ANATOL J FAMILY MED
The Anatolian Journal of Family Medicine

Original Article

DOI: 10.5505/ajfamed.2025.36036
AJFAMED 2025;8(3):76–82

Environmental and Behavioral Determinants of Diarrheal Risk in Toddlers

Ita Marlita Sari, Aryasatya Krisnawan

Department of Community Medicine and Epidemiology, Medical and Health Science Faculty, Sultan Ageng Tirtayasa University, Pakupatan Serang, Indonesia

ABSTRACT

Objectives: Diarrhea remains a major public health issue and is defined by the World Health Organization as passing loose or watery stools three or more times per day, or more often than usual for an individual. It is a leading cause of death in children under five, accounting for about 9% of global fatalities in this age group. This study aimed to assess the relationship between environmental and behavioral factors and diarrhea occurrence among toddlers in two primary health care centers.

Methods: This cross-sectional study (March–June 2024) included 108 parents or caregivers of toddlers visiting two health centers. Data were obtained through interviews and analyzed using univariate statistics and the Chi-square test, with statistical significance set at $p<0.05$.

Results: Environmental factors showed significant associations with diarrheal risk. The absence or poor condition of family toilet facilities (p=0.006, odds ratio [OR]=3.18; 95% confidence interval [CI]=1.43–6.92) and inadequate waste disposal systems (p=0.018, OR=3.64; 95%CI=1.66–7.98) were associated with higher diarrhea prevalence. In contrast, housing components (p=0.902, OR=0.88; 95% CI=0.41–1.90) were not significantly related. Among behavioral factors, handwashing with soap did not show a significant association (p=0.239, OR=0.59; 95% CI=0.27–1.26).

Conclusion: Findings indicate that environmental conditions, particularly toilet facilities and waste disposal, play an important role in diarrhea risk among toddlers. Strengthening sanitation infrastructure in low-resource primary care settings may help reduce the burden of diarrheal diseases among children.

Keywords: Diarrhea, hand hygiene, home environment, preschool child, primary health care, sanitation

Please cite this article as: Sari IM, Krisnawan A. Environmental and Behavioral Determinants of Diarrheal Risk in Toddlers. AJFAMED 2025;8(3):76–82.

Address for correspondence: Dr. Ita Marlita Sari. Department of Community Medicine and Epidemiology, Medical and Health Science Faculty, Sultan Ageng Tirtayasa University, Pakupatan Serang, Indonesia

Phone: +6281386077507

E-mail: itafitrullah@gmail.com

Received Date: 12.09.2025
Revision Date: 30.10.2025
Accepted Date: 02.11.2025
Published Online: 15.12.2025

INTRODUCTION

Diarrhea remains a significant public health concern affecting communities worldwide. The World Health Organization defines diarrhea as the passage of loose or watery stools three or more times per day, or more frequently than is normal for an individual.[1] Based on its duration, diarrhea is classified into two types: acute and chronic. Acute diarrhea refers to the sudden onset of loose or watery stools lasting for 14 days or less, whereas chronic or persistent diarrhea is defined as diarrhea lasting for more than 14 days.[2]

According to the United Nations Children's Fund (UNICEF), diarrhea is the leading cause of death in children globally, contributing to around 9% of all deaths in children under the age of five. This figure is equivalent to nearly 1,200 child deaths every day, or more than 444,000 child deaths every year, even though health services are available.[3] In Indonesia itself, data show that the prevalence of diarrhea among children was 10.9%, with a higher occurrence in rural areas (11.53%) compared to urban settings (10.07%).[4]

Understanding both the global and national burden of diarrhea is essential for identifying the underlying environmental and behavioral determinants that contribute to its persistence in different settings. Numerous studies have shown that diarrheal diseases are closely linked to environmental and hygiene-related factors, such as inadequate sanitation facilities, unsafe water storage, poor hand hygiene, and the presence of disease vectors near food and water sources. A study by Birhan et al. in the South Gondar region of Ethiopia reported a diarrhea prevalence of 29% among toddlers, with significant risk factors including irregular cleaning of toilets and drinking-water sources, unsafe water storage, and contamination from nearby vectors.[5] Similarly, a case–control study involving 315 toddlers in Ethiopia identified major determinants of acute diarrhea, including low family income (AOR=6.22), poor handwashing habits using only water (AOR=3.75), improper disposal of infant feces (AOR=11.01), untreated drinking water (AOR=9.36), and consumption of leftover food stored at room temperature (AOR=5.52).[6] In Indonesia, Manik et al. found a diarrhea incidence of 68.18% among toddlers in Aceh, with almost half of the mothers demonstrating poor hygiene practices and limited knowledge of disease prevention. The study revealed a significant relationship between inadequate clean and healthy living behaviors and the occurrence of diarrhea (p=0.008 and p=0.003).[7]

Although several international and national studies have investigated the determinants of diarrhea, limited research has specifically examined these factors in the Serang region of Banten Province, Indonesia. This area faces diverse challenges related to household sanitation, waste management, and hygiene behavior that may differ from other regions. Therefore, a localized study is essential to better understand how environmental and behavioral conditions influence diarrheal risk among toddlers in Serang. The findings can provide valuable evidence for primary health care programs and community-based sanitation initiatives, supporting targeted interventions to reduce diarrheal incidence and improve child health outcomes.

This study aimed to evaluate the relationship between environmental and behavioral factors, particularly sanitation conditions and handwashing habits, and the occurrence of diarrhea among toddlers in the working areas of the Ciracas and Unyur Primary Health Centres, Serang City, Banten Province, Indonesia. Family physicians and primary health care workers play a crucial role in community-based diarrhea prevention through health education and sanitation surveillance.

METHOD

This study employed a cross-sectional design to examine the relationship between environmental and behavioral factors and the occurrence of diarrhea among toddlers attending the Ciracas and Unyur Primary Health Centres in Serang, Banten Province, Indonesia. The study was conducted between March and June 2024.

The target population consisted of parents or caregivers who visited the primary health centers and their affiliated integrated health posts. The accessible population included those who brought toddlers to the facility according to the midwife's service schedule. Participants were eligible if they lived within the working area of the primary health center and had children aged 2–5 years. Exclusion criteria included parents or caregivers who could not communicate in Indonesian or who did not live in the same household as the toddler.

A purposive sampling technique was used, yielding a total of 108 respondents. The minimum required sample size was calculated using a 95% confidence level, 80% power, a 10% margin of error, and an expected diarrhea prevalence of 30%, resulting in a minimum of 96 respondents; the final sample exceeded this number.

Data were collected using a structured questionnaire adapted from the Standard Household Sanitation Survey of the Indonesian Ministry of Health. The questionnaire was pre-tested among 15 respondents to ensure clarity and validity. Reliability testing produced a Cronbach's alpha of 0.82, indicating good internal consistency. Data processing and analysis were performed using IBM Statistical Package for the Social Sciences version 23.

The study protocol was approved by the Institutional Review Board of the Faculty of Medicine and Health Sciences, Sultan Ageng Tirtayasa University (IRB No. 61/UN.43.20/KEPK/2024). Primary data were collected from toddlers and their parents or companions at Ciracas and Unyur Primary Health Centres in Serang City, Indonesia. All information was kept strictly confidential, with participants' identities protected and the data used solely for research purposes. An informed consent form was attached to the questionnaire, as confirmed (or waived) by the IRB. Completion of this form indicated the respondent's voluntary agreement to participate in the study.

The study evaluated two main groups of variables, such as environmental factors (including family toilet facilities, waste disposal systems, and housing components) and

behavioral factors (particularly the habit of handwashing with soap). Environmental health classifications followed the Ministry of Health's sanitation standards which require healthy toilet facilities to be equipped with a goose-neck structure, septic tank, and adequate ventilation. Proper waste disposal was used of closed waste containers with regular collection. Healthy housing components were constructed with materials that are easy to clean, unlike unfinished cement or soil floors, which are considered less hygienic.

Univariate analysis was performed to describe respondents' characteristics and diarrhea prevalence. Bivariate analysis using the Chi-square test was employed to assess the association between independent variables (environmental and behavioral factors) and the dependent variable (diarrhea occurrence). Statistical significance was set at $p<0.05$. The odds ratio (OR) and 95% confidence interval (CI) were used to measure the strength of associations.

RESULTS

Data collection was assisted by trained midwives and local integrated service post cadres. Initially, 126 respondents were recruited; however, 108 met the inclusion and exclusion criteria and were included in the final analysis. The characteristics of toddlers, parents, and environmental and behavioral factors are summarized in Table 1. More than half of the toddlers were male (52.8%), and 51.9% had experienced diarrhea. The mean age, weight, and height of the toddlers were 3.5 years, 15.1 kg, and 98.8 cm, respectively. The mean ages of mothers and fathers were 31.0 years and 29.0 years. About half of the mothers had an education level below high school (50.9%), while most fathers had completed at least high school or higher (68.5%).

Regarding environmental and behavioral conditions, approximately half of the households had healthy toilet facilities (50.9%) and adequate waste disposal systems (54.6%). Slightly more than half of the mothers (52.8%) reported regular handwashing with soap before feeding and after defecation. In contrast, 59.3% of homes had less healthy structural components, such as unfinished cement or soil floors, which may hinder optimal hygiene.

As shown in Table 2, this study found a significant association between the presence of a family toilet and the occurrence of diarrhea in toddlers (p=0.006, OR=3.18; 95% CI=1.43–6.92). Toddlers living in households without proper toilet facilities were more likely to experience diarrhea (66.7%) compared to those with adequate facilities. Similarly, a significant relationship was observed between the waste disposal system and diarrhea (p=0.018, OR=3.64; 95%CI=1.66–7.98), where 65.3% of households with inadequate waste disposal reported diarrheal cases among toddlers.

In contrast, no significant associations were found between diarrhea and housing components (p=0.902, OR=0.88; 95% CI=0.41–1.90) or handwashing habits (p=0.239, OR=0.59; 95% CI=0.27–1.26). The results also showed no significant differences based on toddler gender (p=0.239, OR=0.59; 95% CI=0.27–1.26) or parental education levels (mother: p=0.994; father: p=0.194).

Table 1. Characteristics of respondents, respondents' parents/guardians, and variables studied (n=108)

	n (%)
Age (years) (mean±SD)	3.4±1.0
Weight (kg) (mean±SD)	15.1±1.9
Height (cm) (mean±SD)	98.8±6.8
Gender	
Male	57 (52.8)
Female	51 (47.2)
Diarrheal occurrence	
Diarrheal	56 (51.8)
No Diarrheal	52 (48.2)
Mother's Age (years) (mean±SD)	30.5±7.8
Father's Age (years) (mean±SD)	29.2±8.1
Mother's Education	
<High school/equivalent	55 (50.9)
>High School/equivalent	53 (49.0)
Father's education	
<High school/equivalent	34 (31.5)
>High school/equivalent	74 (68.5)
Family toilet facilities	
Unhealthy	51 (49.1)
Healthy	57 (50.9)
Waste disposal facilities	
Not Good	49 (45.4)
Good	59 (54.6)
House components	
Not Good	64 (59.3)
Good	44 (40.7)
Washing hands with soap	
Not Good	51 (47.2
Good	57 (52.8)

Table 2. Relationship between the variables studied and diarrhea in toddlers (n=108)

Variable	Diarrhea		p	OR (95% CI)
	Yes n (%)	No n (%)		
Family toilet facilities				
Unhealthy	34 (66.7)	17 (33.3)	0.006	3.18 (1.43–6.92)
Healthy	22 (38.6)	35 (61.4)		
Waste disposal facilities				
Unhealthy	32 (65.3)	17 (34.7)	0.018	3.64 (1.66–7.98)
Good	24 (40.7)	35(59.3)		
House components				
Unhealthy	34 (53.1)	30 (46.9)	0.902	0.88 (0.41–1.90)
Good	22 (50.0)	22 (50.0)		
Hand washing with soap				
Unhealthy	30 (58.8)	21 (41.2)	0.239	0.59 (0.27–1.26)
Good	26 (45.6)	31 (54.4)		
Toddler gender				
Male	26 (45.6)	31 (54.4)	0.239	0.59 (0.27–1.26)
Female	30 (58.8)	21(41.2)		
Mother's education				
<High school/equivalent	28 (50.9)	27 (49.1)	0.994	1.08 (0.51–2.30)
>High school/equivalent	28 (52.8)	25 (47.2)		
Father's education				
<High school/equivalent	14 (41.2)	20 (58.8)	0.194	1.88 (0.82–4.27)
>High school/equivalent	42 (65.6)	32(34.4)		

Values are presented as odds ratio (95% confidence interval).

DISCUSSION

This study revealed that environmental conditions play a critical role in the occurrence of diarrhea among toddlers in Serang City. The availability and quality of family toilet facilities and waste disposal systems were both significantly associated with diarrheal risk. Households lacking proper sanitation infrastructure had a markedly higher prevalence of diarrhea. In contrast, housing components and handwashing behavior were not significantly related to diarrhea occurrence. Likewise, no significant associations were found between diarrhea and child gender or parental education level. These findings highlight that structural environmental factors exert a stronger influence on diarrheal risk than individual behavioral or demographic factors in this population.

Diarrhea is more often experienced by children under 2 years of age, with a peak incidence in the 6–11-month age group. This is caused by several factors such as a decrease in antibodies from the mother, a less-than-optimal active immune system in infants, and the introduction of additional foods that may have been contaminated by bacteria from feces.[8] In addition, the phase in which infants begin to crawl increases the possibility of direct contact with human and animal feces. A study in Aceh Province, Indonesia, revealed that children aged 0–24 months have a 1.63-fold higher risk of developing diarrhea compared with those aged 25–59 months.[9] The younger the toddler, the higher the risk of experiencing diarrhea, because their immune system has not developed optimally.[4] Meanwhile, one study noted that most cases of diarrheal were found in children aged 24–41 months, which was 55.9%.[10] Therefore, the demographics of children with diarrhea in this study are not in line with previous results, possibly because this study only involved children aged between 2 and <5 years according to the inclusion criteria.

Death from diarrhea is generally triggered by dehydration, which begins with various levels of symptoms and weight loss. The level of dehydration is greatly influenced by the

cause of diarrhea, which will determine the frequency and consistency of bowel movements.[2] A high frequency of diarrhea increases the risk of dehydration, which is characterized by weight loss. This occurs because a toddler's body is composed mostly of water, so fluid loss directly affects cellular function. If not managed promptly with adequate rehydration, weight loss will worsen.[11] Therefore, monitoring weight is very important in treating toddlers with diarrhea. In addition, children with diarrhea tend to lose their appetite, which reduces nutritional intake and disrupts nutrient absorption. As a result, body weight decreases gradually, and height growth can also be impaired.[12]

A prospective cohort study conducted in Brazil showed that toddlers who frequently experience diarrhea between 0 and 2 years of age are at risk of long-term growth disturbances up to 5 years later.[13] High frequency of diarrhea in early life may increase the risk of stunting, emphasizing the need for timely and adequate nutritional management.[14] The findings of this study also demonstrate a significant relationship between family toilet facilities and diarrhea in toddlers. These results are consistent with previous studies showing that toilet quality is directly related to diarrheal occurrence.[15,16] Inadequate toilets allow the proliferation of pathogenic bacteria such as Escherichia coli, Shigella, Salmonella, and Staphylococcus enterocolitica, which thrive in unhygienic environments and can contaminate water and food sources, thereby increasing infection risk.[17,18] From an environmental health perspective, proper toilets are essential to interrupt disease transmission originating from human waste.[19] Toilets that fail to meet sanitation standards facilitate diarrhea transmission because unmanaged feces can contaminate water, food, and serve as breeding sites for disease vectors.[20,21]

Improper waste disposal practices also contribute to the spread of diarrheal diseases. Observations showed that many households used open, non-waterproof trash containers, which serve as breeding grounds for flies and rodents, both of which can transmit enteric pathogens.[22,23] Regarding house components, this study found no significant association between floor type and diarrhea, in contrast with studies reporting that non-waterproof floors increase diarrheal risk.[24-26] Similarly, handwashing behavior was not significantly associated with diarrhea, likely due to inconsistencies in reported practices or self-reporting bias. In many households, handwashing may be performed without soap or at incorrect times, limiting its protective effect.[27] Nonetheless, handwashing with soap remains a well-documented preventive measure, capable of reducing diarrheal mortality by nearly 50% when practiced consistently.[28,29]

In terms of gender, male toddlers were more likely to experience diarrhea than females, consistent with evidence suggesting higher susceptibility to infection among boys due to greater physical activity and potentially higher pathogen exposure.[30,31] Parental education also plays a crucial role; mothers with higher education levels tend to have better health literacy, which translates into healthier household practices such as improved hygiene, safer food handling, and cleaner living environments.[32]

This study has several limitations. As a cross-sectional study, causal relationships cannot be established, and reporting bias may be present. Data collection was conducted with the assistance of midwives, and not all were directly supervised by the researcher, which may have affected response accuracy. Environmental variables, such as toilet facilities and waste disposal systems, were self-reported rather than observed directly. Future studies should include direct home observations and assess additional confounding variables, such as septic tank distance, immunization status, and exclusive breastfeeding practices.

These findings underscore the vital role of family physicians and primary health care providers in diarrhea prevention and control. Family doctors are often the first point of contact for families and can play a pivotal role in health education, sanitation advocacy, and early detection of diarrheal diseases in children. Strengthening collaboration between community health workers and family physicians can ensure regular household sanitation monitoring, promote consistent hand hygiene practices, and facilitate timely interventions for at-risk families. Integrating these preventive measures into routine primary care services supports a holistic, community-based approach that aligns with the principles of family medicine.

CONCLUSION

This study highlights the importance of community-based efforts to reduce diarrhea among young children. Improving household sanitation should remain a top priority through the use of proper goose-neck toilets and effective waste disposal systems. Collaboration between health authorities and government agencies is needed to ensure regular supervision of household sanitation. Community health centers should also provide ongoing education for families about hygiene and waste management using culturally appropriate methods.

For family doctors and primary care providers, these findings emphasize the need to strengthen preventive care at the community level. Family physicians can play an active role in educating parents about hygiene, safe food prepa-

ration, and sanitation during routine visits. They can also work with community health workers to identify at-risk families, monitor child growth, and provide early interventions to prevent diarrhea. Strengthening these preventive roles in primary care can help reduce diarrhea cases and improve child health outcomes. Improving sanitation, promoting hygiene, and fostering collaboration between communities and health services are key steps to reduce the burden of diarrhea in early childhood.

Disclosures

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

Funding: None.

Ethics Committee Approval: The study was approved by the Local Ethics Committee. (Date: 05/02/2024, Number: 61/UN43.20/KEPK/2024.

Authorship Contributions: Concept – I.M.S., A.Y.K.; Design – I.M.S., A.Y.K.; Supervision – I.M.S.; Materials – I.M.S., A.Y.K.; Data collection & or processing – A.Y.K.; Analysis and/or interpretation – I.M.S., A.Y.K.; Literature search – I.M.S.; Writing – I.M.S.; Critical review – I.M.S.

REFERENCES

1. Viegelmann GC, Dorji J, Guo X, Lim HY. Approach to diarrhoeal disorders in children. Singapore Med J 2021;62(12):623–9.
2. Nemeth V, Pfleghaar N. Diarrhea. Treasure Island: StatPearls Publishing; 2025. p. 1–11.
3. United Nations Children's Fund (UNICEF). Diarrhoea. 2024. p. 1–6. Available at: https://data.unicef.org/topic/child-health/diarrhoeal-disease/. Accessed Nov 26, 2025.
4. Yunitawati D, Khairunnisa M, Mulyantoro DK, Ashar H, Latifah L. Diarrhea among children under-five: Comparing risk factors in urban and rural areas in Indonesia. Clin Epidemiol Glob Health 2025;35:102136.
5. Birhan TA, Bitew BD, Dagne H, Amare DE, Azanaw J, Genet M, et al. Prevalence of diarrheal disease and associated factors among under-five children in flood-prone settlements of Northwest Ethiopia: A cross-sectional community-based study. Front Pediatr 2023;11:1–7.
6. Derseh BT, Tafese NM, Panari H, Bilchut AH, Dadi AF. Behavioral and environmental determinants of acute diarrhea among under-five children from public health facilities of Siyadebirena Wayu district, north Shoa zone, Amhara regional state, Ethiopia: Unmatched case-control study. PLoS One 2021;16:1–14.
7. Hambali M, Vera Nazhira A, Radhiah Z. Factors associated with the incidence of diarrhea in toddlers in the working area of Suro Health Center, Suro District, Aceh Singkil Regency in 2022. InsoLOGI J Sains dan Teknol 2022;1(6):723–30. [Article in Indonesian]
8. Mogharab V, Rajput S. Factors associated with diarrhea in children under 12 years of age referred to Ostad Motahari hospital of Jahrom in 2020. J Fam Med Prim Care 2022;11(10):6170–6.
9. Adawiah R, Susanna D. Analysis of environmental and sociodemographic factors with the incidence of diarrhea in toddlers in Aceh Province in 2023. J Kesehat 2024;17(3):267–79.
10. Iskandar WJ, Sukardi I Wayan, Soenarto Y. Risk of nutritional status on diarrhea among under five children. Paediatr Indones 2015;55(4):235–8.
11. Daley SF, Avva U. Pediatric dehydration. Available at: https://www.ncbi.nlm.nih.gov/books/NBK436022/. Accessed Nov 26, 2025.
12. Bhutta ZA, Berkley JA, Bandsma RHJ, Al E. Severe childhood malnutrition. Eur PMC Funders Group, Author Manuscr 2017;21(3):17067.
13. Olieman JF, Penning C, Spoel M, Ijsselstijn H, Hoonaard TL van den, Escher JC, et al. Long-term impact of infantile short bowel syndrome on nutritional status and growth. Br J Nutr 2012;107(10):1489–97.
14. Goudet SM, Bogin BA, Madise NJ, Griffiths PL. Nutritional interventions for preventing stunting in children (birth to 59 months) living in urban slums in low- and middle-income countries (LMIC): A systematic review. Cochrane Database Syst Rev 2019;(6):CD011695.
15. Kurniawati DP, Arini SY, Awwalina I, Pramesti N. Poor basic sanitation impact on diarrhea cases in toddlers. J Kesehat Lingkung 2021;13(1):41–7.
16. Kriswanto K, Musyarofah S, Mushidah M. The relationship between environmental sanitation and the incidence of diarrhea in toddlers. Proc Int Conf Nurs Heal Sci 2021;2(2):133–42.
17. Abney SE, Bright KR, McKinney J, Ijaz MK, Gerba CP. Toilet hygiene—review and research needs. J Appl Microbiol 2021;131(6):2705–14.
18. Todd ECD. Foodborne diseases: Overview of biological hazards and foodborne diseases. Encycl Food Saf 2014;1:221–42.
19. Mock CN, Nugent R, Kobusingye O, Smith KR. Water supply, sanitation, and hygiene. In Injury Prevention and Environmental Health. 3rd ed. Washington: The International Bank for Reconstruction and Development; 2017. p. 1–34.
20. Bauza V, Ye W, Liao J, Majorin F, Clasen T. Interventions to improve sanitation for preventing diarrhoea. Cochrane Database Syst Rev 2023;1(1):CD013328.
21. Abney SE, Higham CA, Wilson AM, Ijaz MK, McKinney J, Reynolds KA, et al. Transmission of viruses from restroom use: A quantitative microbial risk assessment. Food Environ Virol 2024;16(1):65–78.
22. Omang DI, John GE, Inah SA, Bisong JO. Public health implication of solid waste generated by households in Bekwarra local government area. Afr Health Sci 2021;21(3):1467–73.
23. Krystosik A, Njoroge G, Odhiambo L, Forsyth JE, Mutuku F,

LaBeaud AD. Solid wastes provide breeding sites, burrows, and food for biological disease vectors, and urban zoonotic reservoirs: A call to action for solutions-based research. Front Public Health 2020;7:1–17.
24. Sahiledengle B, Kumie A, Atlaw D, Tekalegn Y, Woldeyohannes D, Zenbaba D, et al. The role of household flooring on childhood diarrhea among children 0 to 23 months of age in Ethiopia: A nationally representative cross-sectional study using a multi-level mixed effect analysis. Environ Health Insights 2021;15:11786302211064423.
25. Legge H, Pullan RL, Sartorius B. Improved household flooring is associated with lower odds of enteric and parasitic infections in low- and middle-income countries: A systematic review and meta-analysis. PLOS Glob Public Health 2023;3(12):1–21.
26. Rashid T, Vonville H, Hasan I, Garey KW. Mechanisms for floor surfaces or environmental ground contamination to cause human infection: A systematic review. Epidemiol Infect 2017;145(2):347–57.
27. Luby SP, Halder AK, Huda T, Unicomb L, Johnston RB. The effect of handwashing at recommended times with water alone and with soap on child diarrhea in rural Bangladesh: An observational study. PLoS Med 2011;8(6):e1001052.
28. Fatmawati DA, Sumardiyono S, Murti B. Meta-analysis the effects of hand washing behavior using soap and latrine availability on the diarrhea incidence in children under five. J Heal Promot Behav 2024;9(2):119–31.
29. Noguchi Y, Nonaka D, Kounnavong S, Kobayashi J. Effects of hand-washing facilities with water and soap on diarrhea incidence among children under five years in Lao People's Democratic Republic: A cross-sectional study. Int J Environ Res Public Health 2021;18(2):1–15.
30. Jarman AF, Long SE, Robertson SE. Gender differences in acute pediatric diarrhea: A secondary analysis of the DHAKA study. J Epidemiol Glob Health 2018;8(1–2):42–7.
31. Morales F, Montserrat-de la Paz S, Leon MJ, Rivero-Pino F. Effects of malnutrition on the immune system and infection and the role of nutritional strategies regarding improvements in children's health status: A literature review. Nutrients 2024;16(1):1–16.
32. Rezaeizadeh G, Mansournia MA, Keshtkar A, Farahani Z, Zarepour F, Sharafkhah M, et al. Maternal education and its influence on child growth and nutritional status during the first two years of life: A systematic review and meta-analysis. eClinicalMedicine 2024;71:102574.