Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Development of a structured teaching programme module on prevention and management of diarrheal diseases in under-five children for grassroot-level workers at selected PHCs in Yadadri Bhuvanagiri District, Telangana – A mixed method study

Deepanshi Choudhary[1]

deepanshic06@gmail.com

AIIMS Bibinagar Hyderabad Metropolitan Region

Azhar S. M.

AIIMS Bibinagar Hyderabad Metropolitan Region

Dr. A. Serma Subathra[3]

AIIMS Bibinagar Hyderabad Metropolitan Region

Dr. Govindrao N. K.

AIIMS Bibinagar Hyderabad Metropolitan Region

Research Article

Keywords: Diarrhea, child health, ASHA, ANM, knowledge attitude practice, mixed-methods, India, grassroots health workers, community health, structured teaching programme module

Posted Date: November 4th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11166068/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Title:
Development of a structured teaching programme module on prevention and management of diarrheal diseases in under-five children for grassroot-level workers at selected PHCs in Yadadri Bhuvanagiri District, Telangana – A mixed method study

Authors:
Deepanshi Choudhary[1], Azhar S. M.[2], A. Serma Subathra[3], Govindrao N. K.[4]

Affiliations:
[1] M.Sc. Nursing Student, College of Nursing, All India Institute of Medical Sciences (AIIMS), Bibinagar, Hyderabad Metropolitan Region, Telangana – 508126, India
[2] Assistant Professor, College of Nursing, All India Institute of Medical Sciences (AIIMS), Bibinagar, Hyderabad Metropolitan Region, Telangana – 508126, India
[3] Associate Professor, College of Nursing, All India Institute of Medical Sciences (AIIMS), Bibinagar, Hyderabad Metropolitan Region, Telangana – 508126, India
[4] Additional Professor, Department of Community and Family Medicine (CFM), All India Institute of Medical Sciences (AIIMS), Bibinagar, Hyderabad Metropolitan Region, Telangana – 508126, India

Corresponding Author:
Deepanshi Choudhary
College of Nursing, AIIMS Bibinagar
Hyderabad Metropolitan Region, Telangana – 508126, India
Email: deepanshic06@gmail.com
Phone: +91-9773903539

ABSTRACT

Background: Diarrheal diseases remain a leading cause of mortality among children under five in India, with approximately 1,58,209 deaths annually. Grassroots health workers—Accredited Social Health Activists (ASHAs) and Auxiliary Nurse Midwives (ANMs) are pivotal in community-level prevention and management. This study assessed their knowledge, attitudes, and practices (KAP), compared differences between ASHA and ANM cadres, identified associated demographic factors, and explored barriers and challenges encountered in diarrheal disease management, to inform the development of a structured teaching programme module.

Methods: An explanatory sequential mixed-methods design was employed in selected Primary Health Centres of Yadadri Bhuvanagiri District, Telangana. Quantitative data were collected from 95 grassroots health workers (74 ASHAs, 21 ANMs) using a semi-structured knowledge questionnaire, Likert attitude scale, and practice checklist. Qualitative data were collected through 2 focus group discussions and 6 in-depth interviews, analyzed using six-step thematic analysis.

Integration was achieved through triangulation and meta-inference development. The module was developed based on the integrated findings and validated by experts.

Results: Among participants, 43.46% had good knowledge, 37.89% average, and 18.95% poor. Attitudes were predominantly favorable (65.26%), with 31.58% neutral and 3.16% unfavorable. Practice levels showed 43.16% good, 29.47% average, 18.95% excellent, and 8.42% poor. ANMs demonstrated significantly more favorable attitudes than ASHAs (p=0.047, Cohen's d=0.51), but no significant differences in knowledge (p=0.189) or practice (p=0.109). Knowledge was significantly associated with age (p=0.04) and education (p=0.01); attitude with education (p=0.05) and worker type (p=0.03); practice with education (p=0.04) and experience (p=0.04). Knowledge correlated significantly with attitude (r=0.480, p=0.001) and practice (r=0.321, p=0.001). Qualitative analysis revealed five themes: knowledge and perception; case management practices; challenges and barriers; health system navigation and community engagement; and capacity and confidence. A conceptual model was developed illustrating the dynamic interplay between clinical competency, community dynamics, and systemic constraints. A structured teaching programme module was developed and validated, with an overall Scale Content Validity Index (S-CVI/average) of 0.88.

Conclusions: Despite universal training coverage, significant gaps persist in knowledge and practice among grassroots health workers. Barriers are multi-layered, encompassing community myths, supply-chain disruptions, administrative burdens, and insufficient refresher training. Effective interventions must move beyond knowledge transfer to address systemic and contextual constraints. The developed structured teaching programme module addresses these identified gaps and provides a contextually grounded, evidence-based training resource for strengthening frontline health worker capacity.

Keywords: Diarrhea, child health, ASHA, ANM, knowledge attitude practice, mixed-methods, India, grassroots health workers, community health, structured teaching programme module

BACKGROUND

Diarrheal diseases continue to pose a significant public health challenge globally, particularly in low- and middle-income countries. Despite advances in prevention and treatment, diarrhea remains the third leading cause of death among children under five, after pneumonia and preterm birth complications [1]. The World Health Organization (WHO, 2023) reports approximately 480,000 deaths annually among children under five due to diarrhea, accounting for 8% of all deaths in this age group [1]. This translates to more than 1,300 preventable child deaths daily, primarily attributable to inadequate access to safe drinking water, sanitation, hygiene, oral rehydration solution (ORS), and zinc supplementation [1,2].

In India, diarrheal diseases are responsible for approximately 158,209 under-five deaths annually, constituting 9.1% of all child deaths [3,4]. The National Family Health Survey-5 (NFHS-5, 2019–

21) reported that 7.3% of children under five experienced diarrhea in the two weeks preceding the survey, with higher prevalence in rural areas (9.6%) compared to urban settings (8.2%) [5]. Despite widespread awareness of ORS, only about 60% of children receive it, and less than 30% receive zinc as recommended by WHO and UNICEF [5]. This persistent knowledge-practice gap underscores the need for strengthened local interventions.

Environmental and structural determinants significantly contribute to diarrheal disease risk. Inadequate sanitation, unsafe disposal of child feces, dirt floors, and thatched roofing increase risk by 6–11% [6]. Meta-analyses have established strong associations between malnutrition (OR ≈ 1.73), anemia (OR ≈ 1.71), and low socioeconomic status (OR ≈ 7.14) with increased diarrheal risk [6]. Water, Sanitation, and Hygiene (WASH) programs can reduce risk by 7–47%, particularly when sanitation and handwashing practices improve [7]. However, feeding practices during diarrhea remain suboptimal: up to 35% of mothers limit food, 7% stop feeding, and 31% reduce breastfeeding, driven by cultural beliefs and poor health communication [8].

The WHO-UNICEF Global Action Plan for Pneumonia and Diarrhoea (GAPPD) provides a comprehensive framework: protect children through breastfeeding and vaccines, prevent illness with safe sanitation, and treat promptly with ORS and zinc [9]. However, these life-saving tools often fail to reach the most vulnerable families in rural and underserved communities where health workers are scarce and health information is limited.

Grassroots health workers—ASHAs and ANMs are the frontline interface between communities and the health system. They are responsible for health education, case identification, ORS and zinc distribution, and referral. Studies across India have documented variations in their knowledge, attitudes, and practices. A nationwide meta-analysis by Majumdar et al. (2025) found moderate knowledge levels among ASHAs (62% in maternal health, 69% in neonatal/child health), influenced by education, experience, training exposure, and supervisory support [10]. Jagadeesh et al. (2024) reported that while general caregiving practices were adequate, knowledge of zinc course completion and danger sign recognition remained limited [11]. Ahabwe and Kazibwe (2023) found that 47.1% of caregivers had adequate knowledge, 66.1% positive attitudes, but only 41.1% appropriate practices [12].

Barriers to effective diarrhea management are well-documented. Behera et al. (2023) identified fragmented stock management and dispensing errors as major operational barriers [13]. Bist et al. (2023) reported heavy workload, documentation burden, and performance pressure as significant challenges [14]. Vila-Guilera et al. (2022) found low community trust, preference for traditional healers, and weak accountability mechanisms as major constraints [15]. Singh et al. (2021) demonstrated that short, one-time training without follow-up mentoring resulted in poor retention and limited application [16]. Scott et al. (2018) synthesized global evidence showing that community health workers generally have high motivation but wide variation in technical competence, and that organizational support is critical for performance [17].

Telangana mirrors national patterns, with NFHS-5 reporting 7.38% diarrhea prevalence among under-five children [5]. However, district-level studies show higher rates in slums and rural areas with poor water and sanitation. A study in an urban slum in Sangareddy district found 15.7% prevalence—more than twice the state average [18]. Yadadri Bhuvanagiri, like other rural districts, faces challenges of unsafe water, open defecation, poor handwashing, and limited healthcare access.

Despite existing training modules at national and international levels, they often adopt generic, top-down approaches that fail to address specific knowledge gaps, cultural barriers, and practical problems faced by field workers in different local settings [8,15]. Few studies have systematically integrated quantitative baseline assessments with qualitative insights to inform competency-based, context-specific training module development.

This study aimed to address this gap by: (1) assessing KAP regarding diarrheal disease prevention and management among ASHAs and ANMs; (2) comparing KAP scores between ASHA and ANM workers; (3) identifying associations between KAP and demographic variables; (4) examining correlations between knowledge, attitude, practice, and selected demographic variables; (5) exploring barriers and challenges encountered by grassroots workers; and (6) developing a structured teaching programme module based on the integrated findings. The module was designed to be contextually grounded, evidence-based, and aligned with national guidelines and ground-level realities.

METHODS

Study Design and Setting

This study employed an explanatory sequential mixed-methods design, conducted in selected Primary Health Centres (PHCs) of Yadadri Bhuvanagiri District, Telangana, India. The quantitative phase was conducted first, followed by qualitative inquiry to contextualize and explain the quantitative findings. The integrated findings informed the development of a structured teaching programme module. The study was conducted from September 15 to October 25, 2025.

The setting comprised three health facilities: PHC Bommalaramaram (rural), UPHC Narapally (urban), and UPHC Mallapur (urban). These facilities were selected based on accessibility, availability of the required study population, administrative approval, and feasibility within the study timeframe.

The overall study design and methodology are illustrated in **Figure 1**.

Participants and Eligibility

The target population comprised grassroots-level health workers (ASHAs and ANMs) working in the selected PHCs. Inclusion criteria were: (1) actively delivering services to under-five children;

(2) more than 6 months of service at the selected PHC; and (3) willingness to participate and ability to provide informed consent. Exclusion criteria were: unavailability or long-term leave during the study period.

[INSERT FIGURE 1 HERE]

Figure 1. Schematic representation of the research methodology.
Legend: The study employed an explanatory sequential mixed-methods design comprising: (1) quantitative phase with total enumerative sampling of all eligible ASHA and ANM workers (n=95) using demographic proforma, semi-structured knowledge questionnaire, Likert attitude scale, and practice checklist; and (2) qualitative phase with purposive sampling for 2 focus group discussions (n=20) and 6 in-depth interviews, analyzed using six-step thematic analysis. Integration of quantitative and qualitative findings informed the development of a structured teaching programme module.

Quantitative Phase

Sample Size and Sampling: A total enumerative sampling technique was employed, including all eligible ASHAs and ANMs available during data collection. A total of 95 participants (74 ASHAs, 21 ANMs) were enrolled. Based on a previous study by Lamberti et al. (2015) [19], assuming 60% baseline knowledge and a 25% absolute increase, with two-sided alpha of 0.05 and 80% power, the required sample size was 78. Accounting for 10% attrition, the final sample size was determined to be 88. However, due to the total enumerative approach and to maximize representativeness, all 95 eligible workers were included.

Data Collection Tools: Four instruments were used:

1. **Demographic Proforma (Tool I):** Collected age, gender, marital status, educational qualification, designation, years of experience, monthly family income, population covered, number of under-five children in service area, MR and RVV vaccination coverage, drinking water source, toilet facilities, feeding practices, and diarrhea cases reported in the past six months.

2. **Semi-Structured Knowledge Questionnaire (Tool II):** 30 items covering causes, signs, symptoms, dehydration assessment, ORS preparation, zinc supplementation, feeding practices, hygiene, vaccination, and referral practices. Each correct answer scored 1; incorrect scored 0. Total score range: 0–30. Interpretation: poor (0–10), average (11–20), good (21–30).

3. **Likert Attitude Scale (Tool III):** 15 items with 5-point responses (Strongly Agree=5 to Strongly Disagree=1), including both positive and negative statements. Negative items reverse-scored. Total score range: 15–75. Interpretation: unfavorable (15–35), neutral (36–55), favorable (56–75).

4. **Practice Checklist (Tool IV):** 15 items assessing self-reported practices during the last three months, including case reporting, vaccination record maintenance, dehydration assessment, ORS/zinc distribution, referral, breastfeeding promotion, hygiene demonstration, and community education. Each correct practice scored 1; incorrect/not reported scored 0. Total score range: 0–15. Interpretation: poor (0–40%, 0–6), average (41–60%, 7–9), good (61–80%, 10–12), excellent (81–100%, 13–15).

Validity and Reliability: Content validity was established by nine experts from community health nursing and community medicine. The overall Scale Content Validity Index (S-CVI/average) was 0.88, exceeding the recommended cutoff of 0.80. Reliability was assessed using Kuder-Richardson Formula-20 (KR-20=0.88) for the knowledge questionnaire, Cronbach's alpha (α=0.89) for the attitude scale, and Cohen's Kappa (κ=0.86) for the practice checklist, indicating high internal consistency and inter-rater reliability.

Qualitative Phase

Participants and Sampling: Purposive sampling was used to select participants for 2 focus group discussions (FGDs) and 6 in-depth interviews (IDIs). FGD 1 comprised 10 participants (7 ASHAs, 3 ANMs) from a rural PHC; FGD 2 comprised 10 participants (7 ASHAs, 3 ANMs) from an urban PHC. IDIs included 3 ASHAs and 3 ANMs (3 rural, 3 urban). Data saturation guided the final sample size, determined when no new information or themes emerged.

Data Collection: A semi-structured interview guide was developed, covering perceptions of diarrheal diseases, barriers to prevention, challenges in case management, training and capacity-building needs, and systemic challenges. FGDs and IDIs were conducted in Telugu, audio-recorded with consent, transcribed verbatim, and translated while preserving semantic meaning.

Data Analysis: Six-step thematic analysis was employed: (1) transcription, familiarization, and quotation selection; (2) keyword selection; (3) coding; (4) theme development; (5) conceptualization through interpretation; and (6) conceptual model development. Trustworthiness was ensured through peer debriefing, member checking, audit trail maintenance, and thick contextual description.

Integration

Quantitative and qualitative findings were integrated through triangulation, comparing results across both data types to identify convergence, complementarity, and divergence. Meta-inferences were developed to explain quantitative trends through qualitative insights and to inform module development.

Module Development and Validation

Based on the integrated findings, a structured teaching programme module was developed. The module was designed as a three-day Training of Trainers (ToT) resource, incorporating participatory and adult learning principles. Content was drawn from national guidelines (MoHFW, WHO, UNICEF) and contextualized based on the study findings. The module was validated by eight experts from community health nursing and related fields. Content validity was established with an overall S-CVI/average of 0.88. The module includes nine sessions covering: introduction and role clarity; burden of diarrhea; essential concepts; assessment and management; prevention strategies; challenges and solutions; the WHO-UNICEF 7-point plan; effective communication and IEC/BCC; and community engagement and social mobilization.

Statistical Analysis

Quantitative data were analyzed using SPSS version 29. Descriptive statistics (frequencies, percentages, mean, standard deviation) summarized demographic variables and KAP scores. Independent t-tests compared mean scores between ASHA and ANM groups. Chi-square tests examined associations between demographic variables and KAP levels. Pearson's correlation coefficient assessed relationships between knowledge, attitude, practice, and selected demographic variables. Statistical significance was set at $p<0.05$.

Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki and the ICMR National Ethical Guidelines (2017). The study was approved by the Departmental Research Committee (DRC) and Institutional Research Committee (IRC) of College of Nursing, AIIMS Bibinagar. Ethical clearance was obtained from the Institutional Ethics Committee (IEC ref no: AIIMS/BNN/IEC/Apr/2025/712). Administrative approval was obtained from concerned health authorities of selected PHCs. Informed consent was obtained from all participants after explaining the purpose, procedures, and voluntary nature of participation. Confidentiality and anonymity were strictly maintained. Participants were informed of their right to withdraw at any time without penalty.

Clinical trial number: Not applicable.

RESULTS

Socio-Demographic Characteristics

Among 95 participants, 77.89% (n=74) were ASHAs and 22.11% (n=21) were ANMs. The majority (53.68%, n=51) were aged 30–40 years, followed by 38.95% (n=37) above 40 years and 7.37% (n=7) below 30 years. All participants were female. Most were married (91.58%, n=87), while 7.37% (n=7) were widowed and 1.05% (n=1) unmarried. Educational qualifications: 55.79% (n=53) had high school certificates, 33.68% (n=32) higher secondary, and 10.53% (n=10) graduate degrees. Using the B.G. Prasad Scale (2025), 44.21% (n=42) belonged to upper middle class,

33.68% (n=32) lower middle, 14.74% (n=14) middle, and 7.37% (n=7) upper class. Experience distribution was bimodal: 43.16% (n=41) had 8–12 years, 40.00% (n=38) had 18–23 years, and 16.84% (n=16) had 13–17 years. All participants (100%) reported receiving training in diarrhea management and full MR and RVV vaccination coverage. Most served populations of 3000–5000 (41.05%, n=39) with more than 100 under-five children (62.11%, n=59). Piped water was the primary source (63.16%, n=60), and household toilets were available in 86.32% (n=82) of areas. Exclusive breastfeeding up to six months was practiced by 70.53% (n=67) of mothers. In the last six months, 52.63% (n=50) reported 1–5 diarrhea cases, 26.32% (n=25) reported 6–10 cases, and 3.16% (n=3) reported more than 10 cases.

The socio-demographic characteristics of the study participants are presented in **Table 1**.

[INSERT TABLE 1 HERE]

(n=95)

Variable	Category	Frequency (*f*)	Percentage (%)
Age (years)	Below 30 30-40 More than 40	7 **51** 37	7.37% **53.68%** 38.95%
Gender	Female Other	**95** 0	**100.00%** 0.00
Marital status	Married Unmarried Widow Separated	**87** 1 7 0	**91.58%** 1.05% 7.37% 0.00%
Educational qualification	Graduate Degree Higher Secondary Certificate High School Certificate Middle School Certificate	10 33 52 0	10.53% 33.68% **55.79%** 0.00%
SES Score	I (Upper) II (Upper Middle) III (Middle) IV (Lower Middle) V (Lower)	7 **42** 14 32 0	7.37% **44.21%** 14.74% 33.68% 0.00%
Type of grassroot level worker	ASHA worker ANM	**74** 21	**77.89%** 22.11%

Type of health facility UPHC/PHC	UPHC Narapally UPHC Mallapur PHC Bomallaramaram	**36** 24 35	**37.89%** 25.26% 36.84%
Experience	8-12 years 13-17 years 18-23 years	**41** 16 38	**43.16%** 16.84% 40.00%
Training in diarrhea management	Yes No	**95** 0	**100.00%** 0.00
Population covered in service area	Less than 1000 1000- 3000 3000-5000 More than 5000	6 35 **39** 15	6.32% 36.84% **41.05%** 15.79%
Number of under-five children in the service area	Less than 50 50 – 100 More than 100	6 30 **59**	6.32% 31.58% **62.11%**
MR vaccination coverage	All eligible children Some eligible children None of the eligible children Not sure/ No record	**95** 0 0 0	**100.00%** 0.00 0.00 0.00
RVV vaccination coverage	All eligible children Some eligible children None of the eligible children Not sure/ No record	**95** 0 0 0	**100.00%** 0.00 0.00 0.00
Source of drinking water	Piped water Borewell/handpump Open well River, pond/lake Other	**60** 25 10 0 0	**63.16%** 26.32% 10.53% 0.00% 0.00%
Type of toilet facilities	Household toilet Community toilet Open defecation	**82** 11 2	**86.32%** 11.58% 2.11%

Feeding practices	Exclusive breastfeeding up to 6 months Mixed feeding (breast milk + other foods/liquids) Bottle feeding	**67** 17 11	**70.53%** 17.89% 11.58%
Approximate number of diarrhea cases reported in last 6 months	None 1–5 cases 6–10 cases More than 10 cases	17 **50** 25 3	17.89% **52.63%** 26.32% 3.16%
Reported causes of diarrheal disease (Multiple responses)	Contaminated water Poor hygiene Contaminated water, Poor hygiene Contaminated water, Malnutrition Contaminated water, Lack of awareness Poor hygiene, Lack of awareness Contaminated water, Poor hygiene, Malnutrition Contaminated water, Poor hygiene, Lack of awareness Contaminated water, Malnutrition, Lack of awareness Poor hygiene, Malnutrition, Lack of awareness All of the above	**52** 6 2 1 3 5 8 3 7 1 7	**54.74%** 6.32% 2.11% 1.05% 3.16% 5.26% 8.42% 3.16% 7.37% 1.05% 7.37%

Table 1. Frequency and percentage distribution of socio-demographic characteristics of study participants.

Legend: Socio-demographic characteristics of grassroots health workers (n=95). Data presented as frequency (n) and percentage (%). SES = socioeconomic status; ASHA = Accredited Social Health Activist; ANM = Auxiliary Nurse Midwife; MR = measles-rubella; RVV = rotavirus vaccine; UPHC = Urban Primary Health Centre; PHC = Primary Health Centre.

Knowledge, Attitude, and Practice Levels

Knowledge: 43.46% (n=41) had good knowledge, 37.89% (n=36) average, and 18.95% (n=18) poor. Mean knowledge score was 20.78 ± 5.78.

The distribution of knowledge levels is presented in **Figure 2**.

[INSERT FIGURE 2 HERE]

Figure 2. Level of knowledge of grassroots health workers regarding diarrhea prevention and management.
Legend: Distribution of knowledge levels among grassroots health workers (n=95). Among participants, 43.46% demonstrated good knowledge, 37.89% had average knowledge, and 18.95% had poor knowledge regarding prevention and management of diarrheal diseases in under-five children. Scoring: poor (0–10), average (11–20), good (21–30).

Attitude: 65.26% (n=62) had favorable attitudes, 31.58% (n=30) neutral, and 3.16% (n=3) unfavorable. Mean attitude score was 58.92 ± 7.43.

The distribution of attitude levels is presented in **Figure 3**.

[INSERT FIGURE 3 HERE]

Figure 3. Level of attitude of grassroots health workers regarding diarrhea prevention and management.
Legend: Distribution of attitude levels among grassroots health workers (n=95). The majority (65.26%) displayed favorable attitudes, 31.58% had neutral attitudes, and only 3.16% showed unfavorable attitudes toward diarrhea prevention and management in under-five children. Scoring: unfavorable (15–35), neutral (36–55), favorable (56–75).

Practice: 43.16% (n=41) demonstrated good practice, 29.47% (n=28) average, 18.95% (n=18) excellent, and 8.42% (n=8) poor. Mean practice score was 10.53 ± 2.18.

The distribution of practice levels is presented in **Figure 4**.

[INSERT FIGURE 4 HERE]

Figure 4. Level of practice of grassroots health workers regarding diarrhea prevention and management.
Legend: Distribution of practice levels among grassroots health workers (n=95). Among participants, 43.16% demonstrated good practice, 29.47% average practice, 18.95% excellent practice, and 8.42% poor practice regarding prevention and management of diarrheal diseases in under-five children during the last three months. Scoring: poor (0–40%, 0–6), average (41–60%, 7–9), good (61–80%, 10–12), excellent (81–100%, 13–15).

Comparison Between ASHA and ANM Workers

ANMs demonstrated higher mean knowledge scores (22.23 ± 5.03) compared to ASHAs (20.66 ± 4.74), but the difference was not statistically significant (p=0.189, Cohen's d=0.32). ANMs scored significantly higher on attitude (62.10 ± 6.70 vs 58.55 ± 7.22; p=0.047, Cohen's d=0.51). Practice scores were comparable (11.19 ± 2.27 vs 10.32 ± 2.12; p=0.109, Cohen's d=0.39).

The comparison of KAP scores between ASHA and ANM workers is presented in **Table 2**.

[INSERT TABLE 2 HERE]

(n=95)

	Type of grassroot level worker		**Mean difference†**	**t(df)**	**p-value**	**Cohen's d**
	ASHA worker(n=74)	**ANM (n=21)**				
	Mean (SD)	**Mean (SD)**				
Knowledge	20.66 (4.74)	22.23 (5.03)	1.57	t (93) = 1.32	.189	0.32
Attitude	58.55 (7.22)	62.10 (6.70)	3.55*	t (93) = 2.01	.047*	0.51
Practice	10.32 (2.12)	11.19 (2.27)	0.87	t (93) = 1.62	.109	0.39

Table 2. Comparison of knowledge, attitude, and practice scores between ASHA and ANM workers.
Legend: Comparison of mean knowledge, attitude, and practice scores between ASHA (n=74) and ANM (n=21) workers. Data presented as mean (standard deviation). †Mean difference = ANM mean minus ASHA mean. *$p < 0.05$. Independent t-test used for comparison. Effect size interpretation (Cohen's d): small (0.2), medium (0.5), large (0.8). SD = standard deviation; df = degrees of freedom.

Association with Demographic Variables

Knowledge: Significant associations with age (χ^2=6.62, p=0.04) and education (χ^2=8.80, p=0.01). Among graduates, 80% had good knowledge and none had poor knowledge. Among high school certificate holders, only 28.30% had good knowledge while 30.19% had poor knowledge.

The association between knowledge levels and selected demographic variables is shown in **Table 3**.

[INSERT TABLE 3 HERE]

(n=95)

Demographic variable		**Level of knowledge score**						**n**	**Chi square test**	**p value**
		Poor		**Average**		**Good**				
		N	**%**	**n**	**%**	**n**	**%**			
Age (in years)	Below 30 years	3	42.86 %	2	28.57%	2	28.57 %	7	**χ2=6.62**	**p=0.04 (S)** DF=2
	30-40 years	13	25.49 %	15	29.41%	23	45.10 %	51		
	Above 40 years	2	5.41%	19	51.35%	16	43.24 %	37		
Gender	Female	18	18.95 %	36	37.89%	41	43.16 %	95	χ2=0.00	p=1.00 (NS) DF=1
	Male	0	0.00%	0	0.00%	0	0.00 %	0		
	Others	0	0.00%	0	0.00%	0	0.00 %	0		
Marital status	Married	17	19.54 %	32	36.78%	38	43.68 %	87	χ2=1.93	p=0.38 (NS) DF=2
	Unmarried	1	100.00 %	0	0.00%	0	0.00 %	1		
	Widow	0	0.00%	5	71.43%	2	28.57 %	7		
	Separated	0	0.00%	0	0.00%	0	0.00 %	0		
	>10000	0	0.00%	2	50.00%	2	50.00 %	4		
SES Score	Upper	1	14.29 %	3	42.86%	3	42.86 %	7	χ2=3.88	p=0.27 (NS) DF=3
	Upper Middle	6	14.29 %	21	50.00%	15	35.71 %	42		

	Middle	2	14.29 %	5	35.71%	7	50.00 %	14		
	Lower Middle	9	28.13 %	7	21.88%	16	50.00 %	32		
	Lower	0	0.00%	0	0.00%	0	0.00 %	0		
Educational qualification	Graduate	0	0.00%	2	20.00%	8	80.00 %	10	**$\chi 2=8.80$**	**p=0.01 (S) DF=2**
	Higher secondary	2	6.25%	12	37.50%	18	56.25 %	32		
	Higher school	16	30.19 %	22	41.51%	15	28.30 %	53		
	Middle school	0	0.00%	0	0.00%	0	0.00 %	0		
Type of grassroot level worker	ASHA worker	15	20.27 %	25	33.78%	34	45.95 %	74	$\chi 2=1.06$	p=0.30 (NS) DF=1
	ANM (Auxiliary nurse midwife)	3	14.29 %	11	52.38%	7	33.33 %	21		
Subcentre /PHC under which working	UPHC Narapally	9	25.00 %	13	36.11%	14	38.89 %	36	$\chi 2=0.70$	p=0.70 (NS) DF=2
	UPHC Mallapur	6	25.00 %	7	29.17%	11	45.83 %	24		
	PHC Bomallaramaram	3	8.57%	16	45.71%	16	45.71 %	35		
Experience as grassroot level worker (completed years)	8-12 years	15	36.59 %	9	21.95%	17	41.46 %	41	$\chi 2=0.03$	p=0.98 (NS) DF=2
	13-17 years	1	6.25%	8	50.00%	7	43.75 %	16		
	18-23 years	2	5.26%	19	50.00%	17	44.74 %	38		
Income (per capita)	< 5000	16	21.62 %	24	32.43%	34	45.95 %	74	$\chi 2=0.10$	p=0.95 (NS) DF=2
	5001-10000	2	11.76 %	7	41.18%	8	47.06 %	17		

Table 3. Association between knowledge levels and selected demographic variables.
Legend: Association between knowledge levels and selected demographic variables (n=95). Data

presented as frequency (n) and percentage (%). Chi-square test used. S = significant at $p < 0.05$; NS = not significant at $p \geq 0.05$; df = degrees of freedom.

Attitude: Significant associations with education ($\chi^2=5.99$, p=0.05) and worker type ($\chi^2=7.97$, p=0.03). ANMs demonstrated higher favorable attitudes (85.71%) compared to ASHAs (59.46%).

The association between attitude levels and selected demographic variables is shown in **Table 4**.

[INSERT TABLE 4 HERE]

(n=95)

Demographic variable		**Level of Attitude score**						**n**	**Chi square test**	**p value**
		Unfavourable		**Neutral**		**Favourable**				
		n	**%**	**N**	**%**	**N**	**%**			
Age (in years)	Below 30 years	2	28.57%	3	42.86 %	2	28.57 %	7	χ2=4.61	p=0.10 (NS) DF=2
	30-40 years	6	11.76%	11	21.57 %	34	66.67 %	51		
	Above 40 years	4	10.81%	7	18.92 %	26	70.27 %	37		
Gender	Female	11	11.58%	22	23.16 %	62	65.26 %	95	χ2=0.00	p=1.00 (NS) DF=1
	Male	0	0.00%	0	0.00%	0	0.00%	0		
	Others	0	0.00%	0	0.00%	0	0.00%	0		
Marital status	Married	10	11.49%	20	22.99 %	57	65.52 %	87	χ2=0.74	p=0.69 (NS) DF=2
	Unmarried	0	0.00%	0	0.00%	1	100.00 %	1		
	Widow	1	14.29%	2	28.57 %	4	57.14 %	7		
	Separated	0	0.00%	0	0.00%	0	0.00%	0		
Income (per capita)	< 5000	9	12.16%	17	22.97 %	48	64.86 %	74	χ2=2.44	p=0.29 (NS) DF=2
	5001-10000	2	11.76%	5	29.41 %	10	58.82 %	17		
	>10000	0	0.00%	0	0.00%	4	100.00 %	4		
SES Score	Upper	0	0.00%	0	0.00%	7	100.00 %	7	χ2=4.34	p=0.22 (NS) DF=3
	Upper Middle	6	14.29%	11	26.19 %	25	59.52 %	42		

	Middle	2	14.29%	3	21.43 %	9	64.29 %	14		
	Lower Middle	4	12.50%	7	21.88 %	21	65.63 %	32		
	Lower	0	0.00%	0	0.00%	0	0.00%	0		
Educational qualification	Graduate	1	10.00%	1	10.00 %	8	80.00 %	10	**χ2=5.99**	**p=0.05 (S) DF=2**
	Higher secondary	2	6.25%	5	15.63 %	25	78.12 %	32		
	Higher school	8	15.09%	16	30.19 %	29	54.72 %	53		
	Middle school	0	0.00%	0	0.00%	0	0.00%	0		
Type of grassroot level worker	ASHA worker	10	13.51%	20	27.03 %	44	59.46 %	74	**χ2=7.97**	**p=0.03 (S) DF=1**
	ANM (Auxiliary nurse midwife)	1	4.76%	2	9.52%	18	85.71 %	21		
Subcentre /PHC under which working	UPHC Narapally	4	11.11%	8	22.22 %	24	66.67 %	36	χ2=0.70	p=0.70 (NS) DF=2
	UPHC Mallapur	3	12.50%	7	29.17 %	14	58.33 %	24		
	PHC Bomallaramaram	4	11.43%	7	20.00 %	24	68.57 %	35		
Experience as grassroot level worker (completed years)	8-12 years	6	14.63%	11	26.83 %	24	58.54 %	41	χ2=1.47	p=0.48 (NS) DF=2
	13-17 years	2	12.50%	3	18.75%	11	68.75%	16		
	18-23 years	4	10.53%	7	18.42%	27	71.05%	38		

Table 4. Association between attitude levels and selected demographic variables.
Legend: Association between attitude levels and selected demographic variables (n=95). Data presented as frequency (n) and percentage (%). Chi-square test used. S = significant at $p < 0.05$; NS = not significant at $p \geq 0.05$; df = degrees of freedom.

Practice: Significant associations with education ($\chi^2=6.42$, p=0.04) and experience ($\chi^2=6.35$, p=0.04). Participants with 18–23 years of experience demonstrated the best practice (50% good,

26.32% excellent). The association between practice levels and selected demographic variables is shown in **Table 5**.

[INSERT TABLE 5 HERE]

(n=95)

Demographic variable		Level of practice score								n	Chi square test	p-value
		Poor		Average		Good		Excellent				
		n	%	n	%	n	%	N	%			
Age (in years)	Below 30 years	1	14.29 %	4	57.14 %	2	28.57 %	0	0.00%	7	χ2=3.79	p=0.15 (NS) DF=2
	30-40 years	4	7.84%	13	25.49 %	24	47.06 %	10	19.61 %	51		
	Above 40 years	3	8.11%	11	29.73 %	15	40.54 %	8	21.62 %	37		
Gender	Female	8	8.42%	28	29.47 %	41	43.16 %	18	18.95 %	95	χ2=0.00	p=1.00 (NS) DF=1
	Male	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0		
	Others	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0		
Marital status	Married	8	9.20	27	31.03	36	41.38	16	18.39	87	χ2=1.47	p=0.29 (NS) DF=2
	Unmarried	0	0.00	1	100.0 0	0	0.00	0	0.00	1		
	Widow	0	0.00	0	0.00	5	71.43	2	28.57	7		
	Separated	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0		
Income (per capita)	< 5000	6	8.11	19	25.68	33	44.59	16	21.62	74	χ2=2.41	p=0.30 (NS) DF=2
	5001-10000	2	11.76	7	41.18	5	29.41	3	17.65	17		
	>10000	0	0.00	2	50.00	1	25.00	1	25.00	4		
SES Score	Upper	1	14.29	2	28.57	3	42.86	1	14.28	7	χ2=0.94	p=0.81 (NS) DF=3
	Upper Middle	3	7.14	14	33.33	18	42.86	7	16.67	42		
	Middle	1	7.14	5	35.72	6	42.86	2	14.28	14		
	Lower Middle	3	9.37	7	21.88	14	43.75	8	25.00	32		
	Lower	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0		
Educational qualification	Graduate	0	0.00	2	20.00	6	60.00	2	20.00	10	**χ2=6.42**	**p=0.04 (S) DF=2**
	Higher secondary	2	6.25	6	18.75	17	53.13	7	21.87	32		
	Higher school	6	11.32	20	37.73	18	33.96	9	16.99	53		

	Middle school	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0		
Type of grassroot level worker	ASHA worker	7	9.46	23	31.08	31	41.89	13	17.57	74	$\chi 2=1.00$	p=0.31 (NS) DF=1
	ANM (Auxiliary nurse midwife)	1	4.76	5	23.81	10	47.62	5	23.81	21		
Subcentre /PHC under which working	UPHC Narapally	4	11.11	12	33.33	14	38.89	6	16.67	36	$\chi 2=5.51$	p=0.06 (NS) DF=2
	UPHC Mallapur	2	8.33	10	41.67	8	33.33	4	16.67	24		
	PHC Bomallaramaram	2	5.71	6	17.14	19	54.29	8	22.86	35		
Experience as grassroot level worker (completed years)	8-12 years	5	12.20	16	39.02	15	36.59	5	12.19	41	**$\chi 2=6.35$**	**p=0.04 (S) DF=2**
	13-17 years	1	6.25	5	31.25	7	43.75	3	18.75	16		
	18-23 years	2	5.26	7	18.42	19	50.00	10	26.32	38		

Table 5. Association between practice levels and selected demographic variables.
Legend: Association between practice levels and selected demographic variables (n=95). Data presented as frequency (n) and percentage (%). Chi-square test used. S = significant at $p < 0.05$; NS = not significant at $p \geq 0.05$; df = degrees of freedom.

Correlation Analysis

Knowledge correlated significantly with attitude (r=0.480, p=0.001) and practice (r=0.321, p=0.001). Attitude and practice were not significantly correlated (r=0.068, p=0.512). Age and experience were strongly correlated (r=0.587, p=0.001). No significant correlations were found between KAP scores and age, SES, or experience (p>0.05).

The correlation matrix is presented in **Table 6**.

[INSERT TABLE 6 HERE]

(n=95)

Correlation between knowledge, attitude, practice, age, socio-economic status and experience								
			Knowledge	**Attitude**	**Practice**	**Age (in years)**	**SES Score**	**Experience**
Pearson's r	**knowledge**	**Correlation Coefficient**	1.000	**0.480**	**0.321**	0.226	0.230	0.236
		Sig. (2-tailed)	.	**0.001**	**0.001**	0.228	0.208	0.175
		N	95	95	95	95	95	95
	Attitude	**Correlation Coefficient**	**0.480**	1.000	0.068	0.142	-0.050	**0.121**
		Sig. (2-tailed)	**0.001**	.	0.512	0.170	0.633	**0.244**
		N	95	95	95	95	95	95
	Practice	**Correlation Coefficient**	**0.321**	0.068	1.000	0.062	0.191	0.021
		Sig. (2-tailed)	**0.001**	0.512	.	0.553	0.173	0.843
		N	95	95	95	95	95	95
	Age (in years)	**Correlation Coefficient**	0.226	0.142	0.062	1.000	-0.037	0.587
		Sig. (2-tailed)	0.228	0.170	0.553	.	0.725	0.001
		N	95	95	95	95	95	95
	SES Score	**Correlation Coefficient**	0.230	-0.050	0.191	-0.037	1.000	-0.159
		Sig. (2-tailed)	0.208	0.633	0.173	0.725	.	0.123
		N	95	95	95	95	95	95
	Experience as grassroot level	**Correlation Coefficient**	0.236	**0.121**	0.021	0.587	- 0.159	1.000
		Sig. (2-	0.175	**0.244**	0.843	0.001	0.123	.

	worker	**tailed)**						
	(completed years)	**N**	95	95	95	95	95	95

Table 6. Correlation between knowledge, attitude, practice, and selected demographic variables. *Legend:* Pearson's correlation matrix for knowledge, attitude, practice, age, socioeconomic status, and experience (n=95). Data presented as correlation coefficient (r) and p-value. S = significant at $p < 0.05$; NS = not significant at $p \geq 0.05$.

The correlation coefficients with interpretation are presented in **Table 7**.

[INSERT TABLE 7 HERE]

(n=95)

Variable pair	Mean ± SD	Pearson's r	p-value	Interpretation
Knowledge Score vs. Attitude Score	20.78 ± 5.78 / 58.92 ± 7.43	0.480	0.001 **(S)**	There is a significant positive **moderate** correlation between knowledge and attitude. As knowledge increases, attitude score also increases moderately.
Knowledge Score vs. Practice Score	20.78 ± 5.78 / 36.55 ± 2.52	0.321	0.001 **(S)**	There is a significant positive **fair** correlation between knowledge and practice. As knowledge increases, practice score also increases fairly.
Attitude Score vs. Practice Score	58.92 ± 7.43 / 36.55 ± 2.52	0.068	0.512 (NS)	There is **no significant** correlation between attitude and practice. An increase in attitude does not necessarily correspond to an increase in practice score.
Knowledge Score vs. Age	20.78 ± 5.78 / 38.16 ± 6.06	0.226	0.228 (NS)	There is **no significant** correlation between knowledge and age. Knowledge levels are not significantly related to the age of the respondents.

Knowledge Score vs. SES Score	20.78 ± 5.78 / 3.25 ± 1.01	0.230	0.208 (NS)	There is **no significant** correlation between knowledge and SES. Knowledge levels are not significantly related to socioeconomic status.
Knowledge Score vs. Experience	20.78 ± 5.78 / 15.04 ± 4.81	0.236	0.175 (NS)	There is **no significant** correlation between knowledge and experience.
				Knowledge levels are not significantly related to the number of years worked.
Attitude Score vs. Age	58.92 ± 7.43 / 38.16 ± 6.06	0.142	0.170 (NS)	There is **no significant** correlation between attitude and age.
Attitude Score vs. SES Score	58.92 ± 7.43 / 3.25 ± 1.01	-0.050	0.633 (NS)	There is **no significant** negative negligible correlation between attitude and SES.
Attitude Score vs. Experience	58.92 ± 7.43 / 15.04 ± 4.81	0.121	0.244 (NS)	There is **no significant** correlation between attitude and experience.
Practice Score vs. Age	36.55 ± 2.52 / 38.16 ± 6.06	0.062	0.553 (NS)	There is **no significant** correlation between practice and age.
Practice Score vs. SES Score	36.55 ± 2.52 / 3.25 ± 1.01	0.191	0.173 (NS)	There is **no significant** correlation between practice and SES.
Practice Score vs. Experience	36.55 ± 2.52 / 15.04 ± 4.81	0.021	0.843 (NS)	There is **no significant** correlation between practice and experience.
Age vs. Experience	38.16 ± 6.06 / 15.04 ± 4.81	0.587	0.001 **(S)**	There is a significant positive **moderate** correlation between age and experience. Older respondents tend to have significantly more work experience.

Table 7. Correlation between knowledge, attitude, and practice scores with selected demographic variables with interpretation.
Legend: Pearson's correlation coefficients with interpretation for variable pairs (n=95). S = significant at $p < 0.05$; NS = not significant at $p \geq 0.05$.

Qualitative Findings

Five major themes emerged:

Theme 1: Knowledge and Perception — Workers demonstrated strong foundational knowledge of diarrhea definition, etiology, and severity, aligned with WHO/IMNCI guidelines. However, minor variations in diagnostic thresholds (3–5 stools/day) suggested potential knowledge gaps.

Theme 2: Case Management Practices — Workers demonstrated high adherence to IMNCI protocols in assessment, ORS/zinc administration, and referral. They functioned as skilled gatekeepers, making triage decisions and initiating hierarchical referrals.

Theme 3: Challenges and Barriers in Management — Eight sub-themes emerged: misinformation and myths (fluid restriction beliefs, teething misconceptions); lack of seriousness and resistance; non-adherence (zinc course completion); community knowledge and skill gaps (ORS preparation difficulties); supply and infrastructure barriers (stock-outs, transport issues); IEC and training gaps (lack of visual aids, refresher training); administrative and workload challenges (excessive documentation); and community-related behavioral challenges (passive health reporting, delayed care-seeking).

Theme 4: Health System Navigation and Community Engagement — Workers described their dual role as system navigators and community brokers. Trust dynamics favored peer/traditional advice over professional guidance. Existing support structures (monthly meetings, supervisor guidance) were valued but needed strengthening.

Theme 5: Capacity and Confidence — Workers exhibited high self-efficacy rooted in practical training and field experience. They identified needs for refresher training, real-time helplines, better IEC materials, and improved transport.

A summary of the qualitative themes and key insights is presented in **Table 8**.

[INSERT TABLE 8 HERE]

Theme	Sub-themes	Key Insights
1. Knowledge and perception	1.1 Definition of diarrhea 1.2 Etiology of diarrhea 1.3 Severity and rationale	Workers possess strong, protocol-aligned foundational knowledge. Understanding of dehydration risk is particularly well-internalized and framed within a child survival imperative.

2.Case management practices	2.1 Assessment and Identification 2.2 Management of diarrhea 2.3 Escalation and referral	Practices demonstrate high adherence to IMNCI protocols in a systematic, step-wise process. Workers function as skilled gatekeepers, making triage decisions and initiating hierarchical referrals.
3. Challenges and barriers	3.1-3.8 (Eight sub-themes covering myths, resistance, non-adherence, skill gaps, supply issues, IEC/training gaps, admin burden, community behavior)	Barriers are multi-layered: Community-level (myths, distrust, low health literacy) and System-level (stock-outs, transport, admin burden, insufficient support). These interact to impede effective management.
4. Health system navigation and community engagement	4.1 Community trust and Influence 4.2 Guidance and referral Pathways 4.3 Communication and outreach	Effectiveness depends on the worker's dual role as system navigator and community broker. Success is moderated by the degree of community trust and the usability of systemic pathways and communication tools.
5. Capacity and confidence	5.1 Self-efficacy in education 5.2 Skill and knowledge building 5.3 System support	Workers exhibit high self-efficacy rooted in experience and value practical training. Their capacity is underutilized due to gaps in systemic support. They propose solutions like helplines, better IEC materials, and reliable transport.

Table 8. Summary of qualitative themes and key insights.
Legend: Summary of the five major qualitative themes, sub-themes, and key insights derived from focus group discussions and in-depth interviews with grassroots health workers (n=26).

The conceptual model developed from the qualitative findings is presented in **Figure 5**.

[INSERT FIGURE 5 HERE]

Figure 5. Conceptual model of childhood diarrhea management at the grassroots level.
Legend: The model illustrates the dynamic interrelationships among five themes: (1) Knowledge and perception (foundational awareness); (2) Case management practices (operational workflow); (3) Challenges and barriers (constraining ecosystem); (4) Health system navigation and community engagement (relational interface); and (5) Capacity and confidence (enabling competence). The core clinical pathway (Themes 1→2) leads to health outcomes but operates within a constraining ecosystem (Theme 3) shaped by care-seeking dynamics (Theme 5). Capacity and confidence (Theme 4) acts as an enabling counterforce that strengthens case management and mitigates challenges. The model posits that improving diarrhea-related health outcomes requires a multi-pronged strategy addressing clinical knowledge, operational protocols, community engagement, worker resilience, and systemic support.

Integration and Meta-Inferences

Triangulation revealed convergence between quantitative and qualitative findings. Quantitative gaps in zinc adherence were explained by qualitative reports of stock-outs and caregiver resistance. Referral delays were contextualized by transport issues and parental reluctance. The conceptual model (Figure 6) illustrated that effective diarrhea management depends on the interplay between individual capability, community trust, and systemic support.

[INSERT FIGURE 6 HERE]

Figure 6. Integrated conceptual model of childhood diarrhea management at the grassroots level derived from meta-inferences.

Legend: The model synthesizes quantitative and qualitative findings to illustrate that effective diarrhea management depends on the dynamic interplay between individual capability (knowledge, attitude, practice, education, experience), community trust and dynamics (myths, care-seeking behavior, health literacy), and systemic support (supply chain, transport, administrative burden, refresher training, IEC materials). Meta-inferences derived from triangulation explain quantitative gaps through qualitative insights and directly informed the development of the structured teaching programme module. ORS = oral rehydration solution; IEC = information, education, and communication.

The triangulation of findings is presented in **Table 9**.

[INSERT TABLE 9 HERE]

Theme	Quantitative Findings	Qualitative Insights	Triangulation	Meta-Inference for Module Development
Knowledge of diarrhea definition	92% correctly identified WHO definition	Workers articulated ≥3 loose stools/day and dehydration signs	Strong convergence between measured and expressed knowledge	Reinforce knowledge through skill-based application exercises rather than basic definition teaching
ORS and zinc adherence	78% always provided ORS; 62% consistently provided zinc	Workers reported intention to follow ORS+zinc but cited stock-outs and caregiver resistance	Partial convergence; quantitative gap explained by systemic barriers	Include practical strategies for zinc counselling and supply management advocacy
Community myths and resistance	45% caregivers believed fluid restriction stops diarrhea	Workers described myths about teething and fluid restriction	Complementarity: qualitative data explains persistence of myths	Integrate myth-busting communication strategies and IEC tools in module

Referral practices	70% made referrals; only 40% reached facilities within 24 hours	Transport issues and parental reluctance cited	Divergence between referral intent and completion	Add counselling techniques and local referral mapping in training
Training and support needs	65% no refresher training; 80% desired visual aids	Workers expressed need for IEC materials and refresher sessions	Strong convergence	Develop structured refresher component and job aids within STP
Workload and administrative burden	85% spent >30% time on documentation	Workers reported frustration with paperwork	Convergence indicating systemic inefficiency	Include time-management and prioritization strategies in module
Attitude differences (ANM vs ASHA)	Significant difference in attitude ($p = 0.047$)	ANMs reported greater clinical confidence than ASHAs	Quantitative difference supported by qualitative variation in confidence	Tailor module sections differently for ASHAs and ANMs
Education & experience association	Practice significantly associated with education and years of experience ($p = 0.04$)	Experienced workers expressed better confidence in dehydration assessment	Complementary evidence	Include differentiated learning strategies based on experience level

Table 9. Triangulation of qualitative and quantitative findings.
Legend: Integration of quantitative and qualitative findings through triangulation, showing convergence, complementarity, and divergence, with meta-inferences for module development.

Module Development

Based on the integrated findings, a structured teaching programme module was developed. The module addresses the identified knowledge gaps (particularly in zinc therapy, dehydration assessment, and referral criteria) and contextual barriers (community myths, supply constraints, administrative burden). The module was validated by eight experts, with an overall S-CVI/average of 0.88. The module comprises nine sessions with participatory teaching methods including demonstrations, role-plays, case scenarios, and group discussions.

DISCUSSION

This mixed-methods study provides comprehensive evidence on the KAP of grassroots health workers regarding diarrheal disease management in Telangana, India, and informed the development of a structured teaching programme module. The findings reveal that while attitudes are predominantly favorable and practices generally competent, significant gaps persist in knowledge and consistent practice. These gaps are not primarily knowledge-driven but are shaped by systemic and contextual barriers.

The finding that 43.46% had good knowledge, 65.26% favorable attitudes, and 43.16% good practice aligns with recent literature. Halli et al. (2024) reported improved ORS coverage nationally but persistent district-level gaps in zinc use [20]. Jagadeesh et al. (2024) found general caregiving practices surpassed technical understanding, particularly for zinc therapy and danger sign recognition [11]. Ahabwe and Kazibwe (2023) reported comparable figures (47.1% adequate knowledge, 66.1% positive attitudes, 41.1% appropriate practices) [12]. These convergent findings suggest a consistent pattern: favorable attitudes do not automatically translate into optimal knowledge or skilled practice.

The significant association between education and all three KAP domains underscores the importance of educational qualification in shaping competency. This aligns with Majumdar et al. (2025), who found education level significantly influenced knowledge outcomes among ASHAs [10]. The significant association between age and knowledge, and between experience and practice, suggests that both formal education and experiential learning contribute to competency. However, the lack of significant correlation between knowledge and experience ($r=0.236$, $p=0.175$) indicates that knowledge does not automatically accumulate with years of service—highlighting the need for structured refresher training.

The significantly more favorable attitudes among ANMs compared to ASHAs (p=0.047) is consistent with Scott et al. (2018), who reported that formally trained cadres demonstrate stronger professional identity and confidence [17]. This suggests that ASHAs may benefit from additional motivational support and attitudinal training.

The qualitative findings provide critical context for these quantitative patterns. Workers demonstrated strong foundational knowledge and protocol adherence but were constrained by systemic barriers: stock-outs of ORS and zinc, transport difficulties, excessive documentation, and insufficient refresher training. These findings align with Behera et al. (2023) on logistics barriers [13], Bist et al. (2023) on workload and administrative burden [14], Vila-Guilera et al. (2022) on community trust and cultural beliefs [15], and Singh et al. (2021) on training without follow-up mentoring [16].

The conceptual model developed from this study advances understanding by illustrating that diarrhea management at the grassroots level is not merely a clinical task but a socio-systemic process. Success depends on the interplay between individual capability (Themes 1, 2, 5), community trust and dynamics (Theme 4), and systemic support (Theme 3). This systems-view provides a coherent framework for designing interventions that equip workers not only with knowledge but also with strategies to navigate the complex relational and systemic landscape.

The structured teaching programme module developed from these findings addresses the identified gaps through a competency-based, context-sensitive approach. Unlike existing generic training materials, this module integrates quantitative baseline assessments and qualitative insights to create a targeted intervention. The module's emphasis on practical demonstrations, myth-busting communication, referral decision-making, and system navigation directly responds to the barriers identified in the qualitative phase. The validation process (S-CVI=0.88) confirms the content validity and relevance of the module.

Implications for Practice and Policy

The findings have several implications. First, training programs must move beyond didactic knowledge transfer to include hands-on ORS and zinc demonstrations, dehydration assessment, counseling simulations, referral decision-making, and myth-busting communication strategies. Second, systemic barriers—particularly reliable ORS and zinc supply, reduced documentation burden, and improved transport—must be addressed for training to translate into practice. Third, ASHAs may benefit from targeted motivational and attitudinal support. Fourth, the developed structured teaching programme module should be integrated into routine training and monthly review meetings at PHC and sub-center levels.

Strengths and Limitations

Strengths: The mixed-methods design enabled both quantification of KAP indicators and rich contextual explanation. The conceptual model provides a theoretical contribution. The study informed a contextually grounded training module with validated content.

Limitations: The study was limited to one district of Telangana, limiting generalizability. Unequal sample sizes between ASHAs (n=74) and ANMs (n=21) may have reduced statistical power. Self-reported practices may be subject to recall and social desirability bias. No direct observation of field practices was conducted. The module's effectiveness in improving KAP and health outcomes was not evaluated in this study and warrants future research.

CONCLUSIONS

This study demonstrates that grassroots health workers in Telangana possess favorable attitudes and moderate knowledge and practice regarding diarrheal disease management. However, significant gaps persist, particularly in technical knowledge and consistent practice. These gaps are not primarily knowledge-driven but are shaped by systemic barriers including supply-chain disruptions, administrative burdens, and insufficient refresher training, as well as community-level barriers including myths, resistance, and delayed care-seeking. The conceptual model developed illustrates that effective diarrhea management requires a multi-pronged strategy addressing individual capability, community dynamics, and systemic support. The structured teaching programme module developed from these findings provides a contextually grounded, evidence-based training resource with potential to strengthen community-level diarrhea management, reduce preventable deaths, and contribute to national child health priorities and Sustainable Development Goal 3.

LIST OF ABBREVIATIONS

Abbreviation	Full Form
ANM	Auxiliary Nurse Midwife
ASHA	Accredited Social Health Activist
AIIMS	All India Institute of Medical Sciences
CI	Confidence Interval
DRC	Departmental Research Committee
FGD	Focus Group Discussion
GAPPD	Global Action Plan for Pneumonia and Diarrhoea
IDI	In-Depth Interview
IEC	Institutional Ethics Committee; Information, Education, and Communication

IMNCI	Integrated Management of Neonatal and Childhood Illness
IRC	Institutional Research Committee
KAP	Knowledge, Attitude, and Practice
NFHS	National Family Health Survey
ORS	Oral Rehydration Solution
PHC	Primary Health Centre
SD	Standard Deviation
SES	Socioeconomic Status
S-CVI	Scale Content Validity Index
STP	Structured Teaching Programme
ToT	Training of Trainers
UPHC	Urban Primary Health Centre
WASH	Water, Sanitation, and Hygiene
WHO	World Health Organization

DECLARATIONS

Ethics Approval and Consent to Participate

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki (2013 revision) and the National Ethical Guidelines for Biomedical and Health Research Involving Human Participants issued by the Indian Council of Medical Research (ICMR, 2017). The study was approved by the Departmental Research Committee (DRC) and Institutional Research Committee (IRC) of College of Nursing, AIIMS Bibinagar. Ethical clearance was obtained from the Institutional Ethics Committee (IEC ref no: AIIMS/BNN/IEC/Apr/2025/712). Administrative approval was obtained from concerned health authorities of selected PHCs. Informed consent was obtained from all participants after explaining the purpose, procedures, and voluntary nature of participation. Confidentiality and anonymity were strictly maintained. Participants were informed of their right to withdraw at any time without penalty.

Consent for Publication

Not applicable.

Availability of Data and Materials

The datasets generated and/or analyzed during the current study are not publicly available due to participant confidentiality and institutional data policies but are available from the corresponding author on reasonable request. The structured teaching programme module developed in this study is available as Additional file 3.

Competing Interests

The authors declare that they have no competing interests.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Authors' Contributions

DC conceptualized the study, designed the methodology, collected and analyzed the data, developed the structured teaching programme module, and drafted the manuscript. ASM supervised the study, provided methodological guidance, and critically revised the manuscript. ASS provided academic guidance, contributed to the development of the module, and critically revised the manuscript. GNK provided expert guidance in community medicine, contributed to the methodological rigor, and critically revised the manuscript. All authors read and approved the final manuscript.

Acknowledgements

The authors express sincere gratitude to the grassroots health workers who participated in this study, the medical officers of the selected PHCs for their cooperation, and the experts who validated the tools and the structured teaching programme module. Special thanks to the College of Nursing and the Department of Community and Family Medicine, AIIMS Bibinagar, for institutional support. The authors also acknowledge the support of the Institutional Ethics Committee and the research coordinators who facilitated this study.

Authors' Information

Deepanshi Choudhary is an M.Sc. Nursing student in Community Health Nursing at the College of Nursing, AIIMS Bibinagar, with a focus on community health and child survival interventions. Azhar S. M. is an Assistant Professor at the College of Nursing, AIIMS Bibinagar, with expertise in community health nursing and mixed-methods research. A. Serma Subathra is an Associate Professor at the College of Nursing, AIIMS Bibinagar, with expertise in child health nursing and nursing education. Govindrao N. K. is an Additional Professor in the Department of Community and Family Medicine, AIIMS Bibinagar, with expertise in public health and community medicine.

REFERENCES

1. World Health Organization. Diarrhoeal disease [Internet]. Geneva: WHO; 2023 [cited 2024 Jan 15]. Available from: https://www.who.int/news-room/fact-sheets/detail/diarrhoeal-disease
2. United Nations Children's Fund, World Health Organization. Ending preventable child deaths from pneumonia and diarrhoea: Global Action Plan (GAPPD). Geneva: WHO; 2013.
3. Troeger C, Blacker BF, Khalil IA, Rao PC, Cao S, Zimsen SR, et al. Estimates of the global, regional, and national morbidity and mortality of diarrhoeal diseases in children under five years: a systematic analysis. Lancet Infect Dis. 2018;18(11):1211-28.
4. Black RE, Walker CLF, Rudan I, Liu L, Nair H, Theodoratou E, et al. Global, regional, and national causes of child mortality in 2008: a systematic analysis. Lancet. 2010;375(9730):1969-87.
5. International Institute for Population Sciences (IIPS) and ICF. National Family Health Survey (NFHS-5), 2019-21: India. Mumbai: IIPS; 2021.
6. Ministry of Health and Family Welfare. National Family Health Survey-5 (NFHS-5) State Fact Sheet: Telangana. New Delhi: MoHFW; 2021.
7. Fewtrell L, Kaufmann RB, Kay D, Enanoria W, Haller L, Colford JM. Water, sanitation, and hygiene interventions to reduce diarrhoea in less developed countries: a systematic review and meta-analysis. Lancet Infect Dis. 2005;5(1):42-52.
8. Wolf J, Hunter PR, Freeman MC, Cumming O, Clasen T, Bartram J, et al. Impact of drinking water, sanitation and handwashing with soap on childhood diarrhoeal disease: updated meta-analysis and meta-regression. Trop Med Int Health. 2018;23(5):508-25.
9. World Health Organization, United Nations Children's Fund. Global Action Plan for Pneumonia and Diarrhoea (GAPPD): Ending preventable child deaths from pneumonia and diarrhoea by 2025. Geneva: WHO; 2013.
10. Singh S, Tiwary B, Barik M, Arora H, Abraham SS, Majumdar P, et al. Knowledge of Accredited Social Health Activists in India: a systematic review and meta-analysis of evidence drawn from primary studies published between 2005 and 2022. BMC Health Serv Res. 2025;25:58.
11. Jagadeesh KV, et al. Knowledge, attitude and practice of mothers in the management of diarrhoea among under-five children in a rural area of India: a cross-sectional study. J Fam Med Prim Care. 2024;13.

12. Ahabwe D, Kazibwe A. Knowledge, attitudes and practices related to diarrhoea prevention and management among caregivers of under-five children in Uganda. 2023.

13. Behera D, et al. Operational research on zinc-ORS co-packaging and programmatic barriers in diarrhoea case management in India. 2023.

14. Bist RR, Patel K, Pradhan S, Patro BK, Tripathy SK, Gollapalli PK, Jena S. What they know about their work, barriers and challenges faced by community health workers while performing their multiple roles: a mixed-methods study in India. Int J Community Med Public Health. 2023;10(6):2228-2233.

15. Vila-Guilera J, Dasgupta R, Parikh P, Ciric L, Lakhanpaul M. Barriers to the delivery and uptake of water sanitation and hygiene promotion and infant diarrhoea prevention services: a case study in rural tribal Banswara, Rajasthan. Indian Pediatr. 2022;59:38-42.

16. Singh S, et al. Training community health workers for COVID-19 response in India: experiences and lessons for primary care. J Fam Med Prim Care. 2021;10.

17. Scott K, Beckham SW, Gross M, Pariyo G, Rao KD, Cometto G, et al. What do we know about community health workers? A systematic review of existing reviews. Hum Resour Health. 2018;16:39.

18. Humera Abida, Batchu NagaGayathri. The Under 5 Age Children in Urban Area of Sangareddy, Telangana. Indian Journal of Public Health Research & Development. 2020;11(6):344-348.

19. Lamberti LM, Fischer Walker CL, Taneja S, Mazumder S, Black RE. The association between provider practice and knowledge of ORS and zinc supplementation for the treatment of childhood diarrhea in Bihar, Gujarat and Uttar Pradesh, India: a multi-site cross-sectional study. PLoS One. 2015;10(6):e0130845.

20. Halli SS, et al. Oral rehydration therapy and zinc treatment among diarrhoeal children under five years in India: prevalence, determinants and district-level variations. BMC Public Health. 2024;24.

Figures

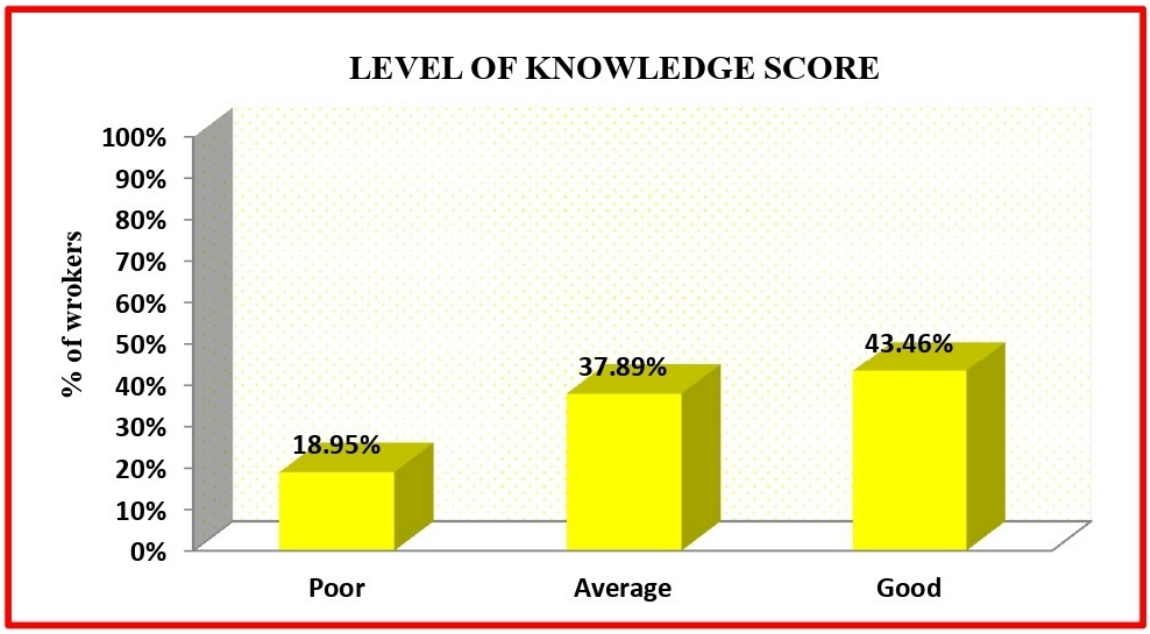


Figure 1

Level of knowledge of grassroots health workers regarding diarrhea prevention and management.
Legend: Distribution of knowledge levels among grassroots health workers (n=95). Among participants, 43.46% demonstrated good knowledge, 37.89% had average knowledge, and 18.95% had poor knowledge regarding prevention and management of diarrheal diseases in under-five children. Scoring: poor (0–10), average (11–20), good (21–30).

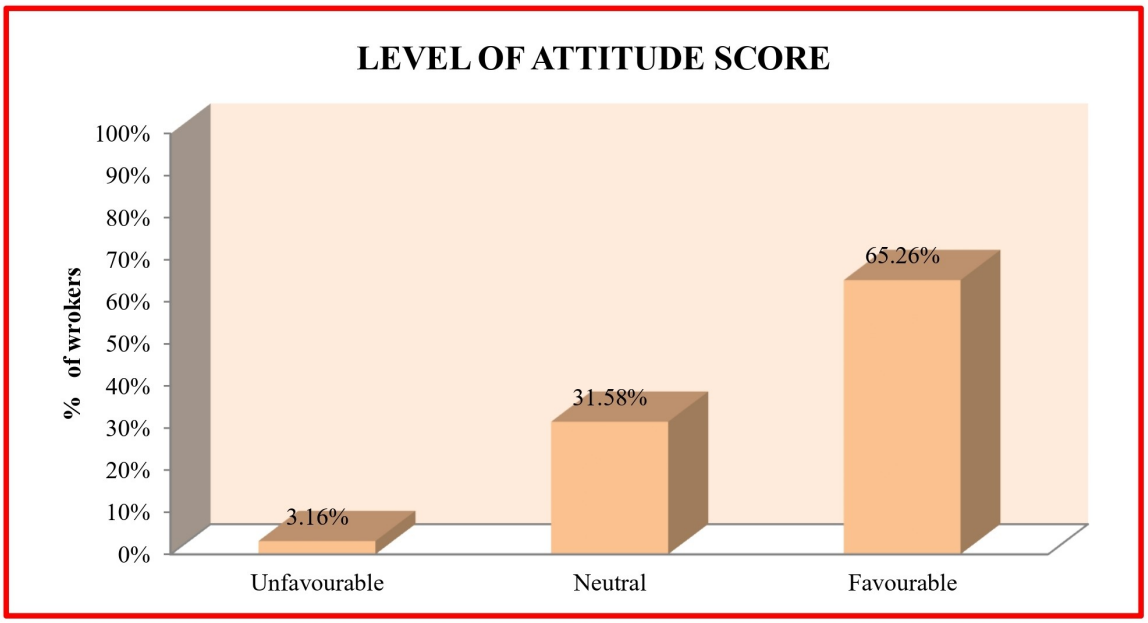


Figure 2

Level of attitude of grassroots health workers regarding diarrhea prevention and management.
Legend: Distribution of attitude levels among grassroots health workers (n=95). The majority (65.26%) displayed favorable attitudes, 31.58% had neutral attitudes, and only 3.16% showed unfavorable attitudes toward diarrhea prevention and management in under-five children. Scoring: unfavorable (15–35), neutral (36–55), favorable (56–75).

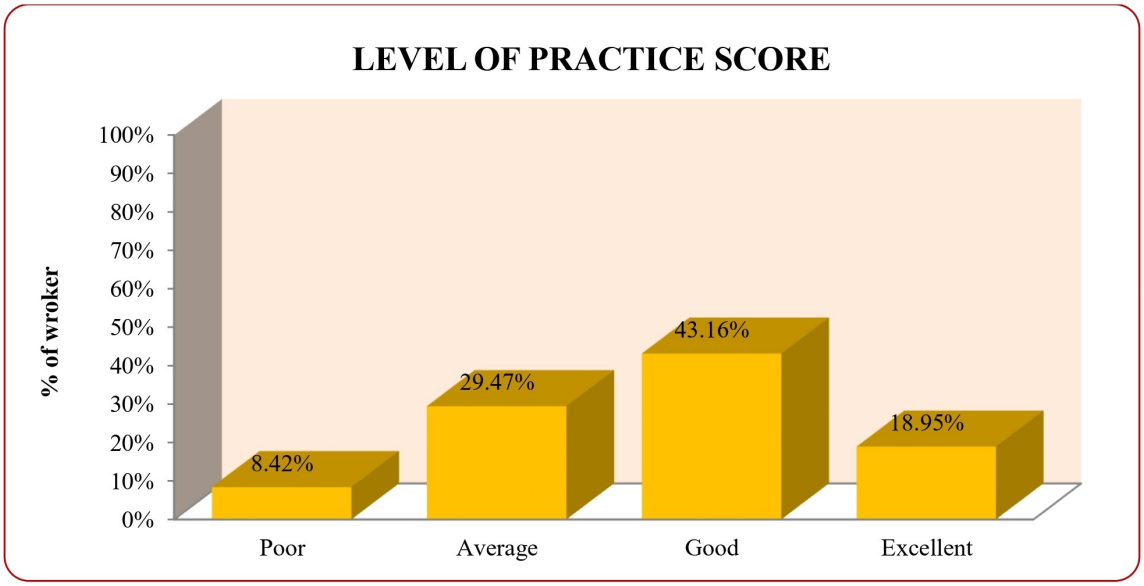


Figure 3

Level of practice of grassroots health workers regarding diarrhea prevention and management.
Legend: Distribution of practice levels among grassroots health workers (n=95). Among participants, 43.16% demonstrated good practice, 29.47% average practice, 18.95% excellent practice, and 8.42% poor practice regarding prevention and management of diarrheal diseases in under-five children during the last three months. Scoring: poor (0–40%, 0–6), average (41–60%, 7–9), good (61–80%, 10–12), excellent (81–100%, 13–15).

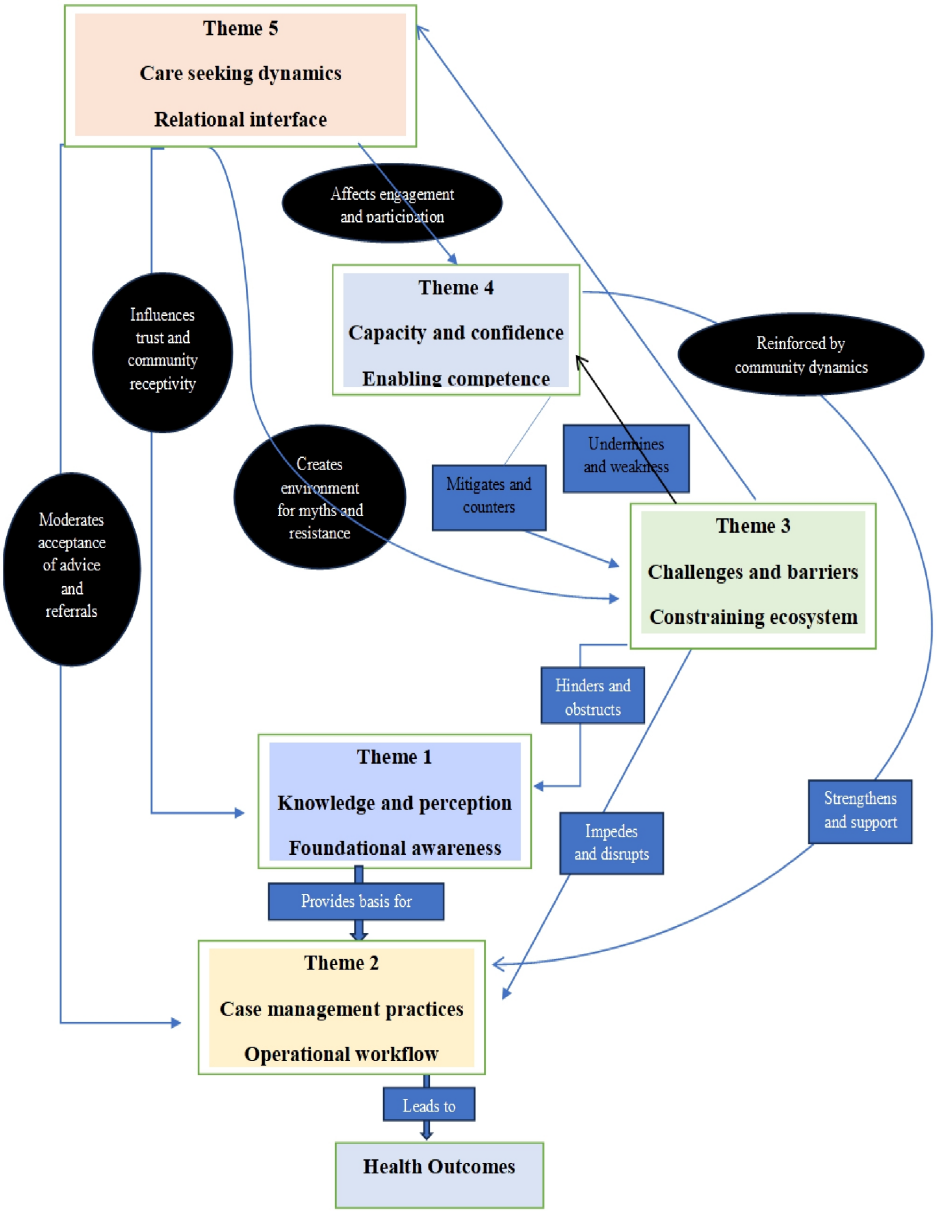


Figure 4

Conceptual model of childhood diarrhea management at the grassroots level.
Legend: The model illustrates the dynamic interrelationships among five themes: (1) Knowledge and perception (foundational awareness); (2) Case management practices (operational workflow); (3) Challenges and barriers (constraining ecosystem); (4) Health system navigation and community engagement (relational interface); and (5) Capacity and confidence (enabling competence). The core

clinical pathway (Themes 1→2) leads to health outcomes but operates within a constraining ecosystem (Theme 3) shaped by care-seeking dynamics (Theme 5). Capacity and confidence (Theme 4) acts as an enabling counterforce that strengthens case management and mitigates challenges. The model posits that improving diarrhea-related health outcomes requires a multi-pronged strategy addressing clinical knowledge, operational protocols, community engagement, worker resilience, and systemic support.

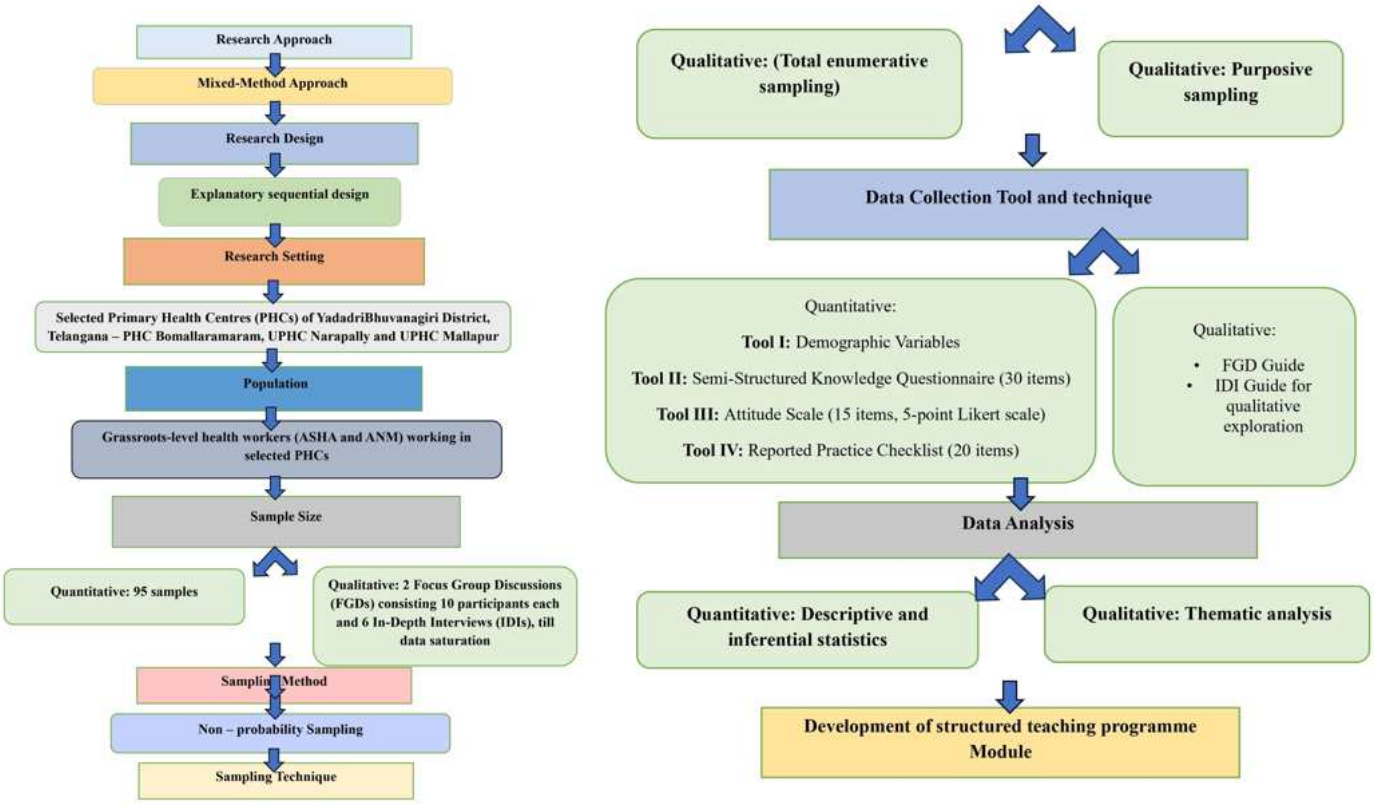


Figure 5

Schematic representation of the research methodology.
Legend: The study employed an explanatory sequential mixed-methods design comprising: (1) quantitative phase with total enumerative sampling of all eligible ASHA and ANM workers (n=95) using demographic proforma, semi-structured knowledge questionnaire, Likert attitude scale, and practice checklist; and (2) qualitative phase with purposive sampling for 2 focus group discussions (n=20) and 6 in-depth interviews, analyzed using six-step thematic analysis. Integration of quantitative and qualitative findings informed the development of a structured teaching programme module.

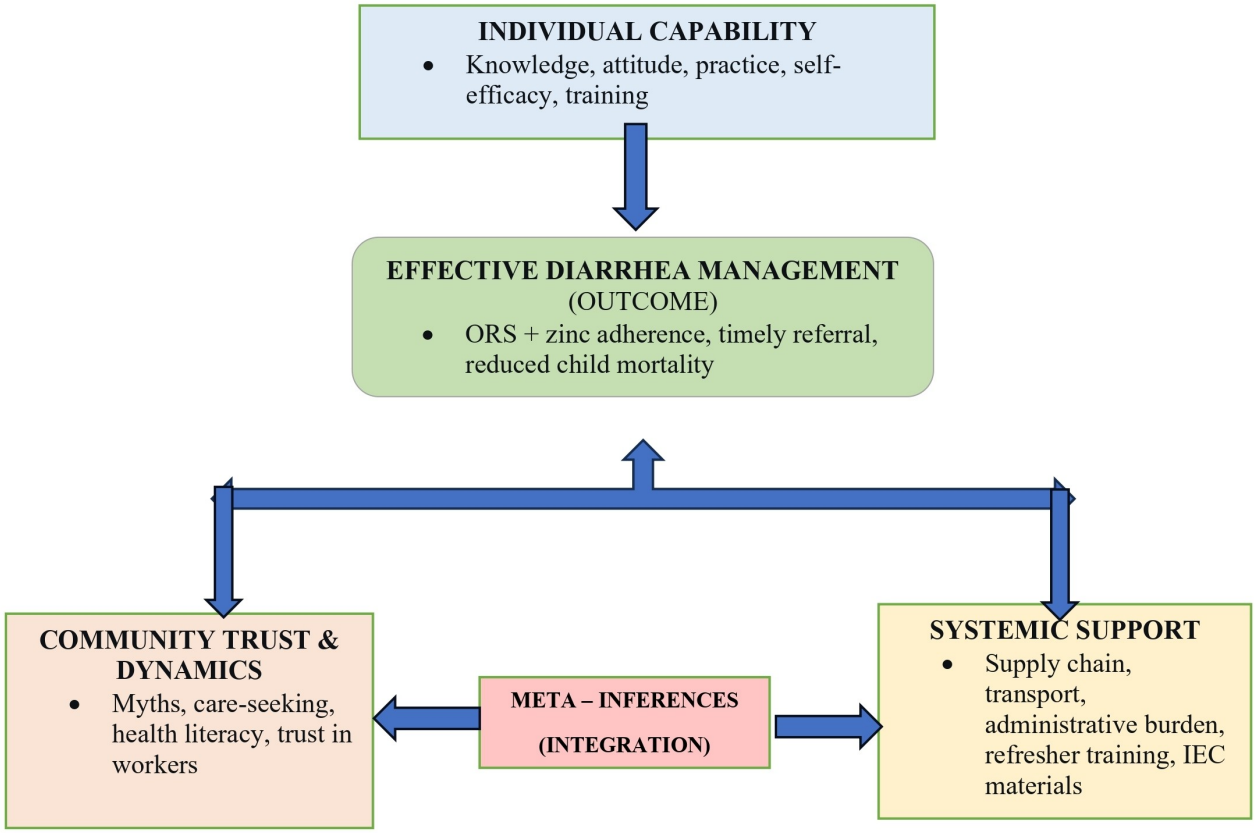


Figure 6

Integrated conceptual model of childhood diarrhea management at the grassroots level derived from meta-inferences.

Legend: The model synthesizes quantitative and qualitative findings to illustrate that effective diarrhea management depends on the dynamic interplay between individual capability (knowledge, attitude, practice, education, experience), community trust and dynamics (myths, care-seeking behavior, health literacy), and systemic support (supply chain, transport, administrative burden, refresher training, IEC materials). Meta-inferences derived from triangulation explain quantitative gaps through qualitative insights and directly informed the development of the structured teaching programme module. ORS = oral rehydration solution; IEC = information, education, and communication.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Additionalfile1.Datacollectiontools.docx
- Additionalfile2.Codingandthematicanalysis..docx
- Additionalfile3.Structuredteachingprogrammemodule.docx
- Additionalfile4.COREQCHECKLIST.docx
- Additionalfile5wavierAPC.pdf