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Environmental Determinants Of ORS-Zinc Use In Child Diarrhoea

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abstract

Objectives: *To assess maternal knowledge and practices regarding the use of oral rehydration salts (ORS) and zinc supplementation in managing diarrhoea among children under five, and to explore associated socio-demographic and environmental factors.*

Methods: *A cross-sectional study was conducted among 221 mothers at a tertiary care hospital in Chennai, India. A structured, pre-tested questionnaire assessed maternal knowledge and practices concerning ORS and zinc. Multivariate logistic regression identified socio-demographic predictors of good knowledge and practice.*

Results: *While 70.6% of mothers knew the correct time to start ORS, only 48.2% were aware of zinc's role in diarrhoea reduction. Good knowledge was associated with older maternal age (>31 years, AOR = 2.27; p = 0.048) and urban residence (AOR = 2.36; p = 0.009). Only 38.5% completed the 14-day zinc course. Maternal education significantly predicted good practice (AOR = 0.40; p = 0.013 for school-educated vs graduates).*

Conclusion: *Despite moderate awareness of ORS among mothers, substantial gaps persist in both zinc-related knowledge and its correct application. Environmental determinants particularly maternal education and urban residence were significantly associated with better knowledge and practices. Strengthening maternal health education through community-level interventions and ensuring consistent availability of ORS and zinc in both urban and rural settings are essential to bridging this gap and enhancing child health outcomes.*

Keywords: *Oral Rehydration Salts, Zinc Supplementation, Maternal Health Education, Environmental Health, Under-Five Children.*

INTRODUCTION:

Diarrhoea remains a leading cause of morbidity and mortality among children under five years of age globally. According to the World Health Organization (WHO), diarrheal diseases are responsible for approximately 525,000 child deaths annually, primarily in low- and middle-income countries .[1] In India, diarrhoea contributes to an estimated 9% of all deaths among children under five, ranking it among the top three causes of under-five mortality.[2]

The cornerstone of diarrhoea management is oral rehydration solution (ORS) and zinc supplementation, a low-cost, evidence-based intervention recommended by both WHO and UNICEF. ORS effectively prevents dehydration and reduces mortality, while zinc has been shown to shorten the duration and severity of diarrheal episodes, reduce stool frequency, and lower the risk of recurrence.[3] Despite its proven benefits, the uptake of ORS and zinc remains suboptimal, particularly in resource-limited settings. The National Family Health Survey-5 (NFHS-5) data for India reported that only 60.6% of children with diarrhoea received ORS, and a mere 30.5% received zinc.[4]

Although the Indian government has integrated ORS and zinc supplementation into national programs such as the Integrated Management of Neonatal and Childhood Illness (IMNCI) and National Health Mission (NHM), gaps remain in implementation and awareness, especially among young, rural, and less-educated mothers. Misconceptions about zinc use, inadequate counseling by healthcare providers, and irregular availability of zinc tablets in public health facilities also contribute to poor adherence.

Given these challenges, understanding the current level of knowledge and actual practices among mothers, as well as the factors associated with them, is crucial for designing effective community-based interventions. This study aims to assess the knowledge and practice of mothers regarding ORS and zinc

in the treatment of diarrhea among children under five, and to identify socio-demographic factors influencing these behaviors. The findings will contribute to public health strategies aimed at improving diarrhea management, ultimately reducing preventable child deaths in India. Environmental and health system factors—such as inconsistent access to clean water, inadequate public health education, and disparities between urban and rural service delivery—contribute significantly to diarrhoea morbidity and suboptimal ORS-zinc usage. Understanding how these environmental determinants influence maternal behaviour is essential for developing holistic public health interventions.

AIMS AND OBJECTIVES:

Aim

The primary aim of this study is to evaluate the knowledge and practices of mothers regarding the use of Oral Rehydration Salts (ORS) in combination with zinc supplementation for the management of diarrhoea in children under five years of age.

This cross-sectional study was conducted in the Department of Paediatrics at Sree Balaji Medical College and Hospital, Chennai, India, over a period of three months from February 2025 to April 2025.

Mothers of children aged below five years who visited the paediatric department and consented to participate were included in the study. Mothers who were unwilling to participate or belonged to a medical background were excluded to eliminate potential bias due to professional knowledge.

The study population comprised children under 60 months of age presenting with diarrhoea over a period of 6 months. The minimum sample size required was calculated using Dobson's formula: $n = (Z^2 \times p \times (1-p)) / e^2$, where Z = 1.96 for a 95% confidence level, p = 0.59 (based on previous prevalence data), and e = 0.11 (margin of error). This yielded a minimum required sample size of 221.

Data were collected using a structured and pre-tested questionnaire developed in English based on a thorough review of existing literature. It consisted of three sections:

1. Socio demographic details of caregivers,
2. Knowledge regarding ORS and zinc supplementation, and
3. Practical application during diarrhoeal episodes.

Face Validity:

To ensure the appropriateness and clarity of the questionnaire, face validity was established by seeking expert opinions from three faculty members from the Departments of Paediatrics and Community Medicine. Their suggestions were incorporated to improve the phrasing, sequencing, and cultural sensitivity of the questions. The final version was pilot-tested on 15 mothers (excluded from the main study) to assess clarity and understanding, and minor modifications were made accordingly.

Questionnaire Details:

The knowledge section included items such as awareness of the role of ORS and zinc, correct preparation, timing of administration, and misconceptions about cost or storage.

The practice section included behavioural questions about actions taken during the most recent diarrheal episode, such as hand washing before preparation, amount of water used, duration of ORS use, and adherence to the 14-day zinc course.

Both sections were scored, and based on cumulative scores, respondents were classified into "good" or "poor" knowledge and practice groups, using predefined operational criteria.

Operational definitions were applied to categorize respondents. Mothers who answered knowledge-related questions correctly were classified as having good knowledge, while those who could not were categorized under poor knowledge. Similarly, practice was assessed, and respondents were grouped as having good practice or poor practice based on correct responses. Notably, the criteria for evaluating practice mirrored those used for assessing knowledge.

Data were collected by the principal investigator through face-to-face interviews after obtaining verbal informed consent from each participant. Mothers of children with active or previous diarrhoea episodes over a period of 6 months were assessed for their response patterns and health-seeking practices.

Statistical analysis was performed using IBM SPSS Version 27. Continuous variables were presented as means ± standard deviation (SD), and categorical variables were summarized as frequencies and percentages. The Pearson correlation coefficient was used to assess relationships between continuous variables, and linear regression analysis was applied to test the significance. A p-value <0.05 was considered statistically significant.

To ensure the quality and consistency of the data, the principal investigator was solely responsible for both data collection and data entry into Microsoft Excel. This approach was adopted to minimize variability and enhance the reliability of the dataset.

RESULTS:

Table 1: Socio-demographic characteristics of the study subjects

Socio-demographic variables	Frequency N=221	Percentage (%)
Age of the child		
0-2	138	62.4
3-5	83	37.6
Gender		
Boy	117	52.9
Girl	104	47.1
Mothers age		
21-25	70	31.7
26-30	84	38.0
>31	67	30.3
Residence		
Rural	125	56.6
Urban	96	43.4
Education of the mother		
Illiterate	50	22.6
School	77	34.8
Diploma	63	28.5
Graduate	31	14
Socio-economic status		

Class 1	20	9
Class- 2	55	25%
Class-3	78	35.3
Class-4	56	25.3
Class-5	11	5%

Table 1 represents the Socio-demographic characteristics of the study subjects.
Out of the 221 children, the majority (62.4%) were aged between 0-2 years, while 37.6% were 3–5 years old. Boys constituted a higher proportion (52.9%) compared to girls (47.1%). Most mothers were in the age group of 26–30 years (38%), followed by 21–25 years (31.7%) and above 31 years (30.3%). A significant number of participants (56%) were from rural areas, with only 44% from urban regions. Regarding maternal education, over (34.8%) had completed school-level education, 28.5% had a diploma, 14% are graduates and 22.6.% were illiterate. Socio-economically, 9% belonged to Class 1, 25% belong to class 2, 35.3 belong to class 3, while 25.3% were in Class 4 and 5% are in class 5.
Table 2: Knowledge of mothers about ORS with zinc supplementation for diarrhoea management

Knowledge	Yes (%)	No (%)
Do you know that ORS is used to treat or prevent dehydration in children with diarrhoea ?	62.8%	17.2
Do you know when ORS should be started?	70.6	29.4
Do you think ORS price is expensive?	48	52
Do you know zinc supplementation reduces duration and severity of diarrhoea?	48.2	51.8

This study assessed mothers' knowledge regarding oral rehydration salts (ORS) and zinc supplementation for diarrhoea management. Among 221 participants, 62.8% knew the purposes of ORS, 70.6% were aware of when ORS should be started, and 48.2% understood that zinc reduces the duration and severity of diarrhoea. However, a notable 48% of mothers perceived ORS as expensive. The proportion of mothers aware of the purpose of ORS (62.8%) and correct initiation (70.6%) in our study is consistent with reports from other low- and middle-income countries.
Ooko et al. 2021 stated that 68.9% of mothers correctly identified ORS as a fluid replacement therapy, and 72.4% knew to start ORS at the onset of diarrhoea.[5] This aligns well with our findings, indicating that most mothers are exposed to the correct timing and use of ORS, likely due to government-led diarrhoeal disease control programs and primary health worker education.
Ugwu et al., 2022 stated that 53.3% of mothers had heard of zinc, and only 42% had ever used it, which was similar to our study, where 48.2% of mothers were aware that zinc reduces the duration and severity of diarrhoea.[6]
Almost half of the respondents (48%) believed that ORS is expensive, despite government policies aiming to provide it free of cost through public health facilities. This finding is consistent with literature from

other low-resource settings. In 2022 a study from Nigeria, Ugwu et al., reported similar cost perceptions, even though ORS was available at subsidized rates. Many caregivers still obtained ORS from private pharmacies due to inaccessibility of government supplies or long waiting times at public facilities.[6]
A qualitative study in India by Bansal et al., 2023 highlighted that even when ORS cost was low, indirect costs, such as transportation, lost wages, or the need to purchase from private vendors due to stock-outs—contributed to the perception of high cost. These barriers resulted in delay or underuse of ORS, despite awareness of its benefits.[7]

Table 3:Practice of mothers about ORS with zinc supplementation for diarrhoea management.

Practice	Yes (%)	No (%)
Did you wash your hands with soap and water before preparing ORS the last time your child had diarrhoea?	74.2	25.8
Did you use the correct amount of water (as per packet instructions) while preparing ORS during your child's last diarrhoea episode?	67.4	32.6
Can ORS be used after 24 hrs of preparation?	45.2	54.8
Have you ever given zinc for 14 days during episode of diarrhoea?	38.5	61.5

The present study assessed the practical behaviours of mothers regarding the administration of oral rehydration salts (ORS) and zinc supplementation during episodes of diarrhoea in under-five children. Among the 221 participants, the findings revealed that 74.2% of mothers practiced hand washing before preparing ORS, 67.4% were aware of the correct quantity of water used for preparation, only 45.2% reported using ORS beyond 24 hours of preparation, and a mere 38.5% administered zinc for the recommended 14-day course.
In our study, 74.2% of mothers practiced hand washing before preparing ORS. Gebremedhin W et al., 2022 stated that 72.3% of caregivers practiced appropriate hygiene, including hand washing before ORS preparation similar to our findings.[8] Regarding preparation accuracy, 67.4% of mothers in our study knew the correct quantity of water to mix with ORS, which is close to the 68.1% reported by Ooko et al., 2021.[5] Only 45.2% of mothers reported using ORS beyond 24 hours after preparation, suggesting suboptimal adherence to WHO guidelines, which recommend discarding ORS after 24 hours to prevent microbial contamination. Ugwu et al., 2022 stated 41% adherence rate, where many caregivers either reused ORS beyond 24 hours or were unaware of the recommended timeframe.[6] A significant gap was observed in zinc supplementation practices, only 38.5% of mothers had administered zinc for the full 14-day course during a diarrhoeal episode. Tadesse et al., 2022, found that zinc adherence was 35% , which was close to our study.[9] Bansal et al., 2023 done a randomized controlled trial in India, found that zinc adherence improved to over 60% when caregivers were provided co-packaged ORS-zinc kits along with pictorial instructions and follow-up calls.[7]

Table 4: Association Between Socio-Demographic Characteristics and Knowledge of ORS and Zinc Supplementation

Variable	Category	Poor Knowledge (n)	Good Knowledge (n)	COR (95% CI)	P-value	AOR (95% CI)	P-value

Child Age	0–2 years (ref)	55	83	1.00	—	1.00	—
	3–5 years	36	47	1.06 (0.58–1.95)	0.847	1.06 (0.54–2.07)	0.847
Gender	Boy (ref)	45	72	1.00	—	1.00	—
	Girl	46	58	1.64 (0.88–3.05)	0.116	1.64 (0.89–3.01)	0.116
Mother's Age	21–25 years (ref)	42	28	1.00	—	1.00	—
	26–30 years	40	44	0.53 (0.25–1.13)	0.089	0.53 (0.25–1.14)	0.089
	>31 years	37	30	2.27 (1.01–5.08)	0.048	2.27 (1.00–5.09)	0.048
Residence	Rural (ref)	67	58	1.00	—	1.00	—
	Urban	24	72	2.36 (1.25–4.45)	0.009	2.36 (1.24–4.48)	0.009
Education	Graduate (ref)	5	26	1.00	—	1.00	—
	Diploma	23	40	1.05 (0.39–2.80)	0.945	1.05 (0.39–2.81)	0.945
	School	42	35	0.81 (0.34–1.90)	0.571	0.81 (0.34–1.91)	0.571
	Illiterate	40	10	0.86 (0.31–2.37)	0.743	0.86 (0.31–2.39)	0.743
Socioeconomic Class	Class 5 (ref)	8	3	1.00	—	1.00	—
	Class 1	7	13	1.50 (0.67–3.33)	0.320	1.50 (0.67–3.34)	0.320
	Class 2	20	35	0.60 (0.23–1.58)	0.317	0.60 (0.23–1.59)	0.317
	Class 3	38	40	1.31 (0.50–3.41)	0.572	1.31 (0.50–3.42)	0.572
	Class 4	18	38	1.31 (0.48–3.56)	0.589	1.31 (0.48–3.57)	0.589

This study assessed maternal knowledge regarding ORS and zinc supplementation for managing diarrhoea in children under five and identified key sociodemographic factors associated with better knowledge. The findings suggest that maternal age and place of residence significantly influence knowledge levels, while education and socioeconomic status showed no significant trends.

Mothers aged over 31 years demonstrated significantly better knowledge of ORS and zinc use compared to those aged 21–25 years (AOR = 2.27; p = 0.048), likely due to greater exposure to child illness episodes, prior caregiving experience, or increased interaction with health services. Similar trends were reported in Nigeria by Oloruntoba EO et al 2021, where caregivers over 30 years exhibited higher awareness of diarrhoea management strategies.[10]

Urban residence was also independently associated with better knowledge (AOR = 2.36; p = 0.009), possibly due to improved access to health facilities, mass media, and awareness campaigns. A recent study in Ethiopia by Amsalu R et al 2022 attributed higher maternal knowledge in urban areas to proximity to healthcare services and enhanced health communication.[11]

Although maternal education did not show a statistically significant association, graduates had a higher proportion of good knowledge. This aligns with findings from Bangladesh, by Khanam M et al, where higher educational attainment correlated with better understanding of diarrhoea treatment.[12] The lack of significance in this study may be due to the relatively small number of graduate mothers.

No significant association was found between maternal knowledge and child's age or sex, consistent with previous research suggesting caregiver characteristics are more influential than child demographics.[13] Surprisingly, socioeconomic status also showed no significant impact on knowledge, contrasting with studies from Kenya by Were V et al 2020 , where higher income was linked to better awareness.[14] This may reflect the role of public health programs in providing uniform health education irrespective of economic background.

Table 5: Association Between Socio-Demographic Characteristics and Practice of ORS and Zinc Supplementation (N = 221)

Variable	Category	Poor Practice (n)	Good Practice (n)	COR (95% CI)	P-value	AOR (95% CI)	P-value
Child Age	0–2 years (ref)	52	86	1.00	—	1.00	—
	3–5 years	36	47	0.81 (0.46–1.44)	0.476	0.81 (0.46–1.45)	0.476
Gender	Boy (ref)	47	70	1.00	—	1.00	—
	Girl	41	63	0.84 (0.47–1.50)	0.559	0.84 (0.47–1.51)	0.559
Mother's Age	21–25 years (ref)	40	30	1.00	—	1.00	—
	26–30 years	24	60	0.87 (0.42–1.81)	0.712	0.87 (0.42–1.82)	0.712
	>31 years	12	55	1.03 (0.45–2.37)	0.929	1.03 (0.45–2.38)	0.929
Residence	Rural (ref)	59	66	1.00	—	1.00	—
	Urban	29	67	1.19 (0.65–2.18)	0.572	1.19 (0.65–2.19)	0.572
Education	Graduate (ref)	5	26	1.00	—	1.00	—

	Diploma	20	43	1.59 (0.57–4.38)	0.372	1.59 (0.57–4.40)	0.372
	School	49	28	0.40 (0.20–0.83)	0.013	0.40 (0.20–0.84)	0.013
	Illiterate	32	18	0.71 (0.31–1.63)	0.413	0.71 (0.31–1.64)	0.413
Socioeconomic Class	Class 5 (ref)	6	5	1.00	—	1.00	—
	Class 1	7	13	1.50 (0.43–5.23)	0.963	1.50 (0.43–5.25)	0.963
	Class 2	22	33	0.78 (0.29–2.12)	0.608	0.78 (0.29–2.13)	0.608
	Class 3	28	50	0.60 (0.25–1.45)	0.262	0.60 (0.25–1.46)	0.262
	Class 4	25	31	0.76 (0.29–2.00)	0.573	0.76 (0.29–2.01)	0.573

This study examined maternal practices related to the administration of ORS and zinc during diarrheal episodes in children under five and their association with sociodemographic factors. The findings indicate suboptimal practice levels in key domains and reveal that maternal education plays a critical role in shaping these behaviours.

Multivariate analysis showed that maternal education was the only significant predictor of good practice. Mothers with only school-level education had significantly lower odds of good practice compared to graduates (AOR = 0.40; $p = 0.013$). This aligns with findings from a large-scale study in Nepal by Shrestha R et al, where maternal education beyond secondary level was strongly associated with correct ORS preparation and complete zinc administration.[15] Similarly a research from rural India by Ranjan et al. (2022) also highlighted poor adherence to zinc therapy and ORS reconstitution instructions among less-educated mothers.[16]

In contrast, maternal age, child age, residence, gender, and socioeconomic class were not significantly associated with ORS and zinc-related practices in the current study. These results differ slightly from a study in Ethiopia by Dadi et al. (2023), where urban residence and higher maternal age were positively correlated with practice adherence.[17] The lack of association in our sample could reflect uniform public health messaging in both urban and rural settings, or the influence of local health workers acting as equalizers across income and age groups.

Despite high overall awareness of ORS, the lower rate of correct practices—particularly zinc administration—mirrors challenges observed in multiple low- and middle-income countries., A UNICEF evaluation (2020) on Integrated Management of Childhood Illness (IMCI) reported that while ORS uptake was generally above 70%, zinc usage was consistently below 50%, often due to lack of availability or misconceptions about its necessity.[18]

The findings highlight the need to enhance maternal education through community-based interventions, including visual aids and demonstrations during antenatal and immunization visits to improve practice.

CONCLUSION

This study highlights a significant gap between knowledge and practice regarding ORS and zinc use among mothers of under-five children. While most were aware of ORS, knowledge of zinc's role and adherence to the 14-day course were limited. Older age and urban residence were linked to better knowledge, while higher education predicted good practice. Strengthening targeted education through community programs and maternal health services is essential to improve diarrhoea management and reduce child morbidity in India. Integrating ORS-zinc promotion into broader environmental health efforts—such as improving sanitation, strengthening primary healthcare delivery, and ensuring uninterrupted access to clean water—can significantly enhance diarrhoea prevention and treatment strategies in vulnerable populations.

CONFLICT OF INTREST: The authors declare no conflict of interest. The study did not receive any specific funding.

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