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QUANTITATIVE STUDIES

A community pediatric nursing evaluation of feeding and hygiene practices in the prevention of infant diarrhea (0–6 months)

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Abstract
Diarrhea remains a major cause of infant morbidity and mortality in low- and middle-income countries. Inappropriate feeding practices, non-exclusive breastfeeding, poor hygiene, and inadequate bottle sanitation are suspected to increase infants' exposure to enteric pathogens. However, research addressing these factors in infants under six months of age is limited in the literature. Therefore, the study was conducted to evaluate feeding and hygiene practices among this population. The study employed a cross-sectional design to achieve its research objectives. Data collection was conducted from September to December 2024 in Kendari City, Indonesia. The study used a purposive sampling method based on eligibility criteria. The inclusion criteria were mothers of infants aged 0–6 months, willingness to participate, provision of written informed consent, the ability to provide complete and accurate information. On the contrary, the exclusion criteria included mothers who were uncooperative during data collection or infants with congenital gastrointestinal disorders. A total of 315 participants were engaged in the study. Data were collected using questionnaires covering feeding practices, breastfeeding behavior, hygiene, and infant health history. All instruments underwent validity and reliability testing, yielding satisfactory results that confirmed their suitability for data collection. Data were analyzed using descriptive statistics, chi-square tests, and multivariate logistic regression. The significance level was set at $p<0.05$ for hypothesis testing. Results showed that early complementary feeding, absence of exclusive breastfeeding, and poor bottle hygiene were significantly associated with diarrhea ($p<0.001$). Poor bottle hygiene was the dominant determinant (OR=44.885; 95% CI=0.031–108.269), followed by lack of exclusive breastfeeding (OR=9.136; 95% CI=0.845–98.804) and early complementary feeding (OR=8.763; 95% CI=0.806–95.318). These findings indicate that suboptimal feeding and hygiene practices increase the risk of diarrhea among infants. The research contributes baseline evidence to the field of nursing, supporting future scholarly work in Indonesia and across the globe.

Keywords: Bottle hygiene, complementary feeding, exclusive breastfeeding, hygiene practice, infant diarrhea

Introduction

Diarrhea remains one of the leading causes of morbidity and mortality among infants and children, particularly in low- and middle-income countries (Zhu et al., 2025). Diarrhea in infants, particularly those aged 0–6 months, is primarily a symptom of gastrointestinal infection caused by various bacterial, viral, and parasitic pathogens (Jones et al., 2024). In this context, bottle feeding, inadequate hygiene and suboptimal washing techniques create a fertile breeding ground for bacteria such as Escherichia coli, Salmonella, and Staphylococcus aureus (Faife et al., 2024). Germs thrive in the warm, nutrient-rich environment provided by residual milk or formula, leading to rapid bacterial multiplication if bottles and teats are not thoroughly sterilized between each use. The incident cases are expected to rise from 2020 to 2040, while the age-standardized incidence rates (ASIRs) and incidence rates are predicted to slightly decrease (Liang et al., 2024). The global burden of diarrhea varies significantly by region, where South Asia and Sub-Saharan Africa remain the areas with the highest reported prevalence (Sarker et al., 2025; Worede et al., 2025). On the other hand, European nations demonstrate substantially lower rates due to improved sanitation, widespread support for exclusive breastfeeding, and stricter hygiene regulations (Wang et al., 2025). The prevalence of diarrhea among children under the age of five in underdeveloped regions of Indonesia was 11.4% (Simaremare et al., 2024). That study also explains that that the child's age, the child's history of ARI, and household awareness of nearby hospitals are critical factors associated with the

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child's diarrhea in underdeveloped regions of Indonesia (e.g., East Nusa Tenggara, West Java, and Papua). This highlights that diarrhea remains a serious public health concern, particularly among infants aged 0–6 months, who are more vulnerable due to their immature immune and digestive systems.

For an infant between 0 and 6 months of age, the standard of care for diarrhea is centered on the liquid intake (Rhoads, 1999; Ciccarelli et al., 2013; Bhattacharya, 2000). At this developmental stage, the primary clinical objective is the prevention of dehydration and the maintenance of electrolyte balance without disrupting the infant's fragile gut microbiome (Aghsaeifard et al., 2022; Anigilaje, 2018). The cornerstone of management is the continuation and intensification of breastfeeding, Low-Osmolarity Oral Rehydration Salts (ORS), and Zinc supplementation. Unlike older children or adults, infants have a higher surface-area-to-mass ratio and higher metabolic rates, meaning they can lose a life-threatening percentage of body water in a matter of hours. Several risk factors are strongly suspected to contribute to the incidence of diarrhea in early infancy (Sadeghi et al., 2024). These include introducing complementary feeding before the recommended age, suboptimal exclusive breastfeeding, and poor hygiene when using feeding tools such as baby bottles. Introducing complementary foods before six months of age may expose infants to foodborne pathogens or unsanitary environmental conditions, while also disrupting their still-developing digestive systems (Chiang et al., 2020). Exclusive breastfeeding for the first six months serves as a protective measure against infectious diseases, including diarrhea (Otim et al., 2022). However, exclusive breastfeeding coverage in Indonesia reached only 72.4% in 2022, falling short of the national target of 80% (Santi et al., 2023). Factors contributing to low exclusive breastfeeding rates include limited maternal knowledge, lack of family and workplace support, and persistent cultural beliefs about early complementary feeding (Tag et al., 2025). Additionally, the use of unhygienic baby bottles can serve as a potential route of transmission for diarrheal pathogens. Bottles and nipples that are not properly cleaned or stored under sterile conditions are susceptible to contamination with pathogens (Mohamed et al., 2023). Hygienic feeding practices, particularly bottle hygiene, play an important role in preventing diarrhea. Improper cleaning, infrequent sterilization, and unsafe storage of feeding bottles elevate the risk of contamination with pathogens (Marege et al., 2023). Furthermore, infant feeding bottles are susceptible to fecal bacterial contamination (Ugboko et al., 2020).

Several studies have demonstrated significant associations between early complementary feeding, inadequate exclusive breastfeeding, and poor bottle hygiene with diarrhea incidence in infants. However, evidence from Eastern Indonesia, remains limited. Understanding the determinants of diarrhea in this context is essential for designing programs in diarrhea prevention and management. Moreover, current research in pediatric health frequently highlights a significant knowledge-practice gap, where caregivers can identify proper hygiene protocols but fail to implement them due to barriers. Although the clinical link between hygiene and diarrhea is well-documented, there is a distinct lack of granular data regarding the nature context in Indonesia. Furthermore, existing literature often focuses on broad epidemiological trends, leaving a void in nursing-specific area research that evaluates the factors leading diarrhea among infant. Therefore, this study aims to examine the determinants of diarrhea among infants aged 0–6 months, focusing on early complementary feeding practices, exclusive breastfeeding status, and bottle hygiene. It is hoped that the finding of the study will provide a baseline data that can be used in studies across other Low- and Middle-Income Countries (LMICs) to meet Sustainable Development Goal (SDG). With positioning the community pediatric nurse as a behavioral scientist, the research elevates the role of nursing in global health policy. Finally, this work contributes to the global body of Evidence-Based Practice (EBP) by shifting infant gastrointestinal health strategies away from generic, top-down advice toward data-driven, household-specific interventions that can be applied in any resource-limited setting worldwide.

Method

The research used an analytical observational design with a cross-sectional approach. This approach facilitates the investigation of interrelationships among exposure variables (early complementary feeding practices, exclusive breastfeeding, and bottle hygiene) and the outcome variable (diarrhea incidence), at a single point in time (Ramji, 2022; Wang & Cheng, 2020). Cross-sectional technique is widely used to assess the prevalence of health outcomes and their associated factors (Figueiredo et al., 2025), making the design appropriate for identifying determinants of diarrhea in early infancy. The study was conducted from September to December 2024 in the urban coastal areas of Kendari, Indonesia. Research sites included five sub-districts as follows Abeli, Anggalomelai, Nambo, Petoaha, and Bungkutoko. Kendari was selected as the study location due to its combination of urban growth, diverse socioeconomic characteristics, variations in breastfeeding practices, and documented diarrhea burden, allowing for a meaningful examination of modifiable behavioral determinants. The study population consisted of mothers with infants aged 0–6 months residing in the selected areas. A purposive sampling technique was used to recruit participants based on predetermined criteria. The inclusion criteria were mothers of infants aged 0–6 months, willingness to participate,

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provision of written informed consent, the ability to provide complete and accurate information. On the other hand, the exclusion criteria included mothers who were uncooperative during data collection or infants with congenital gastrointestinal disorders. Participants were recruited through community health outreach programs and maternal-child health (MCH) service points.

During the sampling process, the researchers trained enumerators on the study's data collection procedures. The enumerators consisted of six community health cadres who had previously received standardized training on diarrhea management, structured interviewing procedures, and data quality assurance. Trained field enumerators screened potential participants using child health records and consultations with local health workers. Involving research assistants or enumerators is a strategic decision that enhances the efficiency and rigor of the data collection process. Furthermore, researchers can gather information far more rapidly than a single investigator could. Outside saving time, local assistants often help build rapport with participants and improves the accuracy of the responses. Furthermore, a well-trained team can minimize researcher bias and maintain high data integrity. However, the fundamental concept of utilizing research assistants appears to be underrepresented in the existing literature.

The sample size calculation was determined using G*Power software version 3.1.9.4 with α=0.05, statistical power of 80%, and an estimated effect size obtained from prior observational research on diarrhea incidence among infants. Although effect size is commonly discussed in intervention studies, it is also applicable in observational designs for estimating the expected magnitude of association between variables (e.g., exposure and outcome). Effect size in cross-sectional studies represents the strength of population relationships, often expressed through odds ratios or proportional differences. This metric is critical for performing power analyses to determine appropriate sample sizes. using measures like Odds Ratios (OR) for categorical data or Cohen's and Pearson's *r* for continuous data (Capili, 2021). In this study, the effect size was adapted from a study, whose observational study had similar population characteristics, exposure variables, and outcome measures. The effect size used for the power analysis was specified as an odds ratio (OR) of 2.0, representing a moderate association for a 2 × 2 cross-sectional comparisons based on methodological literature (Brydges, 2019; Zhang & Hartmann, 2023). The expected OR was derived from the difference in the anticipated prevalence of the outcome between variables reported in previous observational studies examining infant feeding practices and diarrhea incidence. This value was then used as the effect size parameter in G*Power software version 3.1.9.4 to estimate the minimum required sample size with a significance level of α = 0.05 and a statistical power of 80% (Kang, 2021). Based on this calculation, the minimum required sample size was 315 participants, after applying the inclusion criteria. Note that this a priori effect size was used only for sample size estimation. The study results are instead presented using OR from logistic regression, which is the appropriate effect size measure for cross-sectional observational studies. Their reported association was converted into a standardized effect size appropriate for proportion comparison in G*Power. Using this effect size, along with the chosen significance level and desired power, the final calculated sample size was 315 participants.

Data were collected using a structured questionnaire developed based on an extensive literature review. The literature review was conducted by searching databases such as PubMed, ScienceDirect, Google Scholar, and ResearchGate to identify studies on infant feeding practices, bottle hygiene, and the risk of diarrhoea among infants aged 0–6 months. The information obtained was used to develop questionnaire items that were relevant and appropriate. The instrument was subsequently validated by three MCH experts, comprising an academic in MCH, a clinician experienced in managing infant diarrhoea, and a senior nurse working in maternal and child health services. These experts assessed the relevance, clarity, content completeness, and cultural appropriateness of each item using the Content Validity Index (CVI) framework, resulting in a CVI score of 0.92. A pilot test was conducted with 30 mothers of infants aged 0–6 months living outside the study area. The pilot assessed clarity, comprehension, and response patterns. Internal consistency analysis yielded a Cronbach's alpha of 0.81, demonstrating good reliability. The questionnaire consisted of demographic information, infant feeding practices, bottle hygiene practices, and diarrhea history. The questionnaire consisted of nine items grouped into five domains, including demographic characteristics (2 items), early complementary feeding practices (1 item), exclusive breastfeeding status (1 item), bottle hygiene practices (4 items), and history of diarrhea in infants (1 item). Bottle hygiene practices were assessed using four behavioral indicators, and the total score was categorized into adequate and inadequate hygiene for statistical analysis. Diarrhea status was assessed through structured interviews and verified through medical records or the MCH handbook (Shankar & Rosenbaum, 2020). The study utilized enumerator-led data collection rather than self-reported questionnaires, meaning the enumerators filled out the forms based on participant responses. Self-report questionnaires are often more time-efficient and do not require a researcher to administer. However, their subjective nature can lead to inaccuracies in self-evaluations, particularly regarding cognitive constructs.

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Data were analyzed using the Statistical Package for the Social Sciences (SPSS) software, version 26.0. Univariate analysis was performed to describe the distribution of each variable. Bivariate analysis using the chi-squared test was conducted to determine associations between independent and dependent variables. Variables with a $p< 0.05$ in the bivariate analysis were included in the multivariate logistic regression to identify the most dominant factors associated with diarrhea incidence. Results were considered statistically significant at $p<0.05$, and odds ratios (ORs) with 95% confidence intervals (CIs) were reported. Model performance was further evaluated using the Receiver Operating Characteristic (ROC) curve. The Area Under the Curve (AUC) was calculated to determine overall predictive accuracy. The final model generated an AUC of 90.5%, indicating excellent discriminatory ability. Visual inspection of the ROC curve showed that it remained well above the diagonal reference line, reflecting high sensitivity and specificity in predicting diarrhea among infants. Ethical approval was obtained from the Health Research Ethics Committee of Universitas Bani Saleh, Indonesia (Reference Number: EC.087/KEPK/STKBS/IX/2024). Written informed consent was obtained from all participants before data collection. Participants were informed of the study's objectives, procedures, potential risks and benefits, confidentiality measures, and their right to withdraw at any time without consequence.

Results

The table presents the frequency and percentage distribution of the respondents based on two main characteristics such as sex and age group. A total of 315 respondents participated in the study. In terms of sex, the distribution was relatively balanced. Female respondents slightly outnumbered male respondents, accounting for 51.7% (n=163), while male respondents comprised 48.3% (n=152) of the sample. Regarding age group, the largest proportion fell within the 4-month age group (20.7%), followed by 6 months (18.6%), 5 months (17.9%), and 3 months (16.6%). The 2-month (13.8%) and 0–1-month (12.4%) age groups had the lowest representation **(Table 1)**. The table presents the frequency and percentage distribution of the independent and dependent variables assessed in this study. The data show that 58.7% of infants were introduced to complementary feeding before the recommended age. Exclusive breastfeeding was reported in only 37.8% of cases. Additionally, 65.4% of respondents were found to practice inadequate bottle hygiene. The incidence of diarrhea was high, affecting 55.2% of the infants **(Table 2)**. The table displays the Chi-Square test results assessing the associations between the independent variables and the incidence of diarrhea. Significant relationships were observed for early complementary feeding (p=0.001), exclusive breastfeeding (p=0.002), and bottle hygiene (p<0.001) **(Table 3)**. The table presents the results of logistic regression analysis. All independent variables were significantly associated with diarrhea incidence. Inadequate bottle hygiene was identified as the most dominant factor **(Table 4)**. Furthermore, assess the quality of the equation obtained based on the discrimination parameters that were previously assessed using the calibration parameters, namely the Hosmer-Lameshow tests **(Table 5)**. Based on the table of discrimination values obtained, it can be determined by looking at the AUC value. The AUC value obtained in the discrimination equation is 90.5% with clinical or statistical significance having a very strong AUC value **(Figure 1)**.

Discussion

The study highlighted a significant association between the incidence of diarrhea and three main variables such as early introduction of complementary feeding, exclusive breastfeeding, and bottle hygiene. The results indicate that infants who received complementary feeding before the recommended age had a significantly higher risk of experiencing diarrhea compared to those who did not. Multivariate analysis further confirmed that early complementary feeding increased the risk of diarrhea by 4.80 times during analysis. This is consistent with previous studies stating that the digestive systems of infants under six months are not yet adequately developed to process solid foods (Gan et al., 2018; Langley-Evans, 2022). Therefore, introducing solid foods prematurely can elevate the risk of gastrointestinal infections, including diarrhea (Ding et al., 2025; Yu et al., 2019). Studies indicates that introducing complementary foods before the appropriate age can exacerbate the health of the infant's still-developing digestive system (Velasco-Benitez et al., 2025). From a different standpoint, an immature gastrointestinal tract lacks sufficient digestive enzymes, making it susceptible to irritation and disruption of gut microbiota balance when exposed to solid or semi-solid foods too early (Hamer et al., 2022). These findings suggest that community pediatric nurses are instrumental in providing public education regarding the necessity of withholding supplementary foods until an infant is six months old. Furthermore, parents must be equipped with comprehensive and accurate knowledge regarding this practice. In addition to biological determinants, early complementary feeding is also closely linked to limited maternal knowledge regarding appropriate infant feeding practices, as well as cultural beliefs and longstanding family traditions (Kostecka et al., 2021). Some families still believe that feeding infants under six months with bananas, porridge, or other traditional foods promotes faster growth (Parvin et al., 2024).

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Table 1. Demographic profile of the participants.

Variables	Frequency (n)	Percentage (%)
Sex		
Female	163	51.7
Male	152	48.3
Age group		
0-1 month	39	12.4
2 months	44	13.8
3 months	52	16.6
4 months	65	20.7
5 months	56	17.9
6 months	59	18.6

Table 2. Variables in the study.

Variables	Frequency (n)	Percentage (%)
Early introduction of complementary feeding		
Given	185	58.7
Not given	130	41.3
Exclusive breastfeeding		
Given	119	37.8
Not given	196	62.2
Bottle hygiene		
Adequate	109	34.6
Inadequate	206	65.4
Incidence of diarrhea		
Diarrhea	174	55.2
No diarrhea	141	44.8

Table 3. Chi Squared test analysis.

Variables	Incidence of Diarrhea		Total	*p**	Interpretation
	Diarrhea	No Diarrhea			
Early Introduction of complementary feeding					
Given	131 (70.8%)	54 (29.2%)	185	0.001	Significant association
Not given	43 (33.1%)	87 (66.9%)	130		
Exclusive breastfeeding					
Given	33 (27.7%)	86 (72.3%)	119	0.002	Significant association
Not given	141 (72.0%)	55 (28.0%)	196		
Bottle hygiene					
Adequate	22 (20.2%)	87 (79.8%)	109	0.000	Significant association
Inadequate	152 (73.8%)	54 (26.2%)	206		

**p*<0.05.

However, these practices lack a scientific basis and may introduce harmful bacteria and pathogens, especially when food is prepared under unhygienic conditions (Choudhury et al., 2021). The World Health Organization (WHO) and the Indonesian Ministry of Health recommend the initiation of complementary feeding at six months of age, as infants' nutritional needs can be adequately met through exclusive breastfeeding up to that point (Demoze et al., 2024). Early complementary feeding, particularly when it fails to meet hygiene and nutritional standards, may trigger digestive issues (Shi et al., 2024). The WHO notes that early complementary feeding (before six months) contributes to a 30% increase in diarrhea risk among infants in developing countries (WHO, 2021). These findings emphasize the need for public health campaigns emphasizing age-appropriate complementary feeding. Education targeting mothers and families on the risks of early complementary feeding should be widespread through healthcare workers and community health volunteers

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(village-level service cadres) and local leaders. Availability of educational materials, effective health communication strategies, and supportive work environments for breastfeeding mothers are fundamental in preventing risky feeding practices (Simelane & Vermaak, 2023). Infants who were not exclusively breastfed were found to have a higher risk of experiencing diarrhea compared to those who received exclusive breastfeeding (Hossain & Mihrshahi, 2022). Exclusive breastfeeding provides protective benefits against infections, as breast milk contains antibodies, enzymes, and other immunological factors that help build the infant's immune system, including protection against diarrhea.

In contrast, low rates of exclusive breastfeeding in Indonesia, including Kendari, reflect inadequate maternal knowledge and the lack of systemic support in both family and workplace settings. Working mothers often do not have access to lactation rooms or sufficient breastfeeding breaks, driving them to replace breast milk with formula or other foods prone to contamination. The absence of breastfeeding-supportive facilities in public spaces also presents a systemic barrier (De Souza et al., 2021). Social myths and pressures, such as the belief that breast milk is insufficient or that babies need water from an early age, further worsen this issue (Dereje et al., 2024). In reality, introducing other foods or drinks before six months is particularly risky in areas with poor sanitation. A study shows that for every 10% drop in exclusive breastfeeding coverage, there is a significant increase in diarrhea incidence among infants (Lackey et al., 2021). Research confirms that exclusive breastfeeding for six months reduces the risk of gastrointestinal infections by up to 64% compared to infants who were not exclusively breastfed (Froń & Orczyk-Pawiłowicz, 2024).

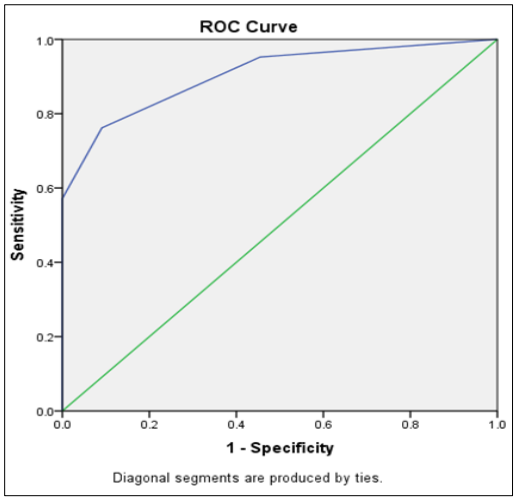

Figure 1. ROC Curve.

Table 4. Logistic regression analysis.

Variables	Coefficient	SE	Wald	df	Sig.	OR/Exp B	CI 95%	*p**	Nagelkerke R^2
Model 1									
Early introduction of complementary feeding	2.171	1.218	3.177	1	0.075	8.763	0.806-95.318	0.917	0.613
Exclusive breastfeeding	3.818	1.355	7.932	1	0.005	45.491	3.192-648.223		
Bottle hygiene	0.602	2.083	0.083	1	0.773	1.825	0.031-108.269		
Constant	-2.630	2.262	1.352	1	0.245	0.072			
Model 2									
Exclusive breastfeeding	2.212	1.215	3.317	1	0.069	9.136	0.845-98.804	0.807	0.611
Bottle hygiene	3.804	1.363	7.785	1	0.005	44.885	3.101-649.595		
Constant	-2.096	1.092	3.683	1	0.055	0.123			

*Hosmer-Lameshow tests.

Table 5. Equation of discrimination parameters.

Area	SE	Asymptotic Sig.	Asymptotic 95% CI	
			Lower Bound	Upper Bound
0.905	0.052	0.000	0.802	1.000

Moreover, the early introduction of formula or other foods/drinks increases microbial contamination risk, especially if prepared without adequate hygiene. Therefore, the failure to provide exclusive breastfeeding is a key factor contributing to increased diarrhea incidence (Panigrahi et al., 2025). Strategies to improve exclusive breastfeeding rates should evolve past standard practices. They must include policy-based support to uphold the rights of breastfeeding

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mothers such as sufficient maternity leave, the provision of breastfeeding spaces, and community health worker empowerment. A cross-sectoral approach involving the education, labor, and social welfare sectors is essential to support and strengthen exclusive breastfeeding efforts.

Bottle hygiene was identified as the most dominant factor contributing to diarrhea in infants. Multivariate analysis identifies bottle hygiene as the most dominant factor associated with diarrhea. After controlling for exclusive breastfeeding, infants with inadequate bottle hygiene are 44 times more likely to experience a high incidence of diarrhea compared to those with adequate hygiene. This finding aligns with prior studies showing that feeding equipment, particularly bottles and nipples, is common vector for pathogenic microorganism contamination when not properly cleaned or sterilized (Marege et al., 2023). A major contributor to inadequate bottle hygiene is the lack of maternal knowledge about correct sterilization procedures. Some mothers only rinse bottles with water or wash them without hot water and soap, let alone using a sterilizer (Soe et al., 2024). Limited access to clean water and sanitation elevates the risk of bottle contamination, especially if prepared milk is left at room temperature rather than being consumed promptly (Tsafack et al., 2025). In urban settings like Kendari City, bottle feeding is prevalent, especially among working mothers. However, many remain unaware that sterilization must be a routine practice rather than a one-time procedure performed only upon initial use. Health education regarding proper bottle hygiene and storage remains insufficient, both within healthcare services and on public information platforms. This brings to light a substantial void in fundamental health knowledge that requires further action. Thus, efforts to mitigate diarrhea related to unhygienic feeding practices must prioritize providing mothers with accessible and actionable information. For instance, community-based interventions can serve as effective solutions. Additionally, it is important to promote safer alternatives to bottle feeding, such as direct breastfeeding or cup feeding, which carry lower infection risks. A study emphasizes that the hygiene of infant feeding equipment, including bottles, is a critical determinant in preventing enteric infections that can lead to acute diarrhea (Andresen et al., 2026). This factor is particularly relevant in the daily practices of working mothers who rely on bottles for feeding. Lack of awareness about sanitation, or limited access to clean water and sterilization tools, increases the risk of infant exposure to diarrhea-causing pathogens such as Escherichia coli and Rotavirus (Asada et al., 2022).

The results of this study have important implications for nursing practice, particularly in maternal and child health. Nurses, especially those working at the community level, should be empowered to provide consistent education to mothers regarding the importance of exclusive breastfeeding, the risks of early complementary feeding, and the correct practices for feeding bottle hygiene. Community health programs and home visit initiatives led by nurses and midwives can serve as effective platforms to promote these behaviors. In terms of policy, findings suggest that nursing professionals should advocate for broader public health initiatives that improve access to clean water, sanitation facilities, and breastfeeding support services, especially in urban and low-income communities. The study emphasizes the importance of including infant feeding education as a standard component of postnatal care and maternal counseling protocols. However, this study is not without limitations. It employed a cross-sectional design, which limits the ability to establish causal relationships. Additionally, environmental and socioeconomic factors, which could influence both feeding practices and diarrhea incidence, were not fully explored. Finally, this research provides a foundational framework for future studies dedicated to mitigating infant diarrhea on a global scale, particularly for the vulnerable 0–6-month age group.

Conclusion

The study concludes that early complementary feeding, lack of exclusive breastfeeding, and poor bottle hygiene are associated with the incidence of diarrhea in infants aged 0–6 months. Among these, poor bottle hygiene emerged as the most dominant factor. These results contribute to the existing body of knowledge by reaffirming and quantifying the risks posed by modifiable infant feeding practices in Indonesia. The results reinforce the need for health promotion strategies in nursing practice, particularly on empowering caregivers with practical skills related to feeding. With identifying specific hygiene determinants in a developing nation context, the finding provides actionable data for international policymakers to integrate sanitation improvements into global health strategies aimed at achieving Sustainable Development Goal (SDG). Furthermore, this study serves as a critical scientific reference for researchers in other tropical regions, helping them understand the complex interaction between environmental pathogens and socio-cultural feeding practices. Future nursing research should explore the influence of environmental sanitation, socioeconomic status, and maternal education level as potential confounding factors. Intervention-based studies may also help evaluate the effectiveness of nursing programs in reducing the incidence of infant diarrhea.

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AI statements
AI tools were used solely for language editing and grammar correction. All research design, data analysis, interpretation, and manuscript preparation were carried out entirely by the authors.

Author's declaration
All authors contributed to the research design, data collection, and the preparation of the manuscript for publication.

Availability of data and materials
Data and materials supporting the findings of this study are available upon request to the corresponding author.

Competing interests
The authors declare that there are no conflicts of interest regarding the publication of this work.

Ethical clearance
Ethical approval was obtained from the Health Research Ethics Committee of The Universitas Bani Saleh, Indonesia (Reference Number: EC.087/KEPK/STKBS/IX/2024).

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Publishers and journal's note
The originality of this research lies in its specific analysis between local habits and environmental hygiene standards in a developing nation context. We believe this article is relevant to journal's readership focusing on maternal, child health and global epidemiology.

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Authors' insight

Key points

- Infants who receive formula or supplementary water are often at a higher risk of diarrhea, as these substitutes can be contaminated or lack the maternal antibodies found in breast milk.
- The study likely evaluates specific hygiene markers such as the sterilization of bottles, the quality of water used for cleaning, and whether caregivers practice consistent handwashing before feeding.
- Factors like maternal education, clean water infrastructure, and the marketing of breast-milk substitutes influence whether a caregiver can maintain the hygiene standards necessary to prevent infections.

Emerging nursing avenues

- How do mixed feeding practices compare to exclusive breastfeeding in terms of diarrheal frequency within this specific cohort?
- What role does the caregiver's hygiene literacy play versus their access to resources available in their environment?
- To what extent does the storage duration and temperature of prepared milk contribute to bacterial growth in these households?

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