Review Article

Role And Barriers of Using Zinc And ORS Combined in Diarrheal Diseases among Under Five Children: A Narrative Review

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Abstract :

India has the highest burden of diarrhea among under-five children globally. In 2004, UNICEF and WHO revised recommendations to include zinc in ORS as a treatment for diarrhea. This narrative review illustrates on therole and effects of Zinc with ORS in diarrheal diseases and also barriers associated with their usage among under-five children. This paper highlights both promising areas and gaps that need to be addressed through future research. Zinc supplementation along with ORS has shown a substantial decline in children experiencing recurrent diarrhea, suggesting that zinc is an important factor in preventing and controlling diarrhea.

Key words : Role, Barriers, Zinc, ORS, Diarrhea, Under 5 children

Introduction :

Diarrheal diseases remain as a most common public health problem in children throughout the world, especially in developing countries with approximately 1.5 billion diarrheal cases per year. Of these cases, 1.5–2.5 million deaths occur per year among children younger than age of five and malnutrition occurs among surviving children.[(1)]To mitigate the diarrheal diseases, the World Health Organization (WHO) has recommended oral rehydration therapy in the year 1970.[(2)]Despite the huge success rate of oral rehydration solution (ORS), diarrheal diseases still remains to be the overall burden of childhood mortality accounting for more than 2 million deaths every year.[(3)] To reduce the incidence and prevalence of diarrheal diseases, WHO and United Nations Children Fund(UNICEF)in year 2004recommended zinc (daily 20 mg zinc supplements for 10-14 days for children with acute diarrheaof age more than 6 months and 10 mg per day for infants below six months of age) with ORS in treatment and preventionof diarrheal episodes.[(4)]Though some contradictory results have been published by about the zinc supplementation for acute infectious diarrhea.[(5)] Still various studies have shown that more than three-quarters of all diarrhea deaths could be reduced with combined utilization of Oral Rehydration Salt (ORS) and adjunct zinc supplementation.[(6)]Despite of these recommendations, the most recent National Family Health Survey (NFHS 4) reported ORS coverage of 26% and zinc coverage of less than 1%.[(7)] so the present narrative review was undertaken to determine role and barriers of using zinc and ORS combined in diarrheal diseases among under 5 children.

Methodology :

Searching: We conducted aliterature search of full text articles which included observational studies and Randomized control trails which were evaluating the use of ORS and Zinc for the treatment and prevention of diarrhea in children under 5 years of age. Literature search was done on search platform like PubMed, Cochrane libraries and Google Scholar. Key words such as Role, Barriers, Zinc, ORS, Diarrhea, Under 5 children and theirMeSH term were used in combinations for searching the literature. Additional studies were identified through hand searches of key references lists and WHO Regional databases. Studies in English were included and the literature search covered studies published over ten years from 2009 to 2018. The search strategy included combinations of the terms: roles and effects, oral rehydration solution, diarrhea, community health workers, knowledge,attitudes and practices, health promotion, zinc therapeutic use.

Inclusion/exclusion criteria:We included randomized controlled trials and observational studies focused on ORS &Zinc in under 5 years of age population and barriers associated with usage. Studies which concentrated on

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knowledge, attitude and practices of caregivers and healthcare providers were also included. We limited our search to studies conducted in low- and middle-income countries, as diarrhea not a problem in developed countries. Only studies using WHO defined ORS and correct dosage of Zinc were considered eligible for this review. We excluded studies which related about cost effectiveness of the regimen.

Results:

18 full text articles were reviewed. As per the required objectives, review on two categories as Effects of zinc and ORS and barriers associated in using ORS was noted. For the first objective -seven original research articles were included as per the inclusion criteria and for the second objective eight original research articles were reviewed. The results of this review highlights the following results in Africa, Asia, India and Telangana state.

Author and Year	Title of Article	Place	Sample Characteristics	Results of Article
Greenland ,Katie et al (2016)	Theory-based formative research on oral rehydration salts and zinc use[8]	Lusaka, Zambia	Behavior change campaign for 14 caregivers on their behaviors such as ORS use, ORS preparation and zinc use.	ORS use was Limited mainly due tolack of immediate availability. ORS preparation: Only 28% prepared ORS correctly and Zinc wasnot used for treatment of Diarrhea.
Feikin et al (2014)	Village-Randomized Clinical Trial of Home Distribution of Zinc for	Rural Western Kenya	16 villages received 10-day course of zinc and ORS sachets every two months at home	Very minimal reduction in the incidence of diarrhea was found between the
	Treatment of Childhood Diarrhea[9]		and 17 villages received only ORS without zinc at home for 1year.	study(59.6%) and control group(58.8%)on usage of ORS alone. But ORS+Zinc used villages found less frequent use of antimalarial and antibiotics
Simpson Et al (2013)	Survey of caregivers to assess perceptions of zinc as a treatment for diarrhea in young children and adherence to recommended treatment behaviors[10]	Kenya	Survey questions on information related to treatment practices of diarrhea, overall satisfaction with use of zinc, comparisons with other products used and understanding of the appropriate dosing regimen.	70 respondents indicated that zinc tablets were most preferred product for treatment of diarrhea. Although 91 respondents were aware of antibiotics and only 5 indicated that antibiotics were most preferred treatment.
Charyeva et al (2015)	Reducing the burden of diarrhea among children under five years old: Lessons learned from ORS corner program implementation[11]	Northern Nigeria	21 communities are selected randomly with ORT corners. Compared the responses of ORT corner users and non users to examine the caregiver knowledge in managing diarrhea.	ORT corner user caregivers have better knowledge and practices in liquid intake, preventing malnutrition, ORS usage (double) and preparation of ORS (3times) when compared to non-ORT users.

B)Summaryof results from Asian countries

Author and Year	Title of Article	Place	Sample Characteristics	Results of Article
Yaza et al (2016)	Effects of zinc or synbiotic on the duration of diarrhea in children with acute infectious diarrhea[5]	Turkey	Randomized control trial among outpatient children (6– 120 months). All 165 children were randomly assigned to 3 interventions (synbiotic, zinc or control group)	Diarrhea was significantly reduced within (~24 hours) amongsynbiotic intake group and (~28 hours) in zinc intake group on comparison with thecontrol group. But this was not significant statistically.
Urooj et al (2009)	Comparison of the effectiveness of zinc supplementation in tablets form with that	Pakistan	Comparative study on 6-24 months children suffering from acute diarrhea.	Group A depicted improvement among 72% and group B with 43%.
	of the suspension form in the treatment of acute diarrhea[12]		-Group A received dispersible zinc tablets and group B received zinc suspension (20mg/day.)	

C)Summary of results from INDIA

Author and Year	Title of Article	Place	Sample Characteristics	Results of Article
Ayyanat (2018)	Listmodeling with monitoring data to estimate impact on child mortality of an ORS and zinc program with public sector providers[13]	Bihar	Monitoring data to estimate coverage rates and Listmodeling to estimate program impact on child mortality. 4 scenarios estimated the effects of rates of program scale-up and coverage by measuring children's lives saved.	Increasing ORS anT zinc coverage raWes Wo 19.8' F 18.3% respecWively haT saveT esWimaWeT 806–975 chilTren wiWh Tiarrhea Turing five-years of Whe projecW phase.
LamberWi eW al (2015)	The AssociaWion beWween ProviTer PracWice anT OnowleTge of ORS anT Rinc SupplemenWaWio for Whe TreaWmenW o ChilThooT MiarrheaJ A MulW-SiWe Cross SecWional SWuTy[14]	Bihar, Gujarat and Uttar Pradesh	Accredited social health activists(ASHAs) and Anganwadi workers (AWWs) were trained withformal classes on diarrhea treatment. Pharmaceutical and NGO representatives identified RMP's and Whe viTeo was TepicWeT on WreaWmenW wiWh C anT zinc. AfWer Wraining assessmenW was Tone	Prescribing zinc anT ORS by ASHA was more when compareT Wo !WW and RMP's. InspiWe of more knowledge RMP's prescribeT more anWibioWics anT anWi microbial.
Palker eW al (2015)	Public secWor scale-up of zinc anT ORS improves coverage[15]	Selected districts in Bihar	Each public health care provider of various cadres received 1day training. Distributed Zinc and ORS to public sector facilities and providers. 2 surveys : Baseline and Endline surveys	Knowledge: Endline>Baseline Awareness: Endline> Baseline Heard of ORS: Endline> Baseline Receiving Zinc: Endline> Baseline
Mohan et al (2016)	Diarrhea no more: does zinc help the poor? Evidence on the effectiveness of	Uttar Pradesh(UP) and Gujarat	Data from cross–secWional baseline anT enTline surveys were useT Wo assess	NnT line surveys finTingsJ UPJ IncreaseT public secWor approach was

	programmatic efforts to reach poorest in delivering zinc and ORS at scale[16]		disparities in six dimensions: socioeconomic strata, gender, caregiver education, ethnicity, geography.	noted. Gujarat: Zinc + ORS usage has increased. ORS usage is doubled in public sector when compared to private sector.
Singh et al (2014)	Impact of Training Workshop on Knowledge and !ttitude for 'Zinc and Its Role in Management of Diarrhea' among Peripheral Health Workers of Primary Health Centre[17]	Tribal area in Thane, Maharashtra.	Two day workshop session was conducted with help of role plays, Flip charts, pamphlets and Zinc tablet demonstration. A questionnaire was used to collect pre-workshop baseline data and post-workshop data which were collected after one month.	Baseline survey: 66% had knowledge of diarrhea, 92% knew about ORS and 97.7% were unaware about Zinc. Endline survey: 42% showed complete gain, 50% partial gain and 8% showed no gain in knowledge about Zinc's role in diarrhea.
Chaudhary et al (2014)	Knowledge, Attitude and Practice of Mothers regarding diarrheal Illness in Children under Five Years of Age: A Cross Sectional Study[18]	An urban slum in Delhi	125 mothers were randomly selected and were interviewed using a structured questionnaire	96% mothers defined diarrhea appropriately. 88% practiced hand washing with soap , 76% used ORS, only 26% considered it as main treatment of diarrhea. 42% mothers had incomplete knowledge regarding proper preparation of ORS
Padhy et al (2017)	Mother's knowledge, attitude and practice regarding prevention and management of diarrhea in children[19]	Southern Odisha	Data was collected from mothers by questionnaire method as per case record format.300 mothers of children suffering with diarrhea who attended the pediatric outdoor or treated in the pediatric indoor.	34% of mothers were aware of assessment of severe signs of dehydration.19% mothers had good knowledge regarding preparation of ORS and 65% mothers had average knowledge.
D)Summary of results from TELANGANA state				
Rani et al (2016)	Knowledge and Attitude of Mothers about Diarrhea, ORS and Feeding Practices in Under-Five Children[20]	Rural area of Rangareddy District	A questionnaire was used for data collection among 210 mothers to assess the KAP of mothers.	73.3% know about ORS, 52.8% knew the correct method of preparing ORS.41.4% mothers do not know the cause of diarrhea.71.9% are giving some home available fluids during diarrhea.
Gandra et al (2017)	Diarrhea, nutrition and oral rehydration therapy: awareness, attitude and practices among mothers of children under five years[21]	Hyderabad	A standard questionnaire including hand washing practice, sanitation, personal hygiene, feeding practice, knowledge about disease was the assessment tool.	Knowledge on oral rehydrating fluids was adequate (80.0%) but correct preparation was inadequate. Not practicing proper hand wash (50.55%) and use of unsafe water (29.49%) .

Discussion:

Role and effects of Zinc and ORS: Zinc supplementation has shown a substantial decline in the proportion of children who experienced recurrent diarrhea, suggesting that zinc is an important underlying factor in preventing and controlling diarrhea. Previous studies have shown that the diarrheal mortality has a skewed distribution and also many children experience exceptionally high diarrhea morbidity.[22]The mechanisms in which Zinc acts- a)improves the absorption of water and electrolytes, improves regeneration of the intestinal epithelium, increases the levels of brush border enzymes, and enhances the immune response, allowing for a better clearance of the pathogens.[23]b)It also plays a critical role in metallo enzymes, polyribosomes and the cell membrane and cellular function, giving credence to the belief that it plays a central role in cellular growth and in the function of the immune system.[24]c)Zinc also acts as a potassium channel blocker, inhibiting cyclic adenosine monophosphate-mediated chlorine secretion.[1]

This has also been supported by studies which revealed that zinc plays a major role in the regulation of intestinal fluid transport, mucosal integrity and modulation of expression of genes encoding important zinc-dependent enzymes like cytokines which play important roles in the immune system and in modulation of oxidative stress.[12] Zinc sulfate is available as tablets, suspensions and may be dispersed in breast milk, in oral rehydration solutions or in water.[25] Some studies also showed that children with diarrhea and fever tended to be less likely to receive antimicrobial medication with usage of zinc with ORS.[19]Christa et al in their systematic review found that usage of zinc with ORS reduces the mortality by 23%, and reduction in diarrhoeal prevalence by 19%. In the same review also found mortality reduction in moderate and low income countries with relative risk of 66%.[26]

Barriers associated with Use of Zinc and ORS: Although Oral Rehydration Salts (ORS) was recommended and made available for the prevention and treatment of diarrhea since the 1980s, yet the most recent national survey reports says that only 26% children with diarrhea were given ORS.([15] Lack of awareness and training were found to be the main reason for not using or delaying the use of zinc supplement during diarrhea. A positive impact was observed on training the caretakers and healthcare workers.[17] Another significant finding was lack of knowledge regarding importance of breast feeding as a tool in prevention of diarrhea.[18] More than half of surveyed women reported that their first intervention was some kind of home remedy such as homemade sugar/salt solution, foods, liquids, or herbs. In addition, antibiotics were first or second choice of 46% of caregivers. For about half of women, zinc was the third or fourth intervention.[10]Behavior and practices of caretakers was not adequate: no participants used ORS for full duration of diarrheal episode and very few prepared ORS solution correctly.[8,11] Training of private sector Registered Medical Practioners(RMPs) had no effect on prescribing practices and continued prescribing antibiotics and antimicrobials despite of having knowledge of Zinc and ORS for the treatment of diarrhea.[14]

Present study stands good in explaining about the roles and barriers in consumption of ORS and Zinc combined in diarrhea in children but limits in number of studies covered as we only focused in free full text. Its also advised that fortified zinc ORS should not be used, rather they should be administered separately when specifically considering for reduction of diarrhea and its complication. As Cochrane review suggested that effects of fortification of foods with zinc on other outcomes including zinc deficiency, children's growth, cognition, work capacity of adults, or on hematological indicators are unknown[27] but effects of zinc syrup is known to be beneficial in diarrhea. [28

Conclusion :

Reduction in diarrheal disease burden can be achieved by improving coverage of zinc and ORS particularly amongst the poorest. There is an urgent need to train caretakers, healthcare providers on the initial fluid replacement and hygienic practices to be followed during an episode of diarrhea and also to improve the availability of ORS with zinc supplementation.Awareness of mothers about health, disease and preventive services is a key measure by which the progression at the level of family, community and the country can be measured.

Conflict of interest : None

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