

RESEARCH NOTE

Open Access



Zinc adherence among caregivers of under five children with diarrhea in Gondar City, Northwest Ethiopia

Saba Atnafu¹, Amare Tariku¹, Mekonnen Sisay^{1*} and Asmamaw Atnafu²

Abstract

Introduction Zinc with oral re-hydration salt supplementation provides much improved outcomes for managing childhood diarrhea. There is scarcity of evidence in the study area regarding zinc supplementation adherence and factors associated with. Thus, the aim of this study was to assess zinc supplementation adherence and associated factors among caregivers of under five children with diarrhea attending health centers in Gondar City.

Methods An institutional based cross-sectional study was conducted with 405 caregivers of under-five children with diarrhea who received zinc supplementation in Gondar City health centers. Bivariable and multivariable logistic regression analysis were computed.

Results 35% (95% CI: 29.91, 39.21) of caregivers of under five children adhered for zinc supplementation. Adherence was observed among caregivers with good knowledge about zinc supplementation (AOR=3.01 95%CI= 1.73, 5.24), and who received counseling (AOR=8.4, 95%CI=4.66, 15.13), presence of side effects (AOR=0.35, 95% CI 0.20, 0.65) was negatively associated with zinc supplementation adherence.

Conclusion In the study area, more than one third of children with diarrhea were adhered to zinc supplementation. Thus, improving the knowledge of caregivers and enhancing counseling services on benefits, dosage, duration and side effects of zinc supplementation are vital to improve adherence in the area.

Keywords Zinc supplementation, Children, Gondar, Ethiopia

Background

Diarrhea is one of the leading causes of morbidity and mortality in children. Globally, 1.7 billion cases of childhood diarrheal disease and 525,000 deaths occur every year [1–4]. According to the world health organization (WHO) fact sheets in 2017, 4% of under-five deaths in America and Europe and 10% in western Mediterranean pacific regions, southeast Asia and Africa were caused by diarrheal disease [5]. It is also one of the leading causes of childhood malnutrition and the detrimental factor for childhood growth and cognitive development [6]. According to 2016 Ethiopian Demographic Health Survey (EDHS) report, 12% of under five children had

*Correspondence:

Mekonnen Sisay
mekudesu@gmail.com

¹Department of Human Nutrition, Institute of Public Health, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia

²Department of Health Systems and Policy, Institute of Public Health, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia



© The Author(s) 2024. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

diarrhea and contributes to 9% of under five deaths in Ethiopia, [5, 7].

Several public health interventions have been recommended to prevent and manage diarrheal morbidity and mortality. Some of the interventions included are provision of safe water or adequate sanitation, improving hygiene, hand washing and routine vaccination. Moreover, provision of appropriate antibiotic for the specific causative agent, breastfeeding, oral rehydration salt and zinc supplementation are essential. Zinc and oral rehydration salt (ORS) are very effective and inexpensive products, which can prevent the death in up to 93% of diarrhea cases [1, 4, 8].

Zinc reduces the period and severity of an episode and decreases the risk of recurrence of diarrhea through it restoring mucosal barrier integrity and enterocyte brush-border enzyme activity on gastro intestinal system, promotes the production of antibodies and circulating lymphocytes against intestinal pathogens, and has direct effect on ion channels and acting as a potassium channel blocker of adenosine 3-5-cyclic mono-phosphate-mediated chlorine secretion [9–11].

The World health organization (WHO) has suggested 10 mg and 20 mg of zinc for infants below six months and under five children to be given with ORS for 10–14 days for diarrhea management, respectively [12]. Most developing countries including Ethiopia have endorsed zinc and ORS in the treatment guideline for the management of diarrhea in under five children.

In Ethiopia, only 33% of the children with diarrhea have obtained zinc treatment given that a treatment course has revealed a highly effective response, included in the guideline and the products being readily accessible on the market [7]. Empirical evidences showed that most caregivers do not administer all the recommended dose of zinc due to different factors. For instance, maternal education, occupation, health care providers instruction, child becomes symptom free are some of the factors that affected zinc supplementation adherence.

However, studies which could provide updated evidence about adherence to zinc with ORS are very scarce in the study area. Hence, the results of this study would provide important information to concerned bodies to help design appropriate and feasible interventions. Therefore, this study aimed at assessing adherence to zinc with ORS and associated factors in Gondar City health centers, northwest Ethiopia.

Methods

Study design and setting

An institution based cross-sectional study was employed in Gondar City administration health centers from February to April, 2019. Gondar City is located in Central Gondar Zone of Amhara National Regional State,

Ethiopia. The City is located 727 km northwest of Addis Ababa, the capital of Ethiopia. The City is divided into 12 administrative areas. According to the 2007 Ethiopian census report, Gondar City had a total population of 338,646. There were one public referral hospital, 2 private hospitals and 8 health centers which provide preventive and curative services for the City and surrounding community.

Source and study population

All caregiver or mother-child pairs who received zinc and ORS supplementation for diarrhea treatment were the source population. Those who randomly selected, willing to participate in the study and signed the informed consent were included. Children who were taking zinc supplementation during data collection and unwilling to participate were excluded.

Sample size determination and sampling procedures

The sample size was determined using single population proportion formula by assuming; 19.1% proportion of zinc supplementation adherence [13], 95% confidence interval and 4% margin of error and a 10% non-response rate, which yields 405.

Systematic random sampling technique was applied to select 405 study participants. An initial assessment was done to establish a baseline data based on the previous two-months patient flow to the pediatric OPD. According to the registry, about 102 children presented with diarrhea. Thus, about 816 children with diarrhea visited the pediatric OPD over 8 weeks. The number of children to be included in each health center was determined using proportional allocation. Hence, based on the baseline information and the sample size estimated, a sampling interval (K) of 2 was obtained. Then, the first child was randomly selected and 1 was drawn as the first participant using the simple random sampling technique. Consequently, participants were selected and included in the study at every 3rd interval. The addresses of the caretaker who is responsible for administering zinc and ORS as well as feeding the child were taken and then traced to estimate adherence to zinc and ORS through household visits. Adherence of zinc and ORS supplementation was ascertained through mothers'/caregivers' self-report and pill count.

Variables of the study

Adherence to zinc supplementation was the dependent variable and socio-economic and demographic characteristics, health provider and treatment related factors, disease characteristic and knowledge of caregivers were the independent variables.

Operational definitions

Zinc supplementation

Refers to provision of 20 mg or 10 mg of zinc for children 6 months to 5 years and infants less than 6 months of age together with ORS for 10–14 days as a treatment for diarrhea, respectively [13, 14].

Zinc supplementation adherence

In this study, it was considered if respondents provided 10 mg of zinc for 10 consecutive days for infants less than six months and/or 20 mg of zinc per day for 10 consecutive days for children 6 months to 5 years of age [15–17].

Caregivers

Any caretaker who is responsible to administer zinc and ORS and also feeding the child.

Knowledgeable

Respondents who score the median and above (≥ 6) were considered as knowledgeable on zinc supplementation out of ten knowledge related questions.

Data collection tools and procedures

Data was collected by using a pretested and structured questionnaire which was further modified by reviewing different literatures [13, 15, 16]. It includes questions used to assess adherence and associated factors. Adherence was measured using a question that assess caregivers' practice on how to deliver zinc to the child, which could be provide 10 or 20 mg of zinc as per the age of the child for 10 consecutive days or not. If the caregiver provides zinc for 10 days with the right dose, it is considered as adhered.

Data quality control

To obtain quality data, maximum efforts were attempted. The data collection tool was pre-tested on 5% of similar study subjects and setting prior to the commencement of the actual data collection period. As a result, necessary modifications were done on the questionnaire. Caution was taken while selecting data collectors and supervisors, those who had previous data collection experience were selected. Four diploma and two-degree holder nurse professionals were recruited as data collectors and supervisors, respectively. All of them have received two days training regarding the objectives of the study, interview techniques, ways of approaching the study participants and ethical issues. Furthermore, on spot site check and close supervision was done and completeness of the questionnaire was checked by principal investigator on daily basis.

Data processing and analysis

After data was coded, cleaned and checked for completeness, then it was entered into EPI data software version 3 and exported in to Stata software version 14 for further analysis. Descriptive statistics including; frequency, percentage, mean and standard deviation were used to describe variables. In addition, results were presented by using tables, figures, and texts. Both bivariate and multivariate analysis were computed to identify variables associated with zinc supplementation adherence. Independent variables with a p-value of 0.2 and less during the bivariate analysis were fitted in to the multivariable logistic regression analysis to control the effects of confounders. Statistically significant association between independent variables and adherence was declared with a p-value of less than 0.05 at 95% CI in the multivariate analysis. Furthermore, model fitness was checked by Hosmer and Lemeshow goodness of fit-test (p-value=0.21).

Ethical consideration

Ethical approval has been provided by the Institutional Review Board of the University of Gondar (Ref. No: IPH/115/2012). Permission letter to proceed was also obtained from Gondar City administration health office. After providing comprehensive information and explanation about the purpose of the study, written informed consent to participate was obtained from all of the study participants and thumbprint for those who cannot read and write. They were also informed they have the right to withdraw at any time and/or to refrain from responding to any questions. Confidentiality of their response were kept using codes instead of any personal identifiers and by keeping their responses locked.

Results

Socio-demographic characteristics of participants

This study included a total of 405 participants. The mean age (\pm SD) of the respondents was 30.43 (\pm 6.45) years. Among the total study participants, about 88.4% were females of whom 84% were biological mothers of children. About 42% of the caregivers were illiterate and 89% were Orthodox Christian in religion. More than three-quarters (87%) of the respondents were married and 57.7% were housewives. Among the children studied, 51% were females and 46% of children were in the age group of 7–23 months (Table 1).

Health care provider information and reasons for non-adherence to zinc supplementation

When participants were asked whether they had follow up after receiving zinc supplementation, over half (52%) of caregivers said yes. They also indicated that pharmacy and outpatient departments were their main sources of information. One third (32.8%) of the participants

Table 1 Socio-demographic characteristics of the study participants attending health centers in Gondar City, northwest Ethiopia, 2019

Variables	Frequency	Percent (%)
Age of the caregiver (years)		
18–24	68	16.79
25–39	118	29.14
30–34	134	33.09
35+	85	20.99
Sex of the caregiver		
Female	358	88.40
Male	47	11.60
Caregivers' relationship with the child		
Mother	338	84.08
Father	37	9.20
Sister /brother/G. mother	27	6.72
Maternal education		
Unable to read and write	171	42.22
Primary school	137	33.83
Secondary and above	97	23.95
Maternal occupation		
Employed	146	36.14
Daily laborer	25	6.19
Housewife	233	57.67
Marital status		
Single	53	13.09
Married	352	86.91
Paternal education		
Unable to read and write	64	15.80
Primary school	107	26.42
Secondary and above	234	57.78
Paternal occupation		
Employed	123	30.37
Daily laborer	81	20.00
Business	201	49.63
Religion		
Orthodox	361	89.14
Muslim	36	8.90
Others*	8	1.98
Number of under five children		
<5	279	68.89
>=5	126	31.11
Sex of the child		
Female	207	51.11
Male	198	48.89
Child birth order		
1st	177	43.70
2nd and above	228	56.30
Age of the child (months)		
1–6	57	14.07
7–23	187	46.17
24–59	161	39.75
Wealth index		
Poor	134	33.25

Table 1 (continued)

Variables	Frequency	Percent (%)
Medium	135	33.50
Rich	134	33.25

*Protestant and Catholic

reported that their child had side effects following zinc tablet supplementation (Table 2).

Early relief of childhood diarrhea symptoms (54%), side effects of the supplement such as vomiting (23%) and unpleasant test (14%) were reasons mentioned by caregivers to discontinued zinc supplementation. Perceived busy schedule and perceived ineffectiveness of zinc supplementation were also reported by 4% and 5% of the caregivers for the non-adherence of the supplement, respectively.

Diarrhoea characteristics and caregiver related factors

Among the total children participated, 93.6% of them had acute diarrhea among which 88.12% was watery diarrhea. Majority (82.34%) of the caregivers reported that diarrheal episodes among children subsided within three days following administration of zinc supplementation. Most of them believed that zinc supplementation is the first treatment choice for diarrhea management and about 62.1% recommended zinc for watery diarrhea treatment. This study illustrated that 55% of caregivers were knowledgeable about zinc supplementation. Regarding feeding practices during diarrheal illness, about 51% and 49% of them offered less fluid and food, respectively than usual to their children (Additional file 1).

Adherence to zinc supplementation

Adherence to zinc supplementation was found to be 34.45% (95% CI=29.91, 39.21) among children.

Factors associated with zinc supplementation adherence

The result of multivariate logistic regression analysis revealed that maternal education, follow up visit, knowledge of caregivers, source of information and presence of side effects were significantly associated with zinc supplementation adherence after holding the other variables constant.

The odds of zinc supplementation adherence were lower among caregivers of children who did not have any formal education. They were 66% less likely to provide Zinc supplementation for their children throughout the entire prescribed period compared to those who had completed secondary and above level of education (AOR=0.34 95% CI=0.16, 0.74). Likewise, lesser odds of zinc supplementation adherence were observed among caregivers who had no follow up appointment compared to those who had follow up appointment (AOR 0.40 95% CI=0.23, 0.70).

Table 2 Health care provider information and treatment related characteristics of caregivers attending health centre in Gondar City, northwest Ethiopia, 2019

Variables	Frequency	Per-cent (%)
Follow up appointment		
Yes	210	51.98
No	195	48.02
Information /counseling		
Health provider at pharmacy	201	49.63
Health provider at pharmacy and outpa-tient department	204	50.37
Presence of side effect		
Yes	135	32.84
No	270	67.16

This study showed that children who experienced side effects of the supplement had lower Zinc supplementation adherence (AOR=0.35 95% CI=0.20, 0.65). Caregivers of children who had good knowledge on Zinc supplementation were 3 times more likely to be adhered with Zinc supplementation compared to those who had poor knowledge (AOR=3.01 95% CI=1.73, 5.24). Zinc supplementation adherence were 8 times higher among caregivers who obtained information from both pharmacy dispensers and health care providers in the clinic than those who obtained information from pharmacy dispensers alone (AOR=8.4 95%CI=4.66,15.13) (Table 3).

Discussion

The aim of this study was to assess Zinc supplementation adherence and associated factors among caregivers of under five children with diarrhea in Gondar City health centers. The study showed that 34.45% (95% CI=29.91, 39.21) of caregivers had provided the full course of Zinc supplementation for their children. Maternal education, follow up visit, knowledge of caregivers, presence of side effects and source of information were significantly associated with Zinc supplementation adherence.

This study uncovered that only one third (34.45%) of caregivers provided Zinc for their children for 10 to 14 days. Studies conducted to assess Zinc supplementation adherence among children with diarrhea in Addis Ababa, Ethiopia and India indicated that 19.1% and 16% [13], of the caregivers appropriately provided the supplement to their children, respectively. Compared to these study reports, the result of this work was higher. This variation could be due to the difference in source of information, unavailability of Zinc tablet at public health facilities and the study period. In this current study, free zinc tablets were given to caregivers at health facilities to be administered to children with diarrheal disease thereby, caregivers of children have received counseling about

Table 3 Multivariate logistic regression analysis of factors associated with adherence to zinc supplementation among caregivers attending health centers in Gondar City, northwest Ethiopia, 2019

Variables	Adherence		COR (95%CI)	AOR (95%CI)
	Yes	No		
Maternal Education				
unable to read and write	48	123	0.47(0.28,0.79)	0.34 (0.16, 0.74) **
Primary school	48	89	0.65 (0.38,1.10)	0.49 (0.24, 1.00)
Secondary and above	44	53	1	1
Paternal education				
unable to read and write	27	37	1.74(0.99, 3.08)	1.19 (0.53, 2.68)
Primary school	44	63	1.67(1.03, 2.69)	0.90 (0.47,1.72)
Secondary and above	69	165	1	1
Maternal occupation				
Employer	39	107	0.52(0.34,0.83)	0.71 (0.38, 1.32)
Daily laborer	5	20	0.36(0.13, 1.00)	0.48 (0.13,1.80)
Housewife	95	135	1	1
Marital status				
Single	14	39	0.64(0.33, 1.23)	0.73 (0.30, 1.76)
Married	126	226	1	1
No of under 5 children				
<5	107	33	1.75(1.10, 2.79)	1.45 (0.78, 2.69)
5 and above	172	93	1	1
Birth order				
1st	73	104	1.68(1.12, 2.55)	1.44 (0.83, 2.52)
2nd and above	67	161	1	1
Follow up visit				
No	61	149	0.60(0.39, 0.90)	0.40 (0.23, 0.70) *
Yes	79	115	1	1
Level of knowledge				
Good knowledge	104	114	3.83 (2.43,6.03)	3.01(1.73, 5.24) *
Poor knowledge	35	147	1	1
Presence of side effect				
Yes	25	107	0.31 (0.19, 0.52)	0.35 (0.20, 0.65) *
No	115	155	1	1
Source of Information				
PHA and OPD**	115	89	9.09(5.51, 15.02)	8.40 (4.66, 15.13) *
PHA professionals	25	176	1	1

*Statistically significant at p-value of <0.05

**Pharmacy and Outpatient Department

the supplement from health care providers. Whereas, only one third of participants in the former studies had received counseling and bought Zinc tablets from private dispensers.

However, this study reported lower zinc supplementation adherence rate compared to study findings reported from Rural Bangladesh (62%) and Nigeria (75.5%) [15, 16]. This might be related to providing counseling, presences of follow up and level of knowledge of caregivers about zinc supplementation were lower in this study compared to studies conducted in Bangladesh and Nigeria. In Bangladesh, all mothers or caregivers has got counseling on how to provide zinc tablets and follow-up visit was provided. In Nepal National scale up zinc promotion through different mass media was done and training was given for health care providers about zinc supplementation before the survey. In Bangladesh there was a strong relationship between government health service providers and local non-governmental organizations to encourage zinc supplementation for under-five diarrhea disease treatment.

This study showed a significant association between zinc supplementation adherence and caregiver's literacy. The odds of adherence of zinc supplementation were higher among caregivers with more than secondary education. This could probably be related to being literate helps to understand and put into practice the health messages provided by health care providers. This study finding implies that education has an importance to adhere with the recommended zinc supplement dosage and duration. Studies conducted in India and Nepal reported similar findings [18, 19].

The current study also showed that caregivers who had good knowledge on zinc supplementation were more likely to be adherent. This could probably be because having appropriate knowledge about the benefits, side effects, dosage, frequency and duration of zinc supplement might foster them to provide it as per prescription for their children. In addition, having good knowledge avoids misunderstanding, misperception and misinterpretation of the health messages delivered by health professionals which can be a cause for non-adherence. It also helps them to have an accurate decision and appropriate administration on the supplement. Therefore, awareness creation for caregivers is one of the major enhancing factors for zinc supplementation adherence for their children. This finding is consistent with those of other studies done in Kenya and Nepal [19–21].

Receiving adequate and appropriate information or instruction from health care providers and pharmacy dispensers was significantly associated with zinc supplementation. This could be explained by receiving counseling about the supplement from health care providers at the clinic and pharmacy dispensers may induce favorable

attitude towards the supplement. Furthermore, caregivers' belief on the efficacy of zinc treated in the treatment of diarrhea will be high. Which in turn, encouraged them to keep providing the supplement with its right dosage, duration and frequency. As indicated by this study finding, providing appropriate information and instruction regarding administration of zinc supplementation has a paramount contribution for adherence. This evidence is supported by studies done in Mali and India [22, 23] which reported that sufficient explanation by health workers on the quantity of zinc needed, duration of treatment, and alternatives for administering the tablets for more than 90% of the caretakers contributed for zinc compliance.

Low adherence rate was observed among caregivers whose children had experienced side effects of zinc supplementation. Related to this fact, caregivers may be frustrated and believed that the supplement is harmful and it might worsen the disease condition of the child. Consequently, caregivers of children discontinued providing the supplement for their children. Parallel to this evidence, study conducted on promoting medication adherence in children showed that fear of side effects is associated with poor medication adherence [24]. Similar result was also reported from Addis Ababa Ethiopia [13] which revealed that side effects related to zinc supplementation affect zinc adherence in children.

Zinc supplementation adherence was found to be higher among caregivers who had follow up appointment than who did not have. This could be partially explained by; follow up appointment enables both the caregiver and the child to see the health care provider for the second time. Accordingly, the progress, adverse outcomes and the adherence status can be evaluated. This in turn, invites the health care provider to take appropriate correction measures to complete the full dose of zinc supplementation. This is in agreement with the study done in Mali [22] that indicated follow up could also have increased the level of compliance specially if families were expecting a visit on the 14th day and suspected the interviewer would examine the blister package.

Limitations of the study

One of the limitations of this study could be due to the cross-sectional nature of the study design used, it is impossible to show the causal relationship between the independent variables and zinc supplementation adherence. In addition, this study was done based on data collected from participants who come to the health facilities and thus, it may not represent for those who did not come to the health facility. Furthermore, the findings may be affected by a recall bias since respondents depended on their memory to recall the administration of zinc supplement to their children.

Conclusion

The finding of the current study showed that only one third of children with diarrhea were adherent to zinc supplementation in Gondar City. Maternal education, presence of follow up, caregivers' knowledge, presence of side effect and receiving counseling about zinc supplementation were significantly associated with adherence. Therefore, enhancing the knowledge of caregivers, strengthening and promoting provision of counseling related to the importance and side effects of the supplement at out-patient department level by health care providers may be essential to improve zinc supplementation adherence among children. Furthermore, arranging follow up appointments and frequent contact with health professionals may have a paramount contribution to improve adherence of supplementation among children.

Abbreviations

AOR	Adjusted Odds Ratio
CI	Confidence Interval
COR	Crude Odds Ratio
EDHS	Ethiopian Demographic and Health Survey
OPD	Outpatient Department
ORS	Oral Rehydration Salt

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s13104-024-06909-2>.

Supplementary Material 1

Acknowledgements

We would like to thank all study participants, data collectors and supervisors for their valuable time. We would also like to extend our gratitude to head of the health centers and health care providers for their unreserved support during the entire data collection period.

Author contributions

Saba Atnafu (SA), conceived the idea of the study, developed the tool, managed data collection, analyses, interpretation, and report writing. Amare Tariku, Mekonnen Sisay, developed the tool, managed data collection, analyses, interpretation, and report writing. Asmamaw Atnafu assisted with tool development, data analysis and interpretation and critically reviewed the manuscript. SA, MS conceptualized and assisted with design of the study, tool development, data interpretation and drafted the manuscript. All authors read and approved the final manuscript.

Funding

No specific funding was received.

Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

Ethical approval has been provided by the Institutional Review Board of the University of Gondar. Permission letter to proceed was also obtained from Gondar City administration health office. Additionally, head of the health centers in Gondar City has provided their support to collect data in the health centers. After providing comprehensive information and explanation about the purpose of the study, verbal informed consent to participate was obtained from all of the study participants. They were also informed they have the right to withdraw at any time and/or to refrain from responding to any questions.

Confidentiality of their response were kept using codes instead of any personal identifiers and by keeping their responses locked.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 26 February 2024 / Accepted: 21 August 2024

Published online: 09 September 2024

References

1. Division US. Oral rehydration salts and zinc: UNICEF suppliers and product range. 2016 February 2016. Report No.
2. Bhutta ZA, Das JK. Global burden of childhood diarrhea and pneumonia: what can and should be done? *Pediatrics*. 2013;131(4):634–6.
3. Walker CLF, Black RE. Zinc for the treatment of diarrhoea: effect on diarrhoea morbidity, mortality and incidence of future episodes. *Int J Epidemiol*. 2010;39(suppl1):i63–9.
4. Organization WH. fact sheet. 2017 may 2017.
5. organization wh. world health statistics. 2015:167.
6. DEFEATDD.ORG. DEFEATDD.ORG. 2018 march 2018. Report No.
7. Central Statistical Agency Addis Ababa E. ETHIOPIA demographic and Health Survey. 2016 July 13 2017. Report No.
8. Aitken I, Jon Rohde, Joan Schubert, Jude Nwokike, Camille Saade, and Yati Soenarto. Assessment for the introduction of Zinc in improved management of Diarrhea in Indonesia. Arlington, Virginia, USA: Basic support for institutionalizing child survival (BASICS) for the united states Agency for international Development (USAID). 2017 2007. Report No.
9. Lazzarini M, Ronfani L. Oral zinc for treating diarrhoea in children. *Cochrane Database Syst Reviews*. 2013(1).
10. Alam K, Poudel A, Palaian S, Koirala B, Shankar PR. Role of zinc in childhood diarrhea management: a case of Nepal. *J Pharm Pract Community Med*. 2017;3(1).
11. Therapeutic effects of oral. Zinc in acute and persistent diarrhea in children in developing countries: pooled analysis of randomized controlled trials-. *Am J Clin Nutr*. 2000;72(6):1516–22.
12. Organization WH. Pocket book of hospital care for children. Printed in China, Hong Kong Special Administrative Region: World Health Organization; 2005 2005.
13. Hassen S, Haidar J, Bogale AL. Occurrence of diarrhea and utilization of zinc bundled with ORS among caregivers of children less than five-years in Addis Ababa, Ethiopia. *J Public Health Epidemiol*. 2018;10(9):348–55.
14. Ethiopia, FDRo. Health Mo. Integrated Management of Newborn and Childhood Illness, Part 1 Blended Learning Module for the Health Extension Programme. 2011. p. 126.
15. Ahmed S, Nasrin D, Ferdous F, Farzana FD, Kaur G, Chisti MJ, et al. Acceptability and compliance to a 10-Day regimen of zinc treatment in diarrhea in rural Bangladesh. *Food Nutr Sci*. 2013;4(04):357.
16. Nasrin D, Larson CP, Sultana S, Khan TU. Acceptability of and adherence to dispersible zinc tablet in the treatment of acute childhood diarrhoea. *J Health Popul Nutr*. 2005;215–21.
17. Lam WY, Fresco P. Medication adherence measures: an overview. *BioMed research international*. 2015;2015.
18. Valekar SS, Fernandez K, Chawla P, Pandve H. Compliance of zinc supplementation by care givers of children suffering from diarrhea. *Indian J Community Health*. 2014;26(Suppl 2):137–41.
19. Wang W, MacDonald VM, Paudel M, Banke KK. National scale-up of zinc promotion in Nepal: results from a post-project population-based survey. *J Health Popul Nutr*. 2011;29(3):207.
20. Simpson E, Zwisler G, Moodley M. Survey of caregivers in Kenya to assess perceptions of Zinc as a treatment for diarrhea in young children and adherence to recommended treatment behaviors. *J Global Health*. 2013;3(1).
21. Otieno GA, Bigogo GM, Nyawanda BO, Aboud F, Breiman RF, Larson CP, et al. Caretakers' perception towards using zinc to treat childhood diarrhoea in rural Western Kenya. *J Health Popul Nutr*. 2013;31(3):321.
22. Winch PJ, Gilroy KE, Doumbia S, Patterson AE, Daou Z, Coulibaly S, et al. Prescription and administration of a 14-day regimen of zinc treatment for childhood diarrhea in Mali. *Am J Trop Med Hyg*. 2006;74(5):880–3.

23. Walker CLF, Taneja S, Lamberti LM, Black RE, Mazumder S. Public sector scale-up of zinc and ORS improves coverage in selected districts in Bihar, India. *J Global Health*. 2015;5(2).
24. Gardiner P, Dvorkin L. Promoting medication adherence in children. *Am Family Phys*. 2006;74(5).

Publisher's note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.