

Original Research Article

Evaluation of the determinants of uptake of oral rehydration salts with zinc in the management of childhood diarrhea in Kakamega County

Irene K. Muhande^{1*}, Job Mapesa¹, Benard Ouna²

¹Department of Public Health, Human Nutrition and Dietetics, Kenya Methodist University, Nairobi, Kenya

²Department of Chemistry and Biochemistry, Laikipia University, Nyahururu, Kenya

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*Correspondence:

Dr. Irene K. Muhande,

E-mail: imuhande@gmail.com

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ABSTRACT

Background: Diarrhea remains a significant public health concern, contributing to high child mortality, particularly in Sub-Saharan Africa and South Asia. Approximately 1.5 million cases of childhood diarrhea are reported annually in Kenya, with a prevalence of 16%. Despite the availability of affordable interventions like oral rehydration salts (ORS) and zinc supplementation, their utilization remains suboptimal in Kakamega County, where child mortality is 45 per 1,000. The combined impact of ORS and zinc in reducing childhood diarrhea and its consequences has not been adequately studied in Kakamega County. This study aims to assess the utilization of ORS and zinc in diarrhea management in Kakamega County.

Methods: We utilized a cross-sectional design to evaluate current practices and outcomes in managing diarrhea among children under five years old. A random sampling approach was applied to ensure a representative sample. Key variables assessed included the frequency of diarrhea episodes, the use of ORS and zinc, and nutritional status. Statistical analyses, including Chi-square tests and descriptive methods, were used to examine the relationships between the variables in SPSS version 26.

Results: Of the 246 children surveyed, 47.4% were under 10 months old. The study found that 26.8% of children had not received rotavirus vaccinations, and diarrhea was significantly ($p < 0.05$) associated with poor nutritional outcomes. ORS had strong support (69.4%), but zinc supplementation showed moderate support (54.3%).

Conclusions: The study highlights the need for increased uptake of ORS and zinc supplementation, as well as enhanced vaccination coverage to prevent diarrhea-related deaths and malnutrition in Kakamega County.

Keywords: Child mortality, Diarrheal diseases, Oral rehydration salts, Rotavirus vaccine, Zinc supplementation

INTRODUCTION

Diarrhea continues to be a major public health issue, contributing to the deaths of one in every five children under five years of age.^{1,2} Sub-Saharan Africa and South Asia bear the highest burden, with nearly half a million diarrheal deaths reported annually.^{3,4} In Africa, the prevalence of childhood diarrhea remains consistently high at 49%, even among communities using oral rehydration salts (ORS) with zinc supplementation.⁵⁻⁸

Repeated diarrheal infections can result in malnutrition, reduced cognitive function, and long-term negative health outcomes.⁹⁻¹¹

Studies estimate that there are approximately 1.5 million cases of childhood diarrhea in Kenya each year, with about a 16% prevalence rate.¹²⁻¹⁴ Although a highly effective and affordable intervention for diarrhea management is available, its utilization remains inadequate.¹⁵⁻¹⁷ Research has shown that zinc supplementation in children with acute or persistent

diarrhea significantly reduces the severity and duration of episodes, and ORS has been shown to reduce mortality rates.^{18–20} However, the combined effect of ORS and zinc has not been extensively studied in Kakamega County. In 2004, the World Health Organization (WHO) recommended zinc supplementation as an additional therapy to enhance diarrhea treatment.^{21,22}

ORS and zinc supplementations are key, cost-effective interventions with the potential to reduce diarrhea-related mortality in young children significantly.^{23,24} However, their utilization remains low.²⁵ In Kakamega County, where child mortality is high at 45 per 1,000, the adoption of these interventions in diarrhea management is still suboptimal.^{26,27} Identifying the factors that influence the use of ORS and zinc could help improve uptake and contribute to achieving Sustainable Development Goal 3, specifically target 3.1, which aims to end preventable deaths in children under five. This study seeks to enhance understanding of effective diarrhea management practices and address barriers to ORS and zinc use.

METHODS

The study was conducted in Kakamega County at coordinates 0. 2827° N, 34. 7519° E between the period of July 2023 to September 2023. A cross-sectional study design was employed to assess the current practices related to diarrheal management for children under 5 years in Kakamega County. The target population was children under 5 years who were randomly sampled to obtain a sample representation. An eligible participant had to be a primary caregiver of a child under the age of 5 years living in the household and voluntarily consented to be interviewed.

The exclusion criteria were children aged 5 years and above, non-residents of Kakamega County, children with severe chronic illnesses or disabilities that might impair diarrhea management or nutritional status, and caregivers who declined informed consent or were unwilling or unable to comprehend the aim and procedures of the study. The research tool instrument used was a questionnaire comprising different parts and variables including, diarrheal incidences, ORS and zinc uptake. The questionnaire collected demographic information on the number of people in the household, if there were any children below five years of age, and their socio-economic status. It also assessed the number of diarrhea episodes, the average duration of the episode as well as the severity of the diarrhea episode with other accompanying signs and care-seeking behavior. Concerning the assessment of the nutritional status of the children, adequate methods, tools, and instruments such as a stadiometer, height board, weighing scale, and MUAC tape were used in defining and measuring nutritional status. Cross-tabulation, descriptive analysis procedures, and chi-square tests were used in establishing the inter-variable correlations. The ethical issues related to the study were handled properly concerning the Do No

Harm, Informed Consent, Confidentiality, Risks and Benefits of participants and the approval from ISERC permit number KeMU/Isrec/HND/04/2023, NACOSTI (NACOSTI/P/24/33255) and Kakamega County.

RESULTS

A total of 246 children participated in the study, which collected a variety of socioeconomic and demographic data (Table 1). 47.4% of the children were under 10 months old, 27.9% were between 11 and 20 months old, and 24.7% were older than 20 months. 12.1% of caregivers had no formal education, 33.6% had completed primary school, 28.7% had completed secondary school, and 25.1% had completed postsecondary education. In terms of monthly earnings, 21.1% of households made more than 10,000 KES, while 78.9% of households made less than 10,000 KES. Caregivers worked in the following occupations: business (19.0%), farming (18.6%), informal labor (18.6%), schooling (6.5%), formal employment (14.2%), and unemployment (23.1%). 93.1% of respondents said they were Christians, 6.5% said they were Muslims, and 0.4% said they practiced other faiths. The data shows that nearly half of the children are under 10 months old, with the remaining children distributed fairly evenly across the 11–20 months and 21–59 months' age groups. Most caregivers have some level of education, with primary and secondary education being the most common. A significant majority of households have a monthly income of ≤10,000 KES, indicating a low-income population. The occupations of caregivers are diverse, with a notable proportion being unemployed or engaged in casual labor. Christianity is the predominant religion among the participants.

To determine the rotavirus vaccination status, children are categorized by age and the number of doses received (Table 2). For children under 10 months old, 13.4% received no doses, 5.3% received one dose, 18.3% received two doses, and 10.6% received three doses. Among children aged 11–20 months, 6.9% received no doses, 0.8% received one dose, 11.0% received two doses, and 9.3% received three doses. For those aged above 20 months, 6.5% received no doses, none received one dose, 6.5% received two doses, and 11.4% received three doses. Overall, 26.8% of the children received no doses, 6.1% received one dose, 35.8% received two doses, and 31.3% received three doses. The age distribution of the children shows that 47.6% were under 10 months old, 28.0% were aged 11–20 months, and 24.4% were aged 21–59 months. There is a statistically significant association [Chi-square value (X) is 19.4 with a (p=0.004)] between age and the number of rotavirus vaccine doses received. The data reveals a significant association between the age of the children and the number of rotavirus vaccine doses received. The highest percentage of children receiving all three recommended doses (33.8%) is among those under 10 months old. As the age increases, the percentage of children who received

three doses decreases but remains notable in the 21-59 months age group (36.4%).

Table 1: Demographic and socioeconomic characteristics of participants.

Characteristic (n=246)	% (N)
Age of child (months)	
≤10	47.4 (117)
11-20	27.9 (69)
21-59	24.7 (61)
Education level (caregiver)	
No formal education	12.1 (30)
Primary	33.6 (83)
Secondary	28.7 (71)
Tertiary	25.1 (62)
Monthly income (KES)	
≤10,000	78.9 (195)
>10,000	21.1 (52)
Occupation	
Schooling	6.5 (16)
Formal employment	14.2 (35)
Business	19.0 (47)
Farming	18.6 (46)
Casual labourer	18.6 (46)
Unemployed	23.1 (57)
Religion	
Christianity	93.1 (230)
Muslim	6.5 (16)
Others	0.4 (1)

We examined the demographic traits and also the impact of diarrheal illnesses on children's nutritional condition (Table 3). 47.4% of the sample consisted of children under 10 months old, of whom 14.2% had severe acute malnutrition (SAM), 2.8% had moderate acute malnutrition (MAM), and 30.4% had normal nutritional status. Age and nutritional status were found to be

significantly correlated by the Chi-square test ($X=36.79$, $p=0.001$). In households earning less than 10,000 KES, 13.0% of children had SAM, 4.0% had MAM, and 61.9% were normal, accounting for 78.9% of the sample. Among households with an income above 10,000 KES, 2.4% of children had SAM, 2.0% had MAM, and 16.6% were normal, making up 21.1% of the sample. No significant ($X=1.99$, $p=0.369$) association was found between income and nutritional status. Among caregivers with primary education, 6.1% of children had SAM, 2.4% had MAM, and 25.2% were normal, making up 33.7% of the sample. No significant ($X=5.15$, $p=0.525$) association was found between education level and nutritional status. Among children who had suffered diarrhea before, 9.7% had SAM, 6.1% had MAM, and 66.4% were normal, accounting for 82.2% of the sample. Children who had not suffered diarrhea before had 5.7% with SAM, none with MAM, and 12.1% were normal, comprising 17.8% of the sample. A significant ($X=13.38$, $p=0.001$) association was found between having suffered diarrhea before and nutritional status. Among children with no episodes of diarrhea, 6.9% had SAM, 2.0% had MAM, and 33.7% were normal, making up 42.7% of the sample. A significant association was found between the number of diarrhea episodes in the last three months and nutritional status ($X=19.76$, $p=0.003$). The study shows significant associations between the age of children, their history of diarrhea, and the number of recent diarrhea episodes with their nutritional status. However, the monthly income and education level of caregivers did not show a significant association with nutritional status. Younger children and those with more frequent diarrhea episodes are at higher risk of malnutrition. These findings suggest the need for targeted interventions focusing on younger children and effective diarrhea management to improve nutritional outcomes. Ensuring access to nutritional support and diarrhea treatment, such as ORS and zinc, is crucial for these vulnerable groups.

Table 2: Rotavirus vaccination status by age group among children.

Vaccine (doses)	Age (months)			% (N)	X (p value)
	<10	11-20	>20		
0	13.4 (33)	6.9 (17)	6.5 (16)	26.8 (66)	19.4 (0.004)
1	5.3 (13)	0.8 (2)	0 (0)	6.1 (15)	
2	18.3 (45)	11.0 (27)	6.5 (16)	35.8 (88)	
3	10.6 (26)	9.3 (23)	11.4 (28)	31.3 (77)	
Age total	47.6 (117)	28.0 (69)	24.4 (60)	100 (246)	

Table 4 presents the findings of a comprehensive consensus survey among participants on the efficacy of Oral Rehydration Salts (ORS) in the community for treating diarrhea in children. A majority, 69.4%, agreed on its effectiveness, and 68.6% believed it should be administered to every child with diarrhea. Additionally, 68.2% found ORS beneficial for treating diarrhea, 66.9% supported its use in management and treatment, and 63.3% considered it sufficient for treatment. Similarly,

69.4% of respondents would recommend ORS for diarrhea management. In comparison, the support for Zinc was moderate. About 54.3% agreed on its effectiveness in managing childhood diarrhea, and 55.9% believed it should be given to every child with diarrhea. Furthermore, 54.3% found Zinc beneficial for treating diarrhea, 55.8% supported its use in management and treatment, and 53.3% considered it sufficient for treatment. Lastly, 55.8% of the respondents would

recommend Zinc for diarrhea management. The results indicate a strong overall support for the use of ORS in the management of community diarrhea. A majority of participants agree on the effectiveness, necessity, and

sufficiency of ORS in treating diarrhea. There is slightly less consensus regarding Zinc, with a moderate majority supporting its use but with a higher percentage of disagreement compared to ORS.

Table 3: Demographic characteristics and the influence of diarrhea infections on nutritional status of children.

Characteristic/ nutritional status	Severe acute malnutrition (SAM)	Moderate acute malnutrition (MAM)	Normal	Characteristic (Sum)	X (p value)
	% (N)	% (N)	% (N)	% (N)	
Age (months)					
<10	14.2 (35)	2.8 (7)	30.4 (75)	47.4 (117)	36.79 (0.001)
11-20	0.8 (2)	2.0 (5)	25.1 (62)	27.9 (69)	
>20	0.4 (1)	1.2 (3)	23.1 (57)	24.7 (61)	
Monthly income (KES)					
<10,000	13.0 (32)	4.0 (10)	61.9 (153)	78.9 (195)	1.99 (0.369)
>10,000	2.4 (6)	2.0 (5)	16.6 (41)	21.1 (52)	
Education level					
No formal education	2.8 (7)	0.8 (2)	8.5 (21)	12.2 (30)	5.15 (0.525)
Primary	6.1 (15)	2.4 (6)	25.2 (62)	33.7 (83)	
Secondary	4.1 (10)	2.0 (5)	22.8 (56)	28.9 (71)	
Tertiary	2.4 (6)	0.8 (2)	22.0 (54)	25.2 (62)	
Suffered diarrhea before					
Yes	9.7 (24)	6.1 (15)	66.4 (164)	82.2 (203)	13.38 (0.001)
No	5.7 (14)	0.0 (0)	12.1 (30)	17.8 (44)	
Suffered diarrhea in the last 2 weeks					
Yes	6.1 (15)	2.4 (6)	19.3 (48)	27.9 (69)	4.58 (0.101)
No	9.3 (23)	3.6 (9)	59.1 (146)	72.1 (178)	
Diarrhea episodes in the last 3 months					
None	6.9 (17)	2.0 (5)	33.7 (83)	42.7 (105)	19.76 (0.003)
1	3.3 (8)	0.8 (2)	17.5 (43)	21.5 (53)	
2	0.8 (2)	0.0 (0)	15.9 (39)	16.7 (41)	
3 and above	4.1 (10)	3.3 (8)	11.8 (29)	19.1 (47)	
Nutritional status (Su	15.4 (38)	6.1 (15)	78.5 (194)	100 (247)	

Table 4: Study participants' opinions on the use of ORS and zinc in childhood diarrhea management.

Characteristic (n=245)	Agree (%)	Disagree (%)
ORS is effective in managing childhood diarrhea	69.4	30.6
ORS should be given to every child with diarrhea	68.6	31.4
ORS is beneficial for treating diarrhea	68.2	31.8
ORS should be used in diarrhea management and treatment	66.9	33.1
ORS is sufficient for treating diarrhea	63.3	36.7
Would you recommend the use of ORS for diarrhea management	69.4	30.6
Zinc is effective in managing childhood diarrhea	54.3	45.7
Zinc should be given to every child with diarrhea	55.9	44.1
Zinc is beneficial for treating diarrhea.	54.3	45.7
Zinc should be used in diarrhea management and treatment	55.8	44.2
Zinc is sufficient for treating diarrhea.	53.3	46.7
Would you recommend the use of zinc for diarrhea management	55.8	44.2

DISCUSSION

Health interventions and messaging

With nearly half of the children being below 10 months old, health interventions, including vaccination programs,

should prioritize this age group to address their vulnerability to diarrhea and its complications. Tailored health education and awareness programs are essential, as a significant portion of caregivers have primary or secondary education levels.^{28,7,29} The low-income status of most households necessitates economic support and subsidies for healthcare services, including rotavirus

vaccinations, to ensure affordability and accessibility, aligning with findings from low-income settings.³⁰ Additionally, the varied occupations of caregivers highlight the need for flexible healthcare delivery strategies, such as mobile clinics or extended clinic hours, to accommodate different schedules, especially for those in casual labor and farming. Given that the majority of the population is Christian, health messages and interventions should align with Christian values, engaging community leaders to support healthcare initiatives. The presence of a Muslim minority requires culturally sensitive approaches to ensure inclusivity and effectiveness in health interventions.³¹ By addressing the socioeconomic, educational, and cultural factors influencing diarrhea management, we can significantly improve health outcomes in Kakamega County.

Enhancing vaccination coverage

Despite good vaccine uptake among younger children, 26.8% of children have not received any doses of the rotavirus vaccine. Efforts should focus on increasing initial vaccination coverage, particularly targeting children under 10 months to ensure they receive all three doses by the recommended age. Educational efforts must be intensified to raise awareness about the importance of completing the rotavirus vaccination schedule.³² Continuous monitoring and follow-up with parents and caregivers are essential and could be facilitated by community health promoters (CHP) as well as regular health check-ups as per the Ministry of Health guidelines.³³

Integrating ORS and zinc in diarrhea management

Data shows strong support for ORS in managing diarrhea, while support for Zinc is moderate. Integrating messages about the importance of the rotavirus vaccine with the benefits of ORS and Zinc could reinforce overall diarrhea management strategies. In Sub-Saharan Africa, the prevalence of childhood diarrhea has remained stable among ORS and Zinc users.⁵ Efforts should be made to further promote the use of ORS and provide additional training to address any remaining doubts or misconceptions in the community. Educational campaigns are needed to increase awareness of Zinc benefits and appropriate usage. Targeted interventions should focus on younger children, particularly those under 10 months, who are more vulnerable to malnutrition. It has been shown that effective strategies to prevent and manage diarrhea, including access to ORS and Zinc supplements, can significantly improve children's nutritional status.²⁶ Combining nutritional support with diarrhea prevention and treatment can yield better health outcomes.^{34,35} While caregiver education level did not show a significant impact, targeted health education remains crucial. Allocating resources to communities with higher incidences of diarrhea can help mitigate its impact on the children's nutritional status.³⁶ Our findings are in agreement with³⁷ which highlights the

need for research to understand the barriers to Zinc usage and adoption alongside ORS, essential in informing the public health strategies to reduce childhood diarrhea mortality and morbidity.³⁸

This study has few limitations. Our reliance on self-reported data from caregivers may have introduced recall bias affecting the accuracy of reported diarrhea episodes and treatment. The sample size, while adequate for this study, may not be representative of the entire population of Kakamega County, limiting the generalizability of the findings. The study does not account for variations in caregivers' awareness and understanding of ORS and zinc supplementation, which could influence their usage and effectiveness.

CONCLUSION

We conclude that, while there is good uptake of the rotavirus vaccine among young children, targeted interventions are necessary to ensure all children complete the vaccination schedule, thus reducing the incidence of rotavirus-related diarrhea in the community. Effective management of diarrhea through the use of ORS and Zinc, coupled with continuous education and support, can significantly improve the nutritional status and overall health of children in Kakamega County.

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REFERENCES

1. Manetu WM, M'masi S, Recha CW. Diarrhea disease among children under 5 years of age: a global systematic review. *Open J Epidemiol*. 2021;11(03).
2. Zhou Y, Zhu X, Hou H, Lu Y, Yu J, Mao L, et al. Characteristics of diarrheagenic *Escherichia coli* among children under 5 years of age with acute diarrhea: A hospital-based study. *BMC Infect Dis*. 2018;15(1).
3. Troeger CE, Khalil IA, Blacker BF, Biehl MH, Albertson SB, Zimsen SR, et al. Quantifying risks and interventions that have affected the burden of diarrhea among children younger than 5 years: an analysis of the Global Burden of Disease Study 2017. *Lancet Infect Dis*. 2020;20(1).
4. GBD Diarrhoeal Diseases Collaborators. Estimates of global, regional, and national morbidity, mortality, and aetiologies of diarrhoeal diseases: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet Infect Dis*. 2017;17(9):897,909-48.
5. Buchwald AG, Verani JR, Keita AM, Jahangir Hossain M, Roose A, Sow SO, et al. Etiology, presentation, and risk factors for diarrheal

- syndromes in 3 sub-Saharan African countries after the introduction of rotavirus vaccines from the Vaccine Impact on Diarrhea in Africa (VIDA) study. *Clin Infect Dis*. 2023;76(Supplement_1):S12-22.
6. Barffour MA, Hinnouho GM, Wessells KR, Kounnavong S, Ratsavong K, Sithideth D, et al. Effects of therapeutic zinc supplementation for diarrhea and two preventive zinc supplementation regimens on the incidence and duration of diarrhea and acute respiratory tract infections in rural Laotian children: A randomized controlled trial. *J Glob Health*. 2020;10(1).
7. Kukeba MW, Lukman S, Darcha R, Doat AR. Caregivers' knowledge, attitude and practice regarding diarrhea in children under five years old in Sub-Saharan Africa: An integrative narrative review. *J Family Med Prim Care*. 2021;4(2):1-7.
8. Khalil I, Colombara DV, Forouzanfar MH, Troeger C, Daoud F, Moradi-Lakeh M, et al. Burden of diarrhea in the eastern mediterranean region, 1990–2013: findings from the global burden of disease study 2013. *Ame J Trop Medi Hyg*. 2016;95(6):1319.
9. Reiner RC, Wiens KE, Deshpande A, Baumann MM, Lindstedt PA, Blacker BF, et al. Department of Error: Mapping geographical inequalities in childhood diarrhoeal morbidity and mortality in low-income and middle-income countries, 2000–17: analysis for the Global Burden of Disease Study 2017 (The Lancet (2020) 395 (10239)(1779–1801),(S0140673620301148),(10.1016/S0140-6736 (20) 30114-8)). *The Lancet*. 2020 Jun 6;395(10239).
10. Wierzba TF, Muhib F. Exploring the broader consequences of diarrhoeal diseases on child health. *Lancet Glob Health*. 2018;6(3).
11. Alia RA, Sadia N, Shammy NP, Tithy FA, Shelim R, Parvin R. Diarrhoeal Disease about Childhood Malnutrition and Its Impact on Socio-economic Condition in Emerging Countries Like Bangladesh. *J Pediatr Perinatol Child Health*. 2022;06(03):370-9.
12. Guillaume DA, Justus OOS, Ephantus KW. Factors influencing diarrheal prevalence among children under five years in Mathare informal settlement, Nairobi, Kenya. *J Public Health Afr*. 2020;11(1).
13. Chesoli RN, Schuster RC, Okelo S, Omatayo MO. Strengthening Care Delivery in Primary Care Facilities: Perspectives of Facility Managers on the Immunization Program in Kenya. *Int J Health Policy Manag*. 2018;7(12):1130-7.
14. Njeru PM, Kariri JM, Murigi MW, Waweru HM, Muriithi FM. Management of diarrheal diseases among children under five years: a case study of mothers at Kakamega county, Kenya. *Int J Community Med Public Health*. 2017;4(8):2762.
15. Lam F, Wentworth L, Cherutich P, Migiro S, Abdala K, Musyoka M, et al. An evaluation of a national oral rehydration solution and zinc scale-up program in Kenya between 2011 and 2016. *J Glo Heal*. 2019;9(1).
16. Lam F, Pro G, Agrawal S, Shastri VD, Wentworth L, Stanley M, et al. Effect of enhanced detailing and mass media on community use of oral rehydration salts and zinc during a scale-up program in Gujarat and Uttar Pradesh. *J Glob Health*. 2019;9(1).
17. Lam F, Abdulwahab A, Houdek J, Adekeye O, Abubakar M, Akinjeji A, et al. Program evaluation of an ORS and zinc scale-up program in 8 Nigerian states. *J Glob Heal*. 2019;9(1).
18. Hassan A, Sada KK, Ketheeswaran S, Dubey AK, Bhat MS. Role of zinc in mucosal health and disease: a review of physiological, biochemical, and molecular processes. *Cureus*. 2020;12(5).
19. Abd El-Ghaffar YS, Shouman AE, Hakim SA, El Gendy YG, Wahdan MM. Effect of zinc supplementation in children less than 5 years on diarrhea attacks: A randomized controlled trial. *Global Pediatr Heal*. 2022;9:2333794X221099266.
20. Smeets HM, Keita FS. Decreasing child death from diarrhea requires more focus on poor hygiene. *J Glob Health*. 2020;10(2).
21. Jabeen S, Shafique T, Basharat S, Khalil AA, Ali M, Saeed M. Effect of zinc supplement on severity of acute diarrhea among children under five years of age. *Pak BioMedi J*. 2021;4(2).
22. Ugwu J, Ezeagu I, Ibegbu M. Awareness and practice of zinc therapy in diarrheal management among under-five caregivers in Enugu State, Nigeria. *Int J Med Heal Developm*. 2019;24(2).
23. Braimoh T, Danat I, Abubakar M, Ajeroh O, Stanley M, Wiwa O, et al. Private health care market shaping and changes in inequities in childhood diarrhea treatment coverage: evidence from the analysis of baseline and endline surveys of an ORS and zinc scale-up program in Nigeria. *Int J Equity Health*. 2021;20(1).
24. Mohamed SOO, Alawad MOA, Ahmed AAM, Mahmoud AAA. Access to oral rehydration solution and zinc supplementation for treatment of childhood diarrhoeal diseases in Sudan. *BMC Res Notes*. 2020;13(1).
25. Egbewale BE, Karlsson O, Sudfeld CR. Childhood diarrhea prevalence and uptake of oral rehydration solution and zinc treatment in Nigeria. *Children*. 2022;9(11).
26. Mohamed SOO, Alawad MOA, Ahmed AAM, Mahmoud AAA. Access to oral rehydration solution and zinc supplementation for treatment of childhood diarrhoeal diseases in Sudan. *BMC Res Notes*. 2020;13(1):1-4.
27. Srivastava P, Mishra C, Nath G. Everything is not on track in management of diarrhea in under-five children: Evidence from a rural area of India. *J Family Med Prim Care*. 2021;10(4):1582-6.
28. Mulatya DM, Ochieng C. Disease burden and risk factors of diarrhea in children under five years: Evidence from Kenya's demographic health survey 2014. *International Journal of Infectious Diseases*. 2020;93:359-66.

29. Ansari M, Mohamed Ibrahim MI, Shankar PR. Mothers' knowledge, attitude and practice regarding diarrhea and its management in Morang Nepal: An interventional study. *Trop J Pharm Res*. 2012;11(5):847-54.
30. Guillaume DA, Justus OOS, Ephantus KW. Factors influencing diarrheal prevalence among children under five years in Mathare informal settlement, Nairobi, Kenya. *J Public Health Afr*. 2020;11(1).
31. Okoniewski W, Sundaram M, Chaves-Gnecco D, McAnany K, Cowden JD, Ragavan M. Culturally sensitive interventions in pediatric primary care settings: a systematic review. *Pediatrics*. 2022;149(2).
32. Varghese T, Kang G, Steele AD. Understanding rotavirus vaccine efficacy and effectiveness in countries with high child mortality. *Vaccines (Basel)*. 2022;10(3):346.
33. Abtew S, Negatou M, Wondie T, Tadesse Y, Alemayehu WA, Tsegaye DA, et al. Poor adherence to the integrated community case management of newborn and child illness protocol in rural Ethiopia. *Am J Trop Med Hyg*. 2022;107(6):1337.
34. Cristina NM, Lucia D. Nutrition and healthy aging: Prevention and treatment of gastrointestinal diseases. *Nutrients*. 2021;13(12):4337.
35. Alam J, Nuzhat S, Billal SM, Ahmed T, Khan AI, Hossain MI. Nutritional profiles and zinc supplementation among children with diarrhea in Bangladesh. *Am J Trop Med Hyg*. 2023;108(4):837.
36. Hasan MZ, Mehdi GG, De Broucker G, Ahmed S, Ali MW, Del Campo JM, et al. The economic burden of diarrhea in children under 5 years in Bangladesh. *Int J Infect Dis*. 2021;107:37-46.
37. Ezezika O, Ragunathan A, El-Bakri Y, Barrett K. Barriers and facilitators to implementation of oral rehydration therapy in low-and middle-income countries: A systematic review. *PLoS One*. 2021;16(4):e0249638.
38. Imdad A, Mayo-Wilson E, Haykal MR, Regan A, Sidhu J, Smith A, et al. Vitamin A supplementation for preventing morbidity and mortality in children from six months to five years of age. *Cochrane database of systematic reviews*. 2022;(3).

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