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Determinants of Zinc Supplementation Utilization among Under-Five Children with Diarrhoea: A Systematic Review

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ABSTRACT/ ABSTRAK

ABSTRACT*. Diarrhoea remains a major public health concern and a leading cause of morbidity and mortality among children, particularly in low- and middle-income countries. Although the World Health Organization recommends zinc supplementation as an adjunct therapy for childhood diarrhoea, its utilization remains suboptimal. This study systematically synthesized evidence on determinants of zinc supplementation utilization among children under five with diarrhoea. A systematic search was conducted in Taylor & Francis, ScienceDirect, and Google Scholar databases for studies published between 2020 and 2025, following PRISMA guidelines. Nine eligible studies were included, reporting zinc utilization prevalence ranging from 8.96% to 43.58%. Higher utilization was associated with maternal education, younger maternal age, media exposure, higher household income, smaller family size, health insurance coverage, prior awareness of zinc supplementation, and improved access to healthcare services. Lower utilization was observed among female children, rural residents, larger households, younger infants, and caregivers seeking initial treatment from non-formal sources. Strengthening caregiver education, improving healthcare access, and promoting zinc supplementation through primary healthcare systems are essential to improve childhood diarrhoea management.*

Kata kunci:

Akses Fasilitas Pelayanan Kesehatan, Diare Anak, Faktor Ibu, Pemanfaatan Suplemen, Suplementasi Zinc

ABSTRAK. Diare masih menjadi masalah kesehatan masyarakat utama dan penyebab signifikan morbiditas serta mortalitas pada anak, terutama di negara berpendapatan rendah dan menengah. World Health Organization merekomendasikan suplementasi zinc sebagai terapi tambahan dalam penatalaksanaan diare anak, namun tingkat pemanfaatannya masih rendah. Penelitian ini bertujuan mensintesis secara sistematis bukti mengenai determinan pemanfaatan suplementasi zinc pada anak usia di bawah lima tahun dengan diare. Penelusuran literatur dilakukan pada basis data Taylor & Francis, ScienceDirect, dan Google Scholar untuk publikasi tahun 2020–2025 dengan mengikuti pedoman PRISMA. Sebanyak sembilan studi memenuhi kriteria inklusi, dengan prevalensi pemanfaatan zinc berkisar antara 8,96%–43,58%. Pemanfaatan yang lebih tinggi berkaitan dengan pendidikan ibu, usia ibu lebih muda, paparan media, pendapatan rumah tangga lebih tinggi, ukuran keluarga lebih kecil, kepemilikan asuransi kesehatan, pengetahuan tentang zinc, serta akses layanan kesehatan yang lebih baik. Sebaliknya, pemanfaatan lebih rendah ditemukan pada anak perempuan, populasi pedesaan, rumah tangga besar, bayi usia lebih muda, dan pencarian pengobatan awal dari sumber nonformal. Penguatan edukasi pengasuh dan peningkatan akses layanan kesehatan diperlukan untuk meningkatkan penatalaksanaan diare anak.

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INTRODUCTION

Diarrhoea remains a major public health concern and a leading cause of morbidity and mortality among children under five years of age, particularly in developing countries. The condition is defined as the passage of loose or watery stools three or more times within a 24-hour period (World Health Organization, 2023). Among young children, diarrhoea can result in severe complications, including acute dehydration, electrolyte imbalance, malnutrition, impaired growth and development, and increased risk of death (Pradhan et al., 2025). Globally, diarrhoeal diseases contribute substantially to child mortality, with approximately 443,832 deaths reported annually among children under five (World Health Organization, 2024). Beyond health consequences, diarrhoeal illness also creates significant socioeconomic burdens through increased healthcare costs, reduced parental productivity, and decreased quality of life (World Health Organization, 2024).

Despite long-term global prevention efforts, diarrhoea continues to account for approximately 9% of all under-five deaths worldwide, with an estimated 444,000 to 525,000 deaths annually (World Health Organization, 2024). Although meta-analytic evidence shows a decline in global prevalence from 22.3% during 1985–1989 to 10.9% in 2020–2024, the burden remains disproportionately high in Africa and Asia (Tag et al., 2025). In Indonesia, national data indicate that 7.4% of children experienced diarrhoea in 2023, reflecting a reduction from the 12.3% prevalence reported in the 2018 Basic Health Research Survey (Tim Penyusun SKI 2023 dalam Angka, 2023; Badan Penelitian dan Pengembangan Kesehatan, 2018). These findings highlight ongoing disparities and the need for strengthened management strategies.

Zinc supplementation is recommended by the World Health Organization as an adjunct therapy for childhood diarrhoea due to its role in reducing disease severity, duration, and recurrence. However, its utilization is influenced by multiple biological, behavioral, and socioeconomic factors. Children with inadequate zinc intake or poor nutritional status tend to experience prolonged diarrhoeal episodes and demonstrate greater clinical response to supplementation (Lazzerini & Wanzira, 2020). Limited dietary diversity reduces consumption of zinc-rich foods, while gastrointestinal infections increase zinc loss and impair absorption (Brown et al., 2019; Zhaqila et al., 2024). Furthermore, adherence to recommended dosage and duration, healthcare access, and supplement availability significantly affect treatment outcomes (Walker & Black, 2020; Bhandari, 2021).

Caregiver-related and health system factors also play a critical role in determining zinc utilization. Limited caregiver knowledge, early discontinuation of supplementation after symptom improvement, and restricted access to healthcare services frequently disrupt the recommended 10 to 14-day treatment regimen. Socioeconomic conditions, healthcare provider compliance with clinical guidelines, and supply availability further influence implementation, particularly in low- and middle-income settings (World Health Organization, 2023). Child characteristics, including age between 6 and 59 months, nutritional status such as stunting, wasting, and underweight, and immune system immaturity, additionally affect supplementation effectiveness (Walker & Black, 2020; Bhandari, 2021). Consistent adherence to WHO recommendations is therefore essential to optimize therapeutic outcomes and prevent recurrence.

Despite strong global recommendations and well-established clinical effectiveness, zinc supplementation utilization remains inconsistent and suboptimal across many settings

(World Health Organization, 2023; Pradhan et al., 2025). Considerable regional variation persists due to disparities in healthcare access, caregiver awareness, socioeconomic conditions, and health system capacity (Bhandari, 2021; Seifu et al., 2024). Previous studies have identified determinants such as maternal education, household income, media exposure, family size, health insurance coverage, and prior experience with zinc supplementation (Kassa et al., 2022; Beressa, 2024). However, existing evidence remains fragmented and context-specific, limiting comparability across studies and constraining the development of targeted public health interventions. A comprehensive synthesis of current findings is therefore required to identify consistent predictors and inform evidence-based strategies to improve zinc utilization (Ali et al., 2024). Accordingly, this study aims to systematically review and synthesize evidence on the determinants of zinc supplementation utilization among children under five years of age with diarrhoea.

RESEARCH METHOD

Search Strategy

A systematic literature search was conducted in three electronic databases: Taylor & Francis, ScienceDirect, and Google Scholar. The search strategy was developed using combinations of the following keywords: zinc supplementation, zinc utilisation, zinc use, childhood diarrhoea, using appropriate Boolean operators (AND/OR) to refine the search results. The search was limited to articles published between 2020 and 2025 and available in full-text format.

Selection Criteria

Studies were included if they met the following eligibility criteria: (1) primary research articles employing cross-sectional or observational study designs; (2) studies involving children under five years of age and/or their mothers or primary caregivers; (3) articles addressing zinc supplementation utilization in the management of childhood diarrhoea; (4) studies reporting the prevalence of zinc use and/or factors associated with zinc supplementation utilization; (5) articles published between 2020 and 2025 in English; and (6) full-text articles available for review.

Study Selection Process

Duplicate articles were identified and removed prior to the screening process. The selection of studies was conducted in two stages. First, titles and abstracts were screened to assess their relevance based on the predefined eligibility criteria. Second, full-text articles of potentially eligible studies were reviewed to determine final inclusion. The study selection process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram to ensure transparency and reproducibility.

Data Extraction

Data extraction was performed using a standardized data extraction form developed in Microsoft Excel to ensure consistency and accuracy. The extracted information included study characteristics (author, year of publication, country, study setting, and study design),

sample characteristics (sample size and participant demographics), and key variables related to zinc supplementation utilization. Information on the prevalence of zinc use and factors associated with zinc utilization was also extracted.

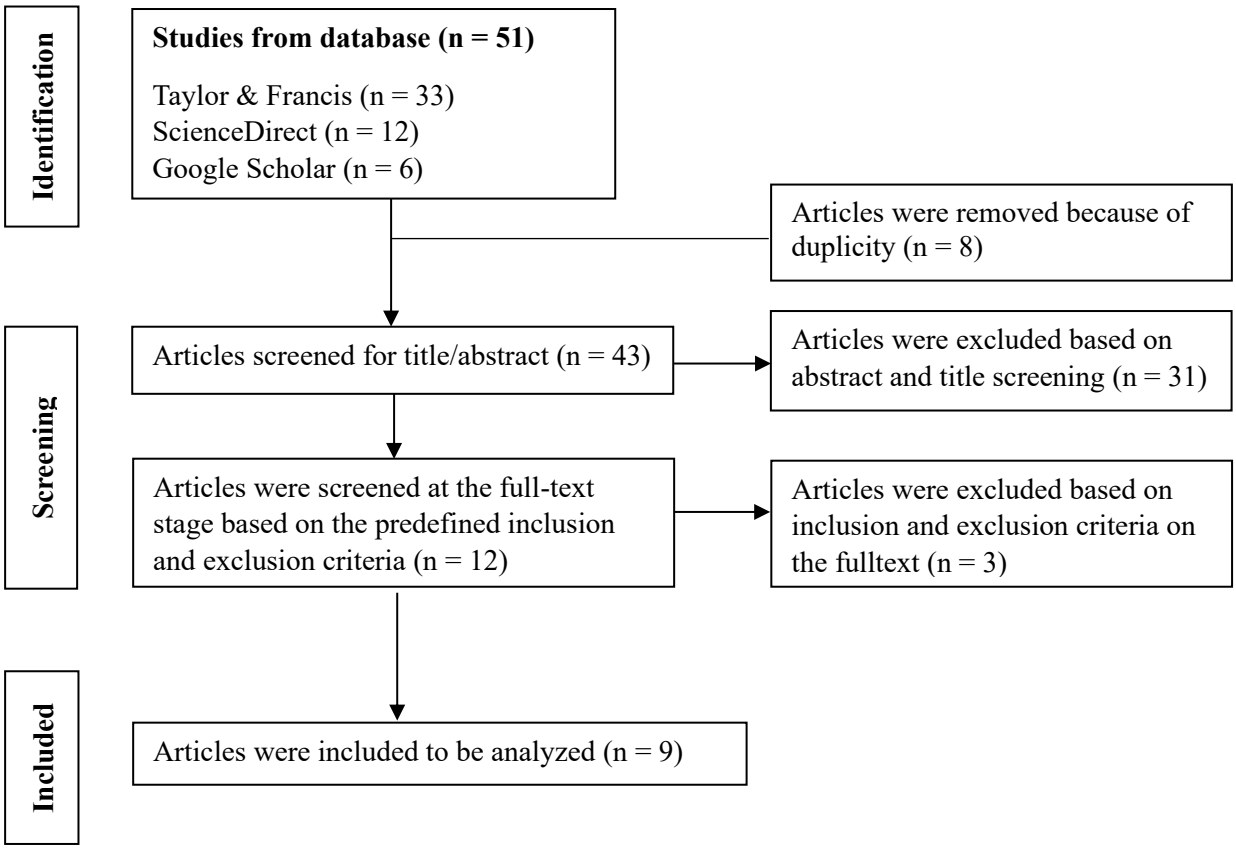

Figure 1. Review Process PRISMA Flow Diagram

Quality Assessment

The assessment considered the appropriateness of study design, clarity of research objectives, sampling methods, measurement of variables, and statistical analysis techniques. Studies were evaluated for potential sources of bias to ensure the credibility of the synthesized findings.

Data Synthesis

Given the heterogeneity of study settings and reported determinants, a narrative synthesis approach was applied. Findings were grouped and summarized according to patterns of zinc supplementation utilization and associated determinants. Similarities and differences across studies were compared to identify consistent factors influencing zinc use in the management of childhood diarrhoea.

RESULTS

Nine cross-sectional studies conducted in Sub-Saharan Africa, Ethiopia, India, and Nigeria were included in this review, with sample sizes ranging from 376 to 44,341 participants. The prevalence of zinc supplementation utilization among children under five with diarrhoea ranged from 8.96% to 43.58%, indicating substantial variation across settings (Beressa, 2024; Seifu et al., 2024). Other reported prevalence estimates included 42.5% (Degefa et al., 2025), 39.6% (Terefa & Shama, 2023), 33.3% (Teshale et al., 2020), 31% (Halli et al., 2024), 29.1% (Ayele et al., 2020; Ogundele et al., 2023), and 16.65% (Kassa et al., 2022).

Maternal education consistently increased the likelihood of zinc utilization. Children whose mothers had primary education were approximately three times more likely to receive zinc (Beressa, 2024; Degefa et al., 2025), while those whose mothers had secondary or higher education were more than five times more likely to use zinc (Degefa et al., 2025). In several studies, formal maternal education increased zinc utilization by 40% to 83% (Kassa et al., 2022; Teshale et al., 2020; Ogundele et al., 2023). Conversely, lack of maternal formal education reduced the likelihood of zinc use by about 82%, and absence of paternal formal education reduced utilization by approximately 95% (Ayele et al., 2020).

Socioeconomic and household characteristics were also significant determinants. Children from smaller households (<5 members) were 1.5 to nearly six times more likely to receive zinc (Kassa et al., 2022; Terefa & Shama, 2023), whereas those from larger households were about 43% less likely to use zinc (Teshale et al., 2020). Belonging to middle- or high-income households increased zinc utilization by approximately 10% to 20% (Ogundele et al., 2023), and younger maternal age was positively associated with higher zinc use (Seifu et al., 2024; Halli et al., 2024). Media exposure increased the likelihood of zinc supplementation (Seifu et al., 2024; Teshale et al., 2020).

Access to healthcare services played an important role. Shorter perceived distance to health facilities increased zinc use by 7% to 60% (Seifu et al., 2024; Kassa et al., 2022), while health insurance coverage increased utilization by approximately 11% (Seifu et al., 2024). In contrast, children whose caregivers initially sought treatment from private facilities were about 34% less likely, and those seeking care from non-formal sources were 70% less likely, to receive zinc (Halli et al., 2024). Rural residence was also associated with lower zinc use, reducing the likelihood by 4% to 60% (Seifu et al., 2024; Ogundele et al., 2023).

Child-related and behavioral factors further influenced zinc utilization. Female children were about 4% less likely to receive zinc (Seifu et al., 2024), and younger infants aged 6–11 months were approximately 87% less likely to be given zinc (Ayele et al., 2020). Lower zinc use was also observed among children with different birth weight categories, with reductions ranging from 44% to 53% (Halli et al., 2024). Behavioral practices during diarrhoeal episodes were important determinants; caregivers who withheld food or fluids were nearly six times more likely to use zinc (Degefa et al., 2025), while reduced or maintained food and fluid intake increased utilization by approximately 31% to 45% (Halli et al., 2024). Additionally, caregivers who perceived the child's illness as moderate or severe were two to six times more likely to administer zinc (Terefa & Shama, 2023).

Table 1. Characteristics and Key Findings of Studies on Zinc Supplementation Utilization among Under-Five Children with Diarrhoea

Study ID	Country	Study design	Age group of the study population	Sample size	Adherence in percentage	Determinants of Zinc Supplementation
Seifu et al., (2024)	Sub-Saharan Africa	Cross-sectional	Under-five age	44,341	43.58%	Lower zinc utilization was associated with female children (aPR = 0.96; 95% CI: 0.94–0.98) and rural residence (aPR = 0.96; 95% CI: 0.92–0.99). Higher utilization was associated with younger maternal age (15–29 years), formal maternal education (aPR = 1.09; 95% CI: 1.06–1.12), middle and high household income, health insurance coverage (aPR = 1.11; 95% CI: 1.05–1.17), media exposure (aPR = 1.08; 95% CI: 1.05–1.11), and shorter perceived distance to health facilities (aPR = 1.07; 95% CI: 1.04–1.10).
Degefa et al., (2025)	Ethiopia	Cross-sectional	Under-five age	417	42.5%	Higher zinc supplementation utilization was associated with withholding food or fluids during diarrhoea (AOR = 5.88; 95% CI: 3.13–11.10), maternal primary education (AOR = 2.88; 95% CI: 1.52–5.46), and secondary education or above (AOR = 5.43; 95% CI: 2.75–10.70). Increased utilization was also observed among mothers without prior experience using zinc (AOR = 2.28; 95% CI: 1.35–3.84). Lower utilization was associated with lack of paternal formal education.
Kassa et al. (2022)	Ethiopia	Cross-sectional	Under-five age	1,228	16.65%	Higher zinc utilization was associated with maternal formal education (AOR = 1.45; 95% CI: 1.01–2.09), smaller household size (<5 members) (AOR = 1.53; 95% CI: 1.09–2.16), and shorter distance to health facilities (AOR = 1.60; 95% CI: 1.02–2.58).
Beressa (2024)	Ethiopia	Cross-sectional	Under-five age	29,525	8.96%	Mothers who completed primary education was significantly associated with zinc utilization (AOR = 3.16; 95% CI: 1.57–6.35)
Terefa and Shama (2023)	Ethiopia	Cross-sectional	Under-five age	540	39.6%	Higher utilization zinc was associated with smaller family size (<5 members) (AOR = 5.72; 95% CI: 2.93–11.15), prior awareness of zinc pack (AOR = 9.52; 95% CI: 4.95–23.68), poor and moderate perceived child health status (AOR = 5.90; 95% CI: 2.58–15.96; AOR = 2.20; 95% CI: 1.02–4.83), moderate perceived illness severity (AOR = 4.48; 95% CI: 1.36–14.76), and non-membership in community-based health insurance (AOR = 2.28; 95% CI: 1.34–6.90).
Teshale et al. (2020)	Ethiopia	Cross-sectional	Under-five age	1,228	33.3%	Higher zinc utilization was associated with maternal formal education (AOR = 1.83; 95% CI: 1.30–2.58) and media exposure (AOR = 1.46; 95% CI: 1.04–

Study ID	Country	Study design	Age group of the study population	Sample size	Adherence in percentage	Determinants of Zinc Supplementation
						2.04), while lower utilization was observed among households with five or more members (AOR = 0.57; 95% CI: 0.39–0.82)
Ayele et al. (2020)	Ethiopia	Cross-sectional	Under-five age	376	29.1%	Lower zinc utilization was associated with lack of maternal formal education (AOR = 0.18; 95% CI: 0.06–0.59), child age of 6–11 months (AOR = 0.13; 95% CI: 0.03–0.68), withholding of food and fluids during acute diarrhoea (AOR = 0.19; 95% CI: 0.07–0.50), and absence of paternal formal education (AOR = 0.05; 95% CI: 0.02–0.13)
Halli et al. (2024)	India	Cross-sectional	Under-five age	16,213	31%	Higher zinc utilization was observed among children of mothers aged 25–34 years (AOR = 1.12; 95% CI: 1.02–1.23) and 35 years or older (AOR = 1.29; 95% CI: 1.09–1.52), reduced fluid intake (AOR = 1.45; 95% CI: 1.16–1.83) and reduced or maintained food intake during diarrhoeal episodes (AOR = 1.31; 95% CI: 1.11–1.55; AOR = 1.45; 95% CI: 1.22–1.73). Lower utilization was reported among children with large, average, low, and very low birth weights (AOR range: 0.47–0.56) and among caregivers who initially sought treatment from private facilities (AOR = 0.66; 95% CI: 0.61–0.72) or other non-formal sources (AOR = 0.30; 95% CI: 0.27–0.33)
Ogundele et al. (2023)	Nigeria	Cross-sectional	Under-five age	3956	29.1%	Higher utilization was observed among children whose mothers had secondary or tertiary education (AOR = 1.40; 95% CI: 1.05–2.22), were exposed to mass media (AOR = 2.50; 95% CI: 1.01–3.87), and belonged to middle (AOR = 1.10; 95% CI: 1.06–1.27) and rich households (AOR = 1.20; 95% CI: 1.02–1.97). Better access to health facilities was also associated with increased zinc use (AOR = 1.24; 95% CI: 1.01–1.47). Conversely, lower zinc utilization was reported among children residing in rural areas (AOR = 0.40; 95% CI: 0.22–0.80) and among children of previously married mothers (AOR = 0.23; 95% CI: 0.13–1.08).

DISCUSSION

This systematic review demonstrates substantial variability in zinc supplementation utilization among children under five with diarrhoea, with prevalence ranging from 8.96% to 43.58% across included studies (Beressa, 2024; Seifu et al., 2024). Although zinc is globally recommended as an essential adjunct therapy for childhood diarrhea (World Health Organization, 2023), utilization remains inconsistent across low- and middle-income countries. The wide disparity in reported coverage across Ethiopia, Sub-Saharan Africa, India, and Nigeria (Ayele et al., 2020; Halli et al., 2024; Ogundele et al., 2023) suggests persistent implementation gaps in diarrhoeal management programs.

Maternal education consistently emerged as the strongest determinant of zinc utilization. Children whose mothers had primary or secondary education were significantly more likely to receive zinc compared to those whose mothers had no formal education (Beressa, 2024; Degefa et al., 2025; Kassa et al., 2022; Ogundele et al., 2023; Teshale et al., 2020). Conversely, lack of maternal or paternal formal education markedly reduced the likelihood of zinc use (Ayele et al., 2020). These findings underscore the critical role of parental education in shaping health-seeking behavior, comprehension of treatment guidelines, and adherence to recommended regimens. Educated caregivers are more likely to recognize diarrhoeal symptoms, seek care from formal health facilities, and follow prescribed supplementation protocols.

Socioeconomic and household factors were also significant predictors. Smaller household size and higher household income were associated with increased zinc utilization (Kassa et al., 2022; Ogundele et al., 2023; Terefa & Shama, 2023), while larger households were less likely to use zinc (Teshale et al., 2020). Media exposure further increased the likelihood of supplementation (Seifu et al., 2024; Teshale et al., 2020), indicating the importance of health communication and information access. These findings are consistent with broader evidence suggesting that socioeconomic empowerment and exposure to health information enhance uptake of recommended child health interventions.

Access to healthcare services played a crucial role in determining zinc use. Shorter distance to health facilities and health insurance coverage increased utilization (Kassa et al., 2022; Seifu et al., 2024), whereas rural residence was associated with lower use (Ogundele et al., 2023; Seifu et al., 2024). Importantly, children whose caregivers initially sought care from private or non-formal providers were less likely to receive zinc (Halli et al., 2024), suggesting inconsistencies in guideline adherence across healthcare sectors. These findings highlight structural barriers and inequities in healthcare delivery that limit optimal zinc coverage.

Child-related and behavioral factors further influenced zinc supplementation. Female children were slightly less likely to receive zinc in some settings (Seifu et al., 2024), and younger infants were substantially less likely to be treated (Ayele et al., 2020). Lower utilization among children with varying birth weights was also observed (Halli et al., 2024). Caregiver perceptions and feeding practices during diarrhoeal episodes significantly influenced zinc use; perceived illness severity and withholding or modification of food and fluids were associated with increased likelihood of supplementation (Degefa et al., 2025; Halli et al., 2024; Terefa & Shama, 2023). These findings suggest that caregiver interpretation of illness severity plays a central role in treatment decisions.

Overall, zinc supplementation utilization is shaped by a complex interaction of educational, socioeconomic, healthcare access, and behavioral determinants. Strengthening caregiver education, improving equitable access to health services, enhancing adherence to

clinical guidelines across healthcare sectors, and expanding media-based health promotion strategies are essential to bridge existing gaps in zinc utilization and improve diarrhoeal management among children under five (World Health Organization, 2023).

CONCLUSION

This systematic review highlights persistent gaps in zinc supplementation utilization in the management of childhood diarrhoea, despite strong global recommendations supporting its routine use. The substantial variation in coverage across settings underscores ongoing inequities in healthcare access, caregiver awareness, and health system performance. Maternal education consistently emerged as a key determinant, alongside socioeconomic status, media exposure, and accessibility to health facilities, indicating that both structural and behavioral factors shape treatment uptake. These findings carry important programmatic implications, particularly for strengthening community-based health education, improving equitable access to primary healthcare services, and ensuring consistent implementation of diarrhoeal management guidelines across public and private sectors. Further research is warranted to explore context-specific barriers and to assess whether improvements in zinc utilization translate into measurable reductions in diarrhoeal morbidity and mortality among children under five.

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