



Maternal Preventive Behaviors and Six-Month Diarrhea Burden Among Under-Five Children: A Community-Based Cross-Sectional Survey in Coastal North Sulawesi, Indonesia

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Abstract

This community-based descriptive cross-sectional survey described the six-month burden of diarrhea and two maternal preventive practices—exclusive breastfeeding and handwashing at critical times—among mothers of under-five children in the Sagerat Public Health Center catchment, Bitung City, North Sulawesi, Indonesia, from July to August 2025. Fifty mothers of children aged 9 months to 5 years were recruited by convenience (accidental) sampling from a population of 3,122. Data were collected using interviewer-administered questionnaires and field observation. Diarrhea was defined as maternal report of at least three loose or watery stools within 24 hours during the preceding six months, and exclusive breastfeeding as breast milk only through six months. Because the seven-item handwashing instrument had no documented validated cut-off, results were reported as complete adherence (7/7 criteria) versus incomplete adherence (<7), rather than good versus poor behavior. Diarrhea was reported in 24 children (48.0%; 95% CI, 34.8%–61.5%); 33 (66.0%; 95% CI, 52.2%–77.6%) had not been exclusively breastfed; and 31 mothers (62.0%; 95% CI, 48.2%–74.1%) showed incomplete handwashing adherence. These findings provide a descriptive primary-care baseline for breastfeeding and hand-hygiene programming. We did not estimate individual-level associations or causal effects.

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Introduction

Diarrheal disease remains an important public-health concern among children under five years of age, particularly in low- and middle-income countries where enteric pathogen exposure is sustained by inadequate water, sanitation, hygiene, nutrition, and health services. Young children are especially vulnerable because they depend on caregivers for feeding and hygiene, while their developing immune systems increase susceptibility. Globally, diarrhea continues to contribute substantially to childhood illness and preventable deaths (World Health Organization [WHO], 2019). In Indonesia, diarrhea among under-five children remains a priority for disease surveillance and child-health programs (Kementerian Kesehatan Republik Indonesia, 2018). This concern is also relevant to North Sulawesi, including Bitung City, where primary-care facilities continue to manage childhood diarrhea. Local health services therefore need current information on both the burden of diarrhea and preventive practices that can be strengthened through routine maternal and child health programs.

From an environmental-health perspective, childhood diarrhea is closely related to fecal-oral transmission. Pathogenic microorganisms can reach children through contaminated water, food, hands, feeding utensils, household surfaces, and unsafe fecal disposal. Household water supply, sanitation facilities, and domestic environmental quality create the broader context for exposure. However, daily caregiving practices also shape immediate transmission opportunities. Mothers and caregivers handle food, prepare drinks, clean children after defecation, breastfeed, prepare milk, and assist with hygiene. These activities can either interrupt or facilitate the movement of pathogens from the environment to the child. Evidence from Indonesian settings indicates that sanitation conditions and household hygiene practices remain important components of diarrhea prevention (Heranita et al., 2019; Kasim & Rivai, 2020). Thus, environmental improvement and caregiver behavior should be viewed as complementary strategies.

Within this prevention framework, two maternal practices are particularly relevant: exclusive breastfeeding during the first six months of life and handwashing with soap at critical times. Exclusive breastfeeding can reduce infants' exposure to potentially contaminated replacement feeds, water, and feeding equipment while providing nutritional and immunological protection. Previous analytic studies have reported a protective relationship between exclusive breastfeeding and diarrheal morbidity in infancy (Mulatu et al., 2021; Ganbold et al., 2025). In the present study, however, exclusive breastfeeding is not treated as an exposure variable for testing risk. Instead, it is included as a descriptive prevention indicator that can inform maternal and child health programming in the local primary-care setting.

Handwashing with soap is another key preventive practice because hands are an important vehicle for fecal-oral transmission. Critical moments include after defecation, after cleaning a child who has defecated, before preparing or serving food, and before breastfeeding or preparing milk. When performed consistently with soap and safe water, handwashing can reduce transfer of enteric pathogens within the household. Intervention and meta-analytic evidence supports the effectiveness of handwashing with soap in reducing childhood diarrhea (Solomon et al., 2021; Wolf et al., 2022). Nevertheless, as with breastfeeding, the present survey does not estimate whether mothers with incomplete handwashing adherence had children with a higher probability of diarrhea. Handwashing

is examined only as a descriptive behavioral indicator within the same population in which recent diarrhea experience is measured.

This distinction is important because the present research uses a community-based descriptive cross-sectional design. The purpose is not to identify determinants, estimate odds ratios, or establish causal relationships between maternal practices and diarrhea. Rather, the study seeks to provide an integrated local profile of three epidemiologically relevant indicators: maternal-reported diarrhea during the preceding six months, exclusive breastfeeding through six months, and adherence to assessed handwashing practices at critical times. Such a descriptive profile has practical value for primary-care planning because it can show whether diarrhea burden coexists with gaps in preventive practices within the same service population, without claiming that one variable caused or was statistically associated with another.

In the Sagerat Public Health Center catchment area of Bitung City, routine records indicated that diarrhea among under-five children remained an ongoing concern. However, a combined descriptive assessment of recent diarrhea experience, exclusive breastfeeding, and maternal handwashing practices had not been available. The present study therefore addresses this information gap by generating a context-specific epidemiological and behavioral baseline. This baseline can support breastfeeding promotion, hand-hygiene education, and broader household environmental-health interventions, while identifying priorities for future research. Accordingly, this community-based descriptive cross-sectional survey aimed to estimate the proportion of under-five children with maternal-reported diarrhea during the preceding six months, the proportion who had not received exclusive breastfeeding through six months, and the proportion of mothers who did not completely adhere to all seven assessed handwashing criteria. No individual-level association or causal effect was tested.

Materials and Methods

Study Design and Setting

A community-based descriptive cross-sectional survey was conducted in the working area of Sagerat Public Health Center, Bitung City, North Sulawesi, Indonesia, from July to August 2025. The catchment comprised 12 administrative villages and had an under-five population of 3,122 children.

Study Population and Sampling

The study population comprised mothers of under-five children residing in the Sagerat Public Health Center catchment. The minimum sample size was calculated using a single-population proportion formula with $Z=1.65$, an expected proportion of 0.50, and an absolute precision of 0.10, yielding 48 participants; 50 mothers were ultimately recruited. Participants were selected using convenience (accidental) sampling. The sample-size calculation was intended for descriptive estimation of proportions and not for hypothesis testing. Given the descriptive design and the small sample, the study was not designed or powered to conduct meaningful bivariable or multivariable analyses of predictors of diarrhea.

Data Collection Instrument and Procedure

Primary data were collected using a structured interviewer-administered questionnaire after written informed consent. Field observation supported information on maternal handwashing practices. The questionnaire included maternal demographic characteristics, breastfeeding history, seven yes/no handwashing items, child demographic characteristics, and a diarrhea-history item. Secondary geographic and demographic information was obtained from Sagerat Public Health Center. Data processing comprised editing, coding, entry, and tabulation.

Research Ethics

The study received ethical approval from the Health Research Ethics Committee of Manado Health Polytechnic, Ministry of Health (approval no DP. 04.03/FXXX.28/329/2025 dated August 29, 2025). Permission was obtained from the community health center head. All participants provided written informed consent after receiving information about the study, including their right to withdraw at any time without consequences.

Operational Definitions

Exclusive breastfeeding was defined as provision of breast milk only from birth through six months, without additional liquids or foods. Mothers were classified according to whether the child had received exclusive breastfeeding through six months.

Maternal handwashing was assessed using seven items covering the use of running water and soap and handwashing at critical times, including before preparing or giving food, after defecation, before breastfeeding or preparing milk, and after cleaning the child. No validated theoretical or empirical cut-off for a “good” handwashing score was documented for this instrument. Therefore, the manuscript does not interpret a score of 7 as a validated quality threshold. Instead, the original scoring is reported descriptively as complete adherence when all seven criteria were fulfilled (7/7) and incomplete adherence when one or more criteria were not fulfilled (<7).

Diarrhea was defined as maternal report that the child had experienced at least three loose or watery stools within 24 hours during the six months preceding the interview. The indicator was classified as any reported diarrhea versus no reported diarrhea during that recall period. Because the six-month recall window is substantially longer than the two weeks commonly used in household surveys, interpret the estimate as six-month reported experience rather than point or short-period prevalence.

Statistical Analysis

Analysis was restricted to univariable descriptive statistics. We calculated frequencies and percentages for maternal and child characteristics, six-month diarrhea experience, exclusive breastfeeding, and handwashing adherence. We calculated Wilson 95% confidence intervals for the three principal proportions. We did not perform chi-square tests, odds ratios, correlation analyses, or regression models because the study objective was descriptive and the sample of 50 participants was not intended to support stable multivariable estimation. Interpretation therefore focuses on the magnitude and population-level coexistence of the three indicators, not on individual-level associations or causality.

Ethical Considerations

All participants provided written informed consent before the interview, and confidentiality was maintained throughout data collection and analysis. Ethical approval: Health Research Ethics Committee, Faculty of Health and Pharmacy, Bani Saleh University, Number EC. 128/KEPK/FKF-UBS/VI/2026

Results and Discussions

Fifty mothers participated. More than half were aged 26–35 years (56.0%), and 74.0% were homemakers. Based on the statistical output appended to the thesis, four children (8.0%) were younger than 1 year, 31 (62.0%) were aged 1–2 years, and 15 (30.0%) were aged 3–5 years. Boys and girls were equally represented.

Table 1. Maternal and child characteristics (N=50)

Characteristic	Category	n (N=50)	%
Maternal Age	19–25 years	13	26.0
	26–35 years	28	56.0
	36–45 years	8	16.0
	46–55 years	1	2.0
	Homemaker	37	74.0
Work	Self-employed	2	4.0
	Private-sector employee	3	6.0
	Civil servant	6	12.0
	Trader	1	2.0
	Village official	1	2.0
Child Age	<1 year	4	8.0
	1–2 years	31	62.0
	3–5 years	15	30.0
Child Sex	Male	25	50.0
	Female	25	50.0

During the preceding six months, 24 of 50 children (48.0%; 95% CI, 34.8%–61.5%) were reported to have experienced at least one episode of diarrhea. Seventeen children (34.0%) had received exclusive breastfeeding through six months, whereas 33 (66.0%; 95% CI, 52.2%–77.6%) had not. Nineteen mothers (38.0%) fulfilled all seven assessed handwashing criteria, while 31 (62.0%; 95% CI, 48.2%–74.1%) showed incomplete adherence to at least one criterion (Table 2). These proportions are presented independently and should not be interpreted as evidence that the children with diarrhea were the same children exposed to non-exclusive breastfeeding or incomplete maternal handwashing.

Table 2. Principal epidemiological indicators and Wilson 95% confidence intervals

Indicator	n/N	%	95% CI
Diarrhea in previous 6 months	24/50	48.0	34.8–61.5
Non-exclusive breastfeeding	33/50	66.0	52.2–77.6
Poor maternal handwashing	31/50	62.0	48.2–74.1

As shown in Table 2, within the intervention group, self-efficacy improved markedly following the Self-Help Group (SHG) intervention, from a pre-intervention median of 21.5 (range 10-42) to a post-intervention median of 68.5 (range 50-80), a median difference of 47.0 points (95% CI: 45.5–48.0; $p=0.001$). The effect size of 0.87 indicates a large effect by conventional interpretation criteria, suggesting that the SHG intervention produced a substantial, clinically meaningful improvement in self-efficacy beyond mere statistical significance.

The present study provides a descriptive profile of three epidemiologically relevant indicators within the Sagerat Public Health Center catchment area: maternal-reported diarrhea during the preceding six months, exclusive breastfeeding through six months, and maternal adherence to handwashing practices at critical times. Nearly half of the children had experienced diarrhea during the six-month recall period, while 66% had not received exclusive breastfeeding and 62% of mothers did not fulfill all seven assessed handwashing criteria. Taken together, these findings indicate that a substantial diarrhea burden coexisted with important gaps in maternal preventive practices within the same primary-care population. However, because the study was descriptive and the behavioral variables were not analyzed jointly with diarrhea at the individual level, these findings should be interpreted as a population-level prevention profile rather than evidence of statistical association or causality.

The reported six-month diarrhea burden requires careful interpretation because of the relatively long recall period. Many population-based surveys use a two-week recall period to estimate childhood diarrhea prevalence. In contrast, the present study assessed whether a child had experienced at least one episode during the preceding six months. A longer recall window increases the likelihood of capturing an episode but also increases the possibility of recall error. Therefore, direct numerical comparison with studies using a two-week prevalence measure would be inappropriate.

Nevertheless, the finding remains important from a primary-care perspective because it indicates that diarrhea continued to affect a substantial proportion of under-five children within the catchment area. Recurrent or severe diarrhea is clinically important because it can contribute to dehydration, electrolyte disturbances, nutritional deterioration, and other complications in young children. The present estimate should therefore be viewed primarily as a local service-planning indicator and as a baseline for future surveillance using a more standardized recall period.

The high proportion of children who had not received exclusive breastfeeding through six months represents another important programmatic finding. Exclusive breastfeeding is biologically plausible as a protective practice because it reduces exposure to potentially contaminated water, replacement foods, and feeding utensils while simultaneously providing immunologically active components that support gastrointestinal and mucosal defense. Evidence from previous analytic studies supports this interpretation. Mulatu et al. (2021) reported lower odds of diarrhea among exclusively breastfed infants, while a meta-analysis by Ganbold et al. (2025) similarly demonstrated a protective association between exclusive breastfeeding and diarrheal morbidity. These external findings strengthen the biological and epidemiological rationale for breastfeeding promotion; however, they should not be interpreted as demonstrating an association within the present sample.

From a programmatic perspective, the breastfeeding gap observed in Sagerat suggests the need for interventions that extend beyond general health education. Breastfeeding practices are influenced

by maternal knowledge, perceived milk insufficiency, maternal illness, employment, family support, and challenges experienced during early lactation. Therefore, counseling alone may be insufficient to achieve sustained exclusive breastfeeding. Primary-care programs should combine antenatal breastfeeding preparation, early postnatal lactation support, management of perceived low milk supply, continued assistance for working mothers, and greater involvement of family members. This approach recognizes exclusive breastfeeding as a behavior shaped by individual, social, and service-level conditions rather than simply a consequence of maternal knowledge.

Maternal handwashing practices constitute a second major area for preventive action. In this study, 62% of mothers did not fulfill all seven assessed handwashing criteria. Because the seven-item instrument did not have a documented, validated cut-off establishing a score of 7 as the threshold for "good" behavior, this finding is more appropriately described as incomplete adherence rather than poor handwashing behavior. This distinction is important because requiring perfect adherence to all items may be overly restrictive without empirical justification. Nevertheless, the high proportion of mothers with incomplete adherence identifies a potentially important opportunity for community health promotion.

Handwashing with soap remains one of the most established measures for interrupting fecal-oral transmission. Hands can serve as vehicles connecting fecal material, contaminated household surfaces, food, fluids, and the child's mouth. External evidence strongly supports the preventive value of hand hygiene. Solomon et al. (2021), in a cluster-randomized trial, demonstrated a substantial reduction in childhood diarrhea after providing soap and promoting hand hygiene. Similarly, a systematic review and meta-analysis by Wolf et al. (2022) concluded that handwashing with soap interventions reduce childhood diarrheal risk in low- and middle-income settings. These findings justify including maternal handwashing as an important prevention indicator in the present study, while again emphasizing that the current data do not estimate its individual-level effect on diarrhea.

Importantly, handwashing behavior should not be considered independently of the household environmental context. Consistent handwashing requires reliable access to safe water, soap, appropriate facilities, and routines that allow caregivers to wash their hands at critical times. Evidence from other settings shows that water insecurity, inadequate stool disposal, poor sanitation, and inconsistent handwashing often occur together and create conditions favorable for fecal-oral transmission (Aydano et al., 2024; Delelegn et al., 2020). From an environmental-health perspective, this supports a systems-based approach to preventing childhood diarrhea. Behavior-change messages are unlikely to achieve their full potential when households lack adequate water, sanitation, and hygiene infrastructure.

The combination of breastfeeding and handwashing findings therefore has greater programmatic value when interpreted within a broader WASH and child-feeding framework. Primary-care responses in Bitung City should not rely on isolated messages such as "breastfeed exclusively" or "wash hands more often." Instead, interventions should combine breastfeeding support, access to soap and safe water, promotion of handwashing at critical times, household sanitation assessment, safe disposal of child feces, and practical counseling adapted to household circumstances. Such an integrated approach is particularly relevant in coastal and urban communities

where environmental exposures, household infrastructure, and caregiving practices interact to shape children's everyday contact with enteric pathogens.

Characteristics of the study population may also help guide intervention delivery. Most participating mothers were aged 26–35 years, and approximately three-quarters were homemakers. These characteristics suggest that community-based and home-linked interventions delivered through primary health care, integrated service posts, or village-level health activities may be feasible strategies for reaching a large proportion of caregivers. However, these characteristics should not be interpreted as determinants of diarrhea or preventive behavior because no analytic testing was performed. Rather, they may help tailor communication channels, schedule activities, and develop locally appropriate health-promotion strategies.

The main scientific contribution of this study lies in its value as a hypothesis-generating and service-planning baseline. Rather than estimating etiologic effects, the study quantifies three related public-health concerns within the same primary-care catchment and reports their magnitude with confidence intervals. This information can help local health services identify areas requiring attention, establish program indicators, and monitor subsequent improvements in breastfeeding and handwashing practices. Future surveillance could also adopt a standardized two-week diarrhea recall period to improve comparability with national and international data.

The findings further provide a foundation for designing a larger analytic study. Such research should recruit a substantially larger sample using probability-based sampling and collect individual-level exposure and outcome data. Potential explanatory variables could include exclusive breastfeeding, validated handwashing measures, household water supply, sanitation, stool disposal, food hygiene, nutritional status, rotavirus vaccination, maternal education, socioeconomic status, and child age. With an adequately powered sample, these factors could be evaluated using multivariable methods to estimate their independent and combined contributions to childhood diarrhea.

Causal interpretation of the present findings must remain limited. The study cannot determine whether non-exclusive breastfeeding or incomplete handwashing adherence caused diarrhea among participating children. Temporality is uncertain; diarrhea was measured retrospectively over six months, and the behavioral indicators were not analyzed jointly with diarrhea at the individual level. The biological and causal relevance of breastfeeding and handwashing is supported by external analytic, experimental, and meta-analytic evidence, not by the current descriptive data. The most appropriate interpretation is therefore that the local pattern is compatible with established pathways of diarrhea prevention, rather than that this study has quantified those effects.

Several limitations should be considered. First, convenience sampling may have introduced selection bias and limits the generalizability of the findings to the wider population of under-five children in the Sagerat catchment. Second, the sample of 50 participants was appropriate only for a small descriptive survey and was insufficient for meaningful bivariable or multivariable modeling across multiple potential predictors. Third, diarrhea, exclusive breastfeeding, and several handwashing items relied primarily on maternal report and are therefore vulnerable to recall and social-desirability bias. Fourth, the six-month diarrhea recall period differs from the two weeks commonly used in household surveillance and may have increased recall error. Fifth, the seven-item handwashing instrument lacked documented psychometric validation and a validated behavioral cut-off. Finally, we did not analyze important contextual factors, including household water quality,

sanitation, stool disposal, food hygiene, nutritional status, vaccination, maternal education, and socioeconomic conditions. These limitations reinforce the present study's role as a descriptive, hypothesis-generating primary-care baseline rather than an assessment of determinants, associations, or causal effects.

Conclusion

Among 50 mother-child pairs in the Sagerat Public Health Center catchment, 48.0% of children had experienced maternal-reported diarrhea during the preceding six months, 66.0% had not received exclusive breastfeeding through six months, and 62.0% of mothers did not completely adhere to all seven assessed handwashing criteria. These findings describe three coexisting primary-care indicators and do not demonstrate that breastfeeding or handwashing practices were associated with, or caused, diarrhea in individual children. The results provide a local baseline for strengthening breastfeeding support, hand-hygiene promotion, and household WASH assessment. Future studies should use probability sampling, larger samples, validated behavioral measures, a standardized diarrhea recall period, and appropriately powered analytic models to estimate independent and combined determinants of childhood diarrhea.

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