3.4. Determinants of Zinc Bundled with ORS Utilization

Some socio-demographic variables, such as the respondents' age, occupation, educational status, family size, the child's age in months, and residence, as well as institutional variables, such as distance from a nearby health facility, level of health facility visited, level of health care professionals providing care, and status of CBHI membership, were associated with zinc-bundled ORS use among children with diarrhea in the study.

After controlling for confounders, a multivariable logistic regression analysis revealed that respondents' age, occupation, educational status, level of health

facility visited and level of health professionals providing care were significantly associated.

From this multivariable logistic regression analysis, age was associated with the utilization of zinc bundled with ORS [AOR and 95% CI = 3.48 (1.41, 8.53)]. This implied that the probability of utilizing zinc bundled with ORS among respondents' households whose ages ranged from 40 to 49 years old was almost three times more likely to be utilized than that of those whose ages ranged from 18 to 29 years old.

Regarding the occupation of the respondents, being a merchant was statistically strongly associated with zinc bundled with ORS [AOR and 95% CI = 4.11 (1.73, 8.12)]. This indicated that those who were merchants were four times more likely to utilize zinc bundled with ORS for their children than those who were farmers.

The educational status of the respondents was also strongly associated with zinc bundles and ORS for those who were able to read and write [AOR and 95% CI = 5.77 (1.22, 11.67)]. This revealed that respondents' households whose educational status was able to read and write were 5.7 times more likely to use zinc and ORS bundling than those whose educational status was unable to read and write.

The study indicated that respondents who had visited secondary level health facilities were 2.8 times [AOR and 95% CI = 2.82 (1.30, 6.10)] more likely to utilize zinc bundled with ORS than those who had visited primary level health facilities, but the probability of utilizing zinc bundled with ORS among

respondents who had visited tertiary level health facilities was reduced by 98.4% [AOR and 95% CI = 0.016 (0.03, 0.97)] as compared to their counterparts. This study also found that for degree and above [AOR and 95% CI = 0.06 (0.03, 0.12)] and doctor (general practitioners) [AOR and 95% CI = 0.13 (0.04, 0.44)] holders, the level of health professionals providing care was statistically strongly associated with the utilization of zinc bundled with ORS. This indicated that the likelihood of using zinc bundled with ORS was reduced by 40% and 87%, respectively, among respondents treated by bachelor's degree and above and doctorate-holding health professionals, when compared to diploma-holding health professionals (Table 4).

Table 4 shows the factors that influence zinc combined with ORS utilization among under-five children with diarrheal diseases in the East Wallaga Zone of western Ethiopia in 2022 (N = 540)

Variables		Zinc Bundled with ORS Utilization		OR[95% CI] And P value	
		Non-Utilized N (%)	Utilized N (%)	COR	AOR
Age of the respondent	18–29	162(49.7%)	98(45.8%)	1	1
	30–39	142(43.6%)	90(42.1%)	1.04(.72,1.50)	1.46(.81, 2.63)
	40–49	22(6.7%)	26(12.1%)	1.9(1.05,3.63)	3.48(1.41, 8.53)**
Occupation	Farmer	148(45.4%)	42(19.6%)	1	1
	Housewife	136(41.7%)	94(43.9%)	2.43(1.581,3.75)	2.49(0.27,4.87)
	Merchant	21(6.4%)	66(30.8%)	11.07(6.08,20.15)	4.11(1.73,8.12)***
	Laborer	5(1.5%)	6(2.8%)	4.22(1.22,14.54)	2.79(1.14,14.45)
	Others [b]	16(4.9%)	6(2.8%)	2.11(.72,6.15)	2.71(1.33,11.18)
Educational status	Unable to read and write	49(15.0%)	39(18.2%)	1	1
	Read and write	20(6.1%)	34(15.9%)	2.13(1.06, 4.276)	5.77 (1.22, 11.67)*
	Primary education (1-8)	163(50.0%)	81(37.9%)	.62(.37, 1.02)	.29(.08, 1.04)
	Grade 9-12	79(24.2%)	43(20.1%)	.68(.39, 1.199)	.14(.032, .65)
	Diploma	10(3.1%)	12(5.6%)	1.50(.59, 3.85)	.32(.03, 3.33)
	Degree and above	5(1.5%)	5(2.3%)	1.25(.339, 4.65)	.02(.00, .06)
Family Size	<5	152(46.6%)	161(75.2%)	3.47(2.38, 5.08)	1.75(0.08, 6.76)

	≥5	174(53.4%)	53(24.8%)	1	1
Age of children in months	6-11 months	91(27.9%)	71(33.2%)	4.48(2.42,8.29)	1.91(0.33, 13.87)
	12-23 months	143(43.9%)	127(59.3%)	5.10(2.85,9.14)	2.07(0.24, 19.72)
	24-59 months	92(28.2%)	16(7.5%)	1	1
Place of residence	Urban	41(12.6%)	45(21.0%)	1	1
	Rural	285(87.4%)	169(79.0%)	1.85(1.16, 2.94)	1.89(.38, 5.23)
Level of health facility visited	Primary Level	290(89.0%)	165(77.1%)	1	1
	Secondary level	31(9.5%)	38(17.8%)	2.15(1.29, 3.59)	2.82 (1.30 , 6.10)**
	Tertiary level	5(1.5%)	11(5.1%)	0.44(0.32,0.86)	.016(.03, .97)*
Level of health professionals provided care	Diploma	27(8.3%)	106(49.5%)	1	1
	Degree and above	264(81.0%)	76(35.5%)	.07 (.04, .12)	.06(.03,.12)***
	Medical Doctor	15(4.6%)	16(7.5%)	.27(.11, .61)	.13(.04,.44)***
	Pediatrician	20(6.1%)	16(7.5%)	.20(.09,.44)	.40(.13, 1.24)
CBHI membership status	Member	295(90.5%)	118(55.1%)	1	1
	Non-Member	31(9.5%)	96(44.9%)	3.03(4.89,12.23)	2.24(.43,11.71)

Note: *P-value <0.05, **P-value <0.01, ***P-value <0.001 and 1=reference, [b]: Students, government workers

4. Discussion

This study aimed to address socio-demographic and institutional determinants of zinc bundles and ORS utilization among under-five children with diarrheal

diseases. Based on this, the study showed that 39.6% (35.6-43.9%) of the studied participant's household had utilized zinc bundled with ORS at least once in the last 12 months. This finding was higher than the study findings from different corners of the world, as in Nigeria, 8.3% [21] ; in Sudan, where only 18.9% and 14.8% of the children had received ORS and zinc supplements, respectively [22] ; and in Ethiopia, where the EDHS 2016 reported that 17% of them received a combination of zinc and ORS. [7] The discrepancy might be due to socio-cultural differences, study area differences, and the time of study considered for those of the studies and surveys conducted even in the study area. Also, for the current study, we have considered primarily rural and semi-urban households, whereas these studies have assessed primarily urban residences, and they were institutional-based studies. However, this study's finding was lower than the study conducted in Kenya, 75%. [15] Furthermore, the finding was lower than in both Ethiopian studies: on the effectiveness of bundling zinc with ORS, 67% [12] ; and on the occurrence of diarrhea and utilization of zinc bundled with ORS among caregivers of children under the age of five in Addis Abeba, where it accounted for two-thirds.[15] The probable differences might be due to differences in the study design used, in which some of them have used randomized controlled trials, and differences in the study settings.

Also, this study's finding was in line with the study conducted in rural China, at 34.6%. [13] This similarity might be due to the fact that in both of the studies, the majority of the cases were considered low-level care for diarrhea among children under five years old.

Zinc bundles with ORS utilization was statistically associated with variables such as respondent age, occupation, educational status, level of health facility visited, and level of health professionals providing care.

The age of the mothers or caregivers was an important variable significantly associated with the utilization of zinc bundled with ORS. This finding was in contradiction with a study conducted on oral rehydration salt use and its correlates in low-level care of diarrhea among children under 36 months old in rural Western China that indicated that children in families with several pre-school-aged children or those of the smaller age groups were less likely to receive ORS therapy against diarrhea.[13] This could be due to socio-cultural differences and differences in study settings, as well as the ages considered, with the Chinese study focusing on children under the age of 36 months.

Regarding the occupation of the respondents, merchants were more likely to utilize zinc bundled with ORS for their children with diarrhea than those who were farmers. This might be explained by different reasons; the exhaustive nature of the work of the farmer in the study setting might force them to not give the drugs on time as needed and even to forget the drugs. Also, the opportunities they might have to move from place to place, especially to urban areas, were minimal for farmers compared to merchants, which might have an influence on the utilization of these drugs.

The educational status of the respondents was also strongly associated with the bundled utilization. This revealed that the likelihood of using zinc combined with ORS was six times higher among those whose educational status allowed them

to read and write than among those whose educational status did not allow them to read and write. A study conducted in Kebri-Dehar Town, Somali Region, Ethiopia, supported this finding. [23] and also, the higher the educational level, the more likelihood of utilization of zinc was reported according to a study conducted in East Africa. [24] This could be due to the fact that education is the way of gaining knowledge, which could lead to an understanding of the utilization of health services.

The level of health facility visited played a vital role in the utilization of zinc with bundled ORS. A study conducted in Addis Ababa, Ethiopia, revealed that 56.6% of the respondents visited health facilities, and nearly all (93.9%) of the mothers or caregivers using public health facilities used health centers (i.e., primary level health facilities). However, only 11.9% of them obtained ORS plus zinc supplementation.[5] This indicated that utilization of zinc bundled with ORS was low at primary level health facilities, which was consistent with our study findings, which revealed that respondents who visited secondary level health facilities used zinc and ORS bundle three times more than those who visited primary level health facilities. This might be due to the similarity of the health system, and the higher the level of the health facility, the greater the capacity and skill of health care professionals to understand and determine healthcare needs. However, in our study findings, at the tertiary level, health facility utilization of zinc with bundled ORS showed a reduction. This might be due to the low number of referral cases associated with the specified disease. Finally, this study showed that a greater reduction in the utilization of zinc bundled with ORS was observed

among respondents who had been treated by bachelor's degree and above and doctorate-holding health professionals than diploma-holding health professionals. This could be due to alignment, utilization, and the ability to follow clinical treatment guidelines that might prevent higher-level healthcare professionals from providing services to service seekers.

Conclusion and Recommendation

The study found that about two in five of the respondents had utilized zinc bundled with ORS for their under-five children with diarrheal diseases. Age of the respondents, occupation, educational status, level of health facilities visited and level of health professionals provided care were the variables statistically associated with utilization of zinc bundled with ORS. So, health professionals at different levels of the health system have to enhance the maximization of its bundled uptake. Additionally, health education and information dissemination services and awareness for the community to improve its utilization should have to be strengthened at different levels of health facilities across different levels of health care professionals.

Declarations

Ethical Approval and Consent to Participate

An appropriate ethical approval was obtained from the Institutional Review Board of Wallaga University, Institute of Health Sciences (Reference number: IRB/205/2022) and a permission letter from the East Wallaga zonal health department. It was conducted in accordance with the Declaration of Helsinki. The tool was designed to be anonymous, and the result did not identify the

personalities of the respondents; rather, it was presented as aggregated statistics. The data was kept in a protected and safe location.

Consent to Participate

Not Applicable

Availability of Data and Materials

All the data supporting the study's findings are within the manuscript. Additional detailed information and raw data will be shared upon request addressed to the corresponding author.

Competing Interest

All authors declared that they have no conflicts of interest related to this work.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Authors Contribution

DRT was contributed to conceptualization and design, data acquisition, analysis, interpretation, writing original draft, review and editing. ATS was contributed to conceptualization and design, data acquisition, critical review and editing. AKK contributed to data acquisition, supervision, review and editing.

Acknowledgments

The authors would like to acknowledge all the study participants and Wallaga University for their due cooperation and involvement during the survey.

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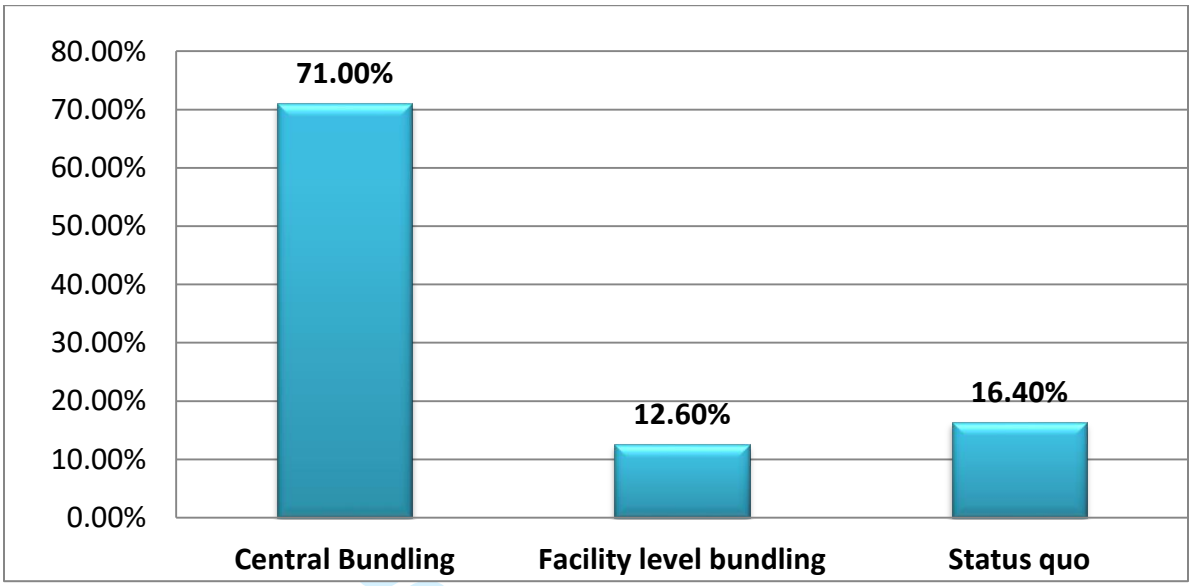

Figure 1. Forms of bundle supplementation among under-five children with diarrheal diseases in East Wallaga Zone, western Ethiopia, 2022(N = 540).

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-7
Objectives	3	State specific objectives, including any prespecified hypotheses	7
Methods			
Study design	4	Present key elements of study design early in the paper	7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	-
Bias	9	Describe any efforts to address potential sources of bias	-
Study size	10	Explain how the study size was arrived at	8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	11
		(*b*) Describe any methods used to examine subgroups and interactions	-
		(*c*) Explain how missing data were addressed	10
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	-
		(*e*) Describe any sensitivity analyses	-
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	-
		(b) Give reasons for non-participation at each stage	-
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	11
		(b) Indicate number of participants with missing data for each variable of interest	-
Outcome data	15*	Report numbers of outcome events or summary measures	-
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	-
		(*b*) Report category boundaries when continuous variables were categorized	-
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	15-19
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	-
Generalisability	21	Discuss the generalisability (external validity) of the study results	-
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	18

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.