Basic Sanitation as a Key Determinant of Diarrhea Among Under-Five Children

Pilipus[1], Apriyani[1], I Putu Sukra[1]
[1]Department of Public Health, Universitas Widya Gama Mahakam Samarinda, Indonesia;
Correspondence: **Apriyani**: Jl. Wahid Hasyim II/28, Sempaja Selatan, Samarinda Utara, Kota Samarinda, Indonesia; apriyani@uwgm.ac.id

ABSTRACT
Basic sanitation represents fundamental efforts to improve human health by ensuring the availability of a clean and safe environment. Core components of basic sanitation include access to clean water, household latrines, solid-waste disposal facilities, and domestic wastewater drainage systems. Inadequate sanitation infrastructure is widely recognized as a major contributor to diarrheal diseases, particularly among vulnerable groups such as under-five children. This study aimed to analyze the relationship between household waste-bin conditions and latrine conditions with the incidence of diarrhea among under-five children in the Baqa Primary Health Center area, Samarinda, in 2023. A quantitative approach with a cross-sectional design was employed. The study involved 96 respondents selected through observational assessment. Data collection utilized structured observation sheets (checklists) to evaluate household waste-bin conditions, latrine conditions, and diarrheal incidence among under-five children. Data analysis was conducted using the Chi-square test and Fisher's Exact Test as an alternative when assumptions were not met. The findings indicated a significant association between household waste-bin conditions and diarrheal incidence among under-five children ($p = 0.002$). A significant relationship was also found between latrine conditions and diarrheal incidence ($p = 0.000$). These results suggest that inadequate waste-bin facilities and substandard latrine conditions contribute to a higher risk of diarrhea among toddlers. In conclusion, improving household sanitation, particularly by providing proper waste-bin facilities and ensuring latrines meet health standards is essential to reducing diarrheal incidence among under-five children. Strengthening community awareness and promoting compliance with sanitation requirements are recommended to minimize disease occurrence.
Keywords: under-five children; basic sanitation; waste-bin condition; latrine condition; diarrhea incidence

INTRODUCTION
Diarrhea is a common public health problem occurring across various community settings [1]. It affects individuals of all ages; including children, adults, older persons, and infants manifesting as increased frequency of defecation accompanied by loose or watery stools. As an environmentally driven disease, diarrhea often arises from unfavorable natural conditions, inadequate hygiene practices, and climatic influences that facilitate the transmission of infectious agents. In Indonesia, the Ministry of Health defines diarrhea as the passage of semi-liquid or liquid stools exceeding normal water content, typically more than 200 grams or 200 milliliters per day, occurring at least three times within 24 hours. In severe cases, stool may contain bodily fluids or blood, and the excretion may occur as pure water [2].

Microorganisms; including bacteria, viruses, and parasites constitute the primary etiological agents of diarrhea. Contaminated food and beverages are common sources of infection, while poor personal hygiene and inadequate environmental sanitation further increase susceptibility. Beyond its role as a major cause of morbidity, diarrhea remains one of the leading contributors to mortality, particularly among infants and young children. In Indonesia, diarrhea accounts for approximately 25.2% of infant deaths annually. National data indicate that the prevalence of diarrhea decreased from 12.3% in 2018 to 4.5% in 2019. In East Kalimantan, 68,256 diarrhea cases were reported in 2019 [2].

In Samarinda City, diarrhea consistently ranks among the top ten most prevalent diseases. Among under-five children, 4,162 cases were recorded in 2018, 3,926 cases in 2019, 1,513 cases in 2020, and 1,236 cases in 2021 (Dinas Kesehatan Kota Samarinda, 2022). According to recent data from Baqa Primary Health Center, 126 diarrhea cases among under-five children were reported in 2022 [3].

Poor basic sanitation is one of the major determinants contributing to high diarrhea incidence, especially in areas with limited access to hygiene facilities. Inadequate sanitation; such as insufficient clean water supply, lack of proper household latrines, and poor waste management facilitates the spread of diarrheal pathogens [4]. The World Health Organization (WHO) emphasizes that improving access to clean water and adequate sanitation can reduce diarrhea cases by up to 50%. Therefore, strengthening household-level and community-level sanitation systems is essential for effective diarrhea prevention, particularly in high-incidence regions [5].

A study conducted by Nasution in 2019 demonstrated a significant association between basic hygiene factors, including toilet cleanliness, clean water availability, waste management, and sanitation conditions, and diarrhea prevalence among young children in Hutaimbaru District, Padangsidimpuan City [6]. Based on this evidence, the study aimed to examine the relationship between basic sanitation, specifically household waste-bin conditions and latrine conditions and diarrhea incidence among under-five children in the working area of Baqa Primary Health Center, Samarinda Seberang, Samarinda City, in 2023.

METHODS
This study was conducted from 23 February 2023 to 14 March 2023 in the working area of Baqa Primary Health Center, located in Samarinda Seberang District, Samarinda City, East Kalimantan. Referring objective, a quantitative research approach was employed using a cross-sectional design. This design was selected to align with the research problem and objectives, allowing the simultaneous assessment of risk factors and diarrhea incidence within a single period. Quantitative research emphasizes numerical aspects such as quantity, frequency, and measurable characteristics of a phenomenon. Cross-sectional studies collect exposure and outcome data at the same point in time to analyze their relationship [7-9].

The study population consisted of all under-five children who experienced diarrhea in the Baqa Primary Health Center area, totaling 126 children. The sampling technique used was simple random sampling, a method that selects respondents randomly without considering strata within the population [8,10]. Based on this technique, a total of 96 respondents, under-five children and their parents were included as the study sample.

Dependent variable was diarrhea incidence among under-five children. Independent variables were household waste-bin condition and household latrine condition. Diarrhea incidence was measured through parental reporting and verification using observation sheets, categorized based on the frequency and consistency of stools according to Ministry of Health standards. Household waste-bin condition was assessed using an observation checklist evaluating criteria such as presence of a lid, cleanliness, accessibility, and proper waste disposal practices. Latrine

condition was measured through direct observation using a structured checklist assessing physical structure, cleanliness, water availability, waste disposal mechanism, and compliance with sanitation standards.

Descriptive analysis was performed using frequencies and percentages because all variables in this study were categorical [11-13], including diarrhea status, waste-bin condition, and latrine condition. This approach allowed the researchers to summarize the distribution of respondent characteristics and household sanitation conditions clearly and accurately. Inferential analysis was then conducted using the Chi-square test [14] to examine associations between basic sanitation variables and diarrhea incidence. When the assumptions of the Chi-square test were not met, specifically when expected cell counts were below five Fisher's Exact Test was applied as a more appropriate alternative to determine statistical significance.

RESULTS

Table 1 presents the distribution of respondent characteristics. Among the 96 parents or guardians participating in the study, 86.6% were female and 10.4% were male. Meanwhile, of the 96 under-five children assessed, 68.8% were male and 31.2% were female.

Table 2 summarizes the distribution of the main research variables. Of the 96 participants, 78.1% children had experienced diarrhea, while 21.9% children had not. In terms of household sanitation, 85.4% respondents had waste-bin facilities that did not meet health standards, whereas only 14.6% respondents had compliant waste-bin facilities. Regarding latrine conditions, 45.8% respondents possessed healthy latrines, while 54.2% respondents used unhealthy latrines.

The results in Table 3 indicate strong and statistically significant associations between household sanitation conditions and diarrhea incidence among under-five children. First, waste-bin condition shows a marked difference in diarrhea prevalence: 84.1% of children living in households with non-standard waste bins experienced diarrhea, compared with only 42.9% in households with proper waste-bin facilities. The p-value of 0.002 confirms that this relationship is statistically significant, suggesting that inadequate waste management substantially increases exposure to diarrheal pathogens.

Similarly, latrine condition demonstrates an even stronger association with diarrhea incidence. Among households with unhealthy latrines, 96.2% of children experienced diarrhea, whereas only 56.8% of children in households with healthy latrines were affected. The p-value of 0.000 indicates a highly significant relationship, reinforcing that poor latrine conditions greatly elevate the risk of diarrheal disease.

Overall, the findings show that both waste-bin condition and latrine condition are critical determinants of diarrhea incidence. Children living in environments with inadequate sanitation infrastructure face substantially higher risk, underscoring the importance of improving basic household sanitation to reduce diarrheal morbidity.

Table 1. Distribution of demographic haracteristics of food handler

Demographic variable	Frequency	Percentage
Parent's sex		
Male	10	10.4
Female	86	86.6
Chlid's sex		
Male	66	68.8
Female	30	31.2

Table 2. Distribution of diarrhea incidence and household sanitation

Variable	Frequency	Percentage
Diarrhea incidence		
Diarrhea	75	78.1
No diarrhea	21	21.9
Waste-bin condition		
Meets standards	14	14.6
Does not meet standards	82	85.4
Latrine condition		
Healthy	44	45.8
Unhealthy	52	54.2

Table 3. Relationship between household sanitation and diarrhea incidence

Household sanitation	Diarrhea incidence		p
	Diarrhea	No diarrhea	
	Percentage	Percentage	
Waste-bin condition			
Meets standars	42.9	57.1	0.002
Does not meets standars	84.1	15.9	
Latrine condition			
Healthy	56.8	43.2	0.000
Unhealthy	96.2	3.8	

DISCUSSION

Poor environmental sanitation remains one of the most influential determinants of diarrheal disease, particularly in communities where waste management systems are inadequate or poorly regulated. Improperly managed household waste creates conditions conducive to the proliferation of pathogenic microorganisms and attracts disease-carrying vectors such as flies, cockroaches, and rodents. These vectors frequently come into contact with human food sources or drinking water, facilitating the transmission of enteric pathogens responsible for diarrhea. Furthermore, the accumulation of uncovered or openly disposed waste contributes to environmental contamination, increasing the likelihood of disease transmission within the community [15].

Findings from this study demonstrate a significant association between household waste-bin conditions and diarrhea incidence among under-five children ($p = 0.002$). Households with non-compliant waste-bin facilities exhibited a markedly higher prevalence of diarrhea (84.1%) compared to households with compliant waste-bin facilities (42.9%). These results underscore the critical role of proper waste management in reducing exposure to diarrheal pathogens. Waste bins that are open, lack lids, are damaged, or allow leakage create environments that support vector breeding and pathogen dissemination, thereby elevating the risk of diarrheal disease among young children [16].

The present findings align with the study conducted by Nasution (2019) in Hutaimbaru District, Padangsidimpuan City, which also reported a significant relationship between waste management practices and diarrhea prevalence among early childhood populations. Nasution's study highlighted that children living in areas with poor waste management systems were more susceptible to diarrhea than those residing in cleaner environments [6]. This convergence of evidence suggests that limited community awareness regarding environmental hygiene continues to pose challenges for preventing environmentally transmitted diseases.

In addition to waste management, latrine conditions play a pivotal role in the transmission dynamics of diarrheal disease. Inadequate sanitation can lead to environmental contamination with fecal matter containing diarrheagenic bacteria such as *Escherichia coli* [17]. This study found a

highly significant association between latrine condition and diarrhea incidence (p = 0.000). Households with unhealthy latrines reported a substantially higher prevalence of diarrhea (96.2%) compared to households with healthy latrines (56.8%). These findings highlight the importance of proper sanitation infrastructure in preventing fecal contamination and reducing disease transmission [18].

Within the Baqa Primary Health Center area, traditional pit latrines remain in use, particularly among households located near riverbanks. Some households do not utilize standardized septic tanks; instead, they rely on tidal river flows to dispose of fecal waste. Such practices significantly increase the risk of diarrheal disease transmission, especially through flies that move between fecal matter and human food sources. During the rainy season, rising river water levels may disperse fecal contaminants into surrounding residential areas, further amplifying the risk of diarrheal outbreaks.

Comparable findings were reported by Sidqi et al. (2021) in Banyumas Regency, where the use of non-compliant latrines was associated with a two-fold increase in diarrhea risk among children [19]. Similarly, research by Anpetri et al. (2023) in Pontianak revealed that low community awareness regarding the importance of healthy latrine use contributed significantly to high diarrhea incidence. In communities lacking adequate sanitation facilities, open defecation practices remain prevalent, leading to environmental contamination and increased infection risk [20].

Another contributing factor is the level of community education and awareness regarding basic sanitation. Many households remain unaware of the importance of using covered waste bins and maintaining healthy latrines as part of diarrhea prevention efforts. Yet numerous studies have shown that simple practices, such as proper waste disposal, handwashing with soap, and maintaining latrine cleanliness can substantially reduce diarrheal risk. When viewed collectively, the present findings and supporting literature affirm that basic sanitation, particularly waste management and latrine condition, plays a crucial role in preventing diarrheal disease [18,21].

Strategic interventions are therefore needed to enhance community awareness, including educational programs on environmental hygiene, improved access to adequate sanitation facilities, and strengthened policies related to waste management and healthy latrine standards. Beyond education and policy, the role of local government and relevant institutions is essential in ensuring equitable access to proper sanitation facilities. Efforts such as expanding access to clean water, providing appropriate waste-bin facilities in residential areas, and monitoring open defecation practices are vital steps toward reducing diarrhea incidence in the Baqa Primary Health Center area and other regions facing similar challenges.

Sustained improvements in basic sanitation are expected to significantly reduce diarrhea cases among under-five children, thereby enhancing overall community health. Achieving this goal requires strong collaboration among community members, local authorities, and health professionals to create healthier environments free from environmentally transmitted diseases such as diarrhea.

CONCLUSION

Poor environmental sanitation, particularly inadequate waste management and unhealthy latrine conditions shows a strong and significant association with diarrhea incidence among under-five children in the Baqa Primary Health Center area. Households with non-compliant waste bins and unhealthy latrines exhibited markedly higher rates of diarrhea, underscoring the critical role of basic sanitation in preventing enteric infections. Strengthening community awareness and improving access to proper sanitation facilities are essential steps toward reducing diarrheal disease in this population.

Ethical consideration, competing interest and source of funding

-This study obtained ethical approval, ensuring that all research procedures adhered to established health research ethics. Ethical principles applied included informed consent, confidentiality of respondent data, voluntary participation, and protection of participant welfare throughout the study.
-There is no conflict of interest related to this publication.
-Source of funding is authors.

REFERENCES

1. Mokomane M, Kasvosve I, Melo ED, Pernica JM, Goldfarb DM. The global problem of childhood diarrhoeal diseases: emerging strategies in prevention and management. Therapeutic Advances in Infectious Disease. 2018 Jan;5(1):29-43.
2. Kemenkes RI. Profil Kesehatan Indonesia tahun 2019. Jakarta: Kementerian Kesehatan Republik Indonesia; 2020.
3. Puskesmas Baqa. Laporan kinerja Puskesmas Baqa tahun 2023. Baqa: Puskesmas Baqa; 2023.
4. Apriani D. Hubungan sanitasi dasar dengan kejadian diare pada balita di wilayah kerja Puskesmas Pembina Kota Palembang. Jurnal Ilmiah Universitas Batanghari Jambi. 2021;21(1):253-62.
5. Aksi, Pramadita S, Jumiati. Analisis sanitasi lingkungan permukiman tepian Sungai Kapuas Kelurahan Sungai Jawi Luar dan Sungai Beliung Kecamatan Pontianak Barat. Report. 2020;1(1):1–10.
6. Nasution AR. Hubungan sanitasi dasar dengan kejadian diare pada balita di Kelurahan Hutaimbaru Kota Padangsidimpuan. Thesis. USU. 2019.
7. Nugroho HSW. Methodological rigor in health research: Ensuring the best approach to address clinical and public health objectives. Health Notions. 2026 Jan 31;10(1):1-3.
8. Suharto A, Nugroho HSW, Santosa BJ. Metode penelitian dan statistika dasar. Bandung: Media Sains Indonesia; 2022.
9. Nugroho HSW. Ensuring replicability in health research: The critical role of transparent and systematic methodological reporting. Health Notions. 2026 Feb 28;10(2):31-3.
10. Nugroho HSW. Biostatistik untuk mahasiswa D3 kebidanan. Ponorogo: FORIKES; 2013.
11. Suparji, Nugroho HSW, Martiningsih W. Tips for distinguishing nominal and ordinal scale data. Aloha International Journal of Multidisciplinary Advancement (AIJMU). 2019;1(6):133-5.
12. Nugroho HSW, Santosa BJ. Misleading use of the terms of univariate and bivariate analysis in health research. Health Notions. 2019 Aug 31;3(8):352-6.
13. Nugroho HSW. Analisis data secara deskriptif untuk data kategorik. Ponorogo: Forum Ilmiah Kesehatan (FORIKES); 2014.
14. Polnok S, Auta TT, Nugroho HSW, Putra GD, Sudiantara K, Gama IK, Mustika IW, Suparji, Onggang FS, Rusni W, Subrata T. Statistics Kingdom: A very helpful basic statistical analysis tool for health students. Health Notions. 2022 Oct 31;6(9):413-20.

15. Boafo YA, Ohemeng FN, Ayivor J, Ayitiah JA, Yirenya-Tawiah D, Mensah A, Datsa C, Annang TY, Adom L. Unraveling diarrheal disease knowledge, understanding, and management practices among climate change vulnerable coastal communities in Ghana. Frontiers in Public Health. 2024 Jun 14;12:1352275.
16. 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. Frontiers in Public Health. 2020 Jan 17;7:405.
17. Julian TR. Environmental transmission of diarrheal pathogens in low and middle income countries. Environmental Science: Processes & Impacts. 2016;18(8):944-55.
18. Alum EU, Obeagu EI, Ugwu OP. Enhancing quality water, good sanitation, and proper hygiene is the panacea to diarrhea control and the attainment of some related sustainable development goals: A review. Medicine. 2024 Sep 20;103(38):e39578.
19. Sidqi D, Anasta N, Mufidah P. Analisis spasial kasus diare pada balita di Kabupaten Banyumas tahun 2019. Jurnal Biostatistik, Kependudukan, dan Informatika Kesehatan. 2021;1(1):135-42.
20. Anpetri HM, Apriani I, Pramadita S. Pemetaan kondisi sanitasi lingkungan dasar pada sekolah dasar di Kelurahan Sungai Jawi Luar Kota Pontianak. Jurnal Teknologi Lingkungan Lahan Basah. 2023;11(2):468-72.
21. McClelland PH, Kenney CT, Palacardo F, Roberts NL, Luhende N, Chua J, Huang J, Patel P, Sanchez LA, Kim WJ, Kwon J. Improved water and waste management practices reduce diarrhea risk in children under age five in rural Tanzania: A community-based, cross-sectional analysis. International Journal of Environmental Research and Public Health. 2022 Apr 1;19(7):4218.