

Analysis of Environmental and Sociodemographic Factors with the Incidence of Diarrhea in Toddlers in Aceh Province in 2023

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How to cite: Adawiah, R., & Susanna, D. Analysis of Environmental and Sociodemographic Factors with the Incidence of Diarrhea in Toddlers in Aceh Province in 2023. Jurnal Kesehatan, 17(3), 267–279. <https://doi.org/10.23917/jk.v17i3.6878>

Article Info

Article History:

Submission: 15 October 2024

Revision: 1 November 2024

Reception: 15 November 2024

Keywords: Toddlers,
Diarrhea, Environment,
Sociodemographics

ABSTRACT

Introduction: Diarrhea disease is one of the gastrointestinal disorders that often occurs in children under five years of age. There was an increase in diarrhea cases among children under five years old by 16% in 2021, 29% in 2022 and 31.7% in 2023 in Aceh Province. Environmental and sociodemographic factors are interrelated factors for the occurrence of diarrhea in toddlers. The purpose of this study was to analyze environmental and sociodemographic factors with the incidence of diarrhea in toddlers in Aceh Province. **Methods:** This study used a *cross-sectional* study design and the data source was obtained from the Survei Kesehatan Indonesia (SKI) in 2023 with a total sample size of 4,234 children aged 0-59 months in Aceh Province. Data analysis was performed using univariate and bivariate *complex samples* analysis using the *Chi-Square* test. **Results:** There was an association between child age and the incidence of diarrhea in children under five years of age in Aceh Province in 2023 (p-value = 0.032, OR: 1,610 (1,037-2,500). In this population, we have 95% confidence that age of the child is a risk factor for the incidence of diarrhea in children aged 0-24 months in Aceh Province with a range between 1.051-2.539. **Conclusion:** Children aged 0-24 months are at 1.634 times greater risk of diarrhea in children under five compared to children aged 25-59 months. Cross-sectoral cooperation is needed to improve the role of posyandu in health promotion efforts through integrated health counseling on the growth and development of children under five and education on clean and healthy living behaviors in the household environment.

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INTRODUCTION

Diarrhea is a digestive tract disorder that has symptoms in the form of defecation more than three times a day accompanied by liquid feces (World Health Organization, 2024b). Gastrointestinal disorders often occur in children under the age of five because they are very vulnerable to infectious diseases because early in life the body's immunity is still

not functioning optimally. The risk of death from diarrheal disease is greatest in children under the age of five (Podewils et al. 2020; Puhi, Sudirman, and Febriyona 2023). In fact, children under five years of age or toddlers are an important generation, because the future of the nation is determined by the quality of children under five years of age from an early age and health is a major factor in the process of child growth and development (Melvani, Zulkifli, and Faizal 2019).

The World Health Organization (WHO) notes that every year there are 1.7 billion cases of diarrhea in children under five years of age worldwide, causing 443,832 children under five years of age to die (World Health Organization, 2024b). South Asia and sub-Saharan Africa are the regions with the highest mortality from diarrhea in children under five years of age (United Nations Children's Fund 2024). The prevalence of diarrhea in children under five in Indonesia is 4.9% and the prevalence of diarrhea in children under five based on clinical symptoms in Indonesia is 7.4%. Meanwhile, Aceh Province has a prevalence of diarrhea in children under five at 4.3% and a prevalence of diarrhea in children under five based on clinical symptoms at 6.0% (Health Development Policy Agency of the Ministry of Health of the Republic of Indonesia 2023). There has been an increase in cases of diarrhea in children under five years in Aceh Province with the number of cases in 2021 reaching 17,063 cases or 16%, in 2022 reaching 18,030 cases or 29% and in 2023 reaching 85,691 cases or 31.7% (Central Bureau of Statistics of Aceh Province 2023; Aceh Provincial Health Office 2021, 2022).

Diarrhea in toddlers can be caused by many factors, including environmental and sociodemographic factors (Nopriansyah et al. 2024). Drinking water sources, fecal disposal facilities that do not meet health requirements, trash management, waste management and unsafe drinking water treatment are environmental factors that contribute to the occurrence of diarrheal disease in children under five years of age (Ganiwijaya, Rahardjo, and Nurjazuli 2016; Iryanto et al. 2022). Age of toddlers, gender and place of residence are supporting factors in the process of diarrhea in toddlers (Aziza and Rukmana 2023; Nopriansyah et al. 2024).

The 2023 SKI noted that households do not have access to proper sanitation at 6.4% in Aceh Province. Open defecation is still found in Aceh Province at 6.9% (Health Development Policy Agency of the Ministry of Health of the Republic of Indonesia 2023). There has been a decrease in access to proper sanitation in the last three years, namely in 2021 by 77.55%, in 2022 by 77.48% and in 2023 by 65.2% (Central Bureau of Statistics of Aceh Province 2023; Aceh . Unsafe sanitation is closely related to open defecation behavior which ultimately causes high fecal oral transmission of diseases and leads to infectious diseases such as diarrhea (Kurniawati et al., 2021).

The increase in diarrhea cases in children under five years of age in Aceh Province indicates the need for *renewal* of data related to the factors that cause the incidence of diarrhea in children under five years of age in Aceh Province. This study is to analyze environmental and sociodemographic factors with the incidence of diarrhea in children under five years of age in Aceh Province in 2023. The results of this study are expected to be information and consideration for local governments in developing programs related to factors that cause diarrhea in children under five.

LITERATURE REVIEW

Diarrhea is a symptom of intestinal tract infection that often occurs in toddlers and can be seen through the release of watery or liquid stools for three times a day or more, causing water and salt in the body to decrease (World Health Organization, 2024b). Toddlers aged <5 years are the most at-risk age group for diarrhea because at that age,

children still do not have a strong immune system because they are still in the growth stage (Puihi et al., 2023).

The incidence of diarrhea in toddlers can be influenced by internal and external factors (Puihi et al., 2023). Internal factors include toddler age, gender and place of residence (Salma, Dyah, and Santik 2024; Sari and Budyanra 2017). In addition, access to drinking water, sanitation, trash management, waste management and drinking water treatment are external factors that also play a role in influencing the incidence of diarrhea in children under five years of age (Munawaroh, Sulistiyani, and Darundiati 2024).

Access to drinking water is one of the things that is quite potential in determining diarrhea because diarrhea infectious germs can be transmitted through the oral *fecal* route (Fitriani, Darmawan, and Puspasari 2020). Sanitation is closely related to diarrhea in toddlers (Maywati, Gustaman, and Rini Riyanti 2023). Previous research revealed that safe defecation habits in households can lead to twice the risk of diarrhea in toddlers when compared to those with safe defecation habits (Rohmah, 2016).

Unsafe Trash and waste management factors can increase the risk of water and soil pollution which in turn can become a nesting place for disease-carrying insects, so management from the source, collection, transportation and final disposal is an important thing that needs attention. (Pitri et al. 2023; Rahmania and Yudhastuti 2023). In addition, the absence of safe drinking water treatment management can cause germs to spread from contaminated places to spread to food or drink places, causing diarrhea in children under five years old (Pitri et al., 2023).

METHOD

This study used a *cross-sectional* study design with secondary data sources obtained from the Survei Kesehatan Indonesia (SKI) conducted in Aceh Province from July to August 2023. SKI data was accessed from the data and information center service of the Health Development Policy Agency of the Ministry of Health of the Republic of Indonesia through the website <https://layanandata.kemkes.go.id/> (Health 2024). The study population was all households with children aged 0-59 months with a sample size of 4,324 children under five. The incidence of diarrhea was calculated using cases of diarrhea that combined both diagnosis and symptoms. The incidence of diarrhea in children under five was categorized into diarrhea and non-diarrhea. Diarrhea is said if there are symptoms such as defecation >3 times per day with soft or watery stool texture (Health Development Policy Agency of the Ministry of Health of the Republic of Indonesia 2023).

Environmental factors include household access to drinking water and are categorized based on the source of drinking water used. It is said to be safe if households use drinking water sources from piped water, boreholes/pumps, protected dug wells, protected springs, rainwater harvesting, water hydrants and water terminals (National Development Planning Agency 2020). Sanitation is categorized based on ownership and behavior of latrine use, type of latrine and location of fecal flow and is said to be safe if the household has a latrine and is used and there is a superstructure and a gooseneck toilet that drains into a septic tank or soil pit (PPN/Bappenas, 2020). Trash management is grouped according to the type of place or collection and how to handle trash, categorized as safe if there is a closed trash collection place and handling by means of being transported by officers / buried in the ground / recycled / composted / deposited in a trash bank / disposed of by yourself to a landfill (Ministry of Health 2014). Waste management is grouped according to the place of disposal of wastewater from the bathroom or washing place or kitchen and is categorized as safe if it has a wastewater disposal site with a closed reservoir. (Haryani, Hadisoebroto, and Aryantie 2019).. Drinking water treatment is

categorized based on how water is treated before drinking and the type of storage container, it is said to be safe if the household treats drinking water by cooking and stored in kettles, jugs, teapots and covered (Ministry of Health 2014). Sociodemographic factors include the age of toddlers who are categorized into two groups, namely age 0-24 months and age 25-59 months (Sari and Budyanra 2017). Gender is categorized into female and male. Place of residence is categorized into rural and urban areas (Nopriansyah et al. 2024).

Diarrhea incidence variables were obtained from the individual questionnaire block A number A01, A02A, A02B, A02C, A03A, A03B, A03C. Household drinking water access variables were taken from the block VI household questionnaire number B6R1, B6R2, B6R3A, B6R3B. Sanitation is taken from the block VI household questionnaire number B6R11, B6R12, B6R13, B6R14. Trash management is taken from the block VI household questionnaire number B6R18A, B6R18B, B6R19. Waste management is taken from the block VI household questionnaire number B6R17A and B6R17B. Drinking water treatment is taken from the block VI household questionnaire number B6R5, B6R6A, B6R6B, B6R6C, B6R6D, B6R6E, B6R6F, B6R7A, B6R7B, B6R7C, B6R7D, B6R7E. The age of children under five was taken from the household questionnaire in block IV number B4K7BLN. Gender was taken from the block IV household questionnaire number B4K4. Place of residence is taken from the household questionnaire of block 1 number B1R5.

Statistical data analysis was performed using the SPSS *Statistic Version 22 (free access)* application with *complex samples* analysis. Data were analyzed univariately and presented in the form of numbers and percentages which were then analyzed bivariately using the *chi square* test to see the relationship between the dependent and independent variables and the magnitude of risk (OR) with a 95% confidence interval. The results of the statistical test on the independent and dependent variables with $p < 0.05$ and a significance level of 5% mean that there is a significant relationship. This study has received ethical approval by the Ethics Commission for Research and Community Health Services, Faculty of Public Health, University of Indonesia number: Ket- 601/UN2.F10.D11/PPM.00.02/2024.

RESULT AND DISCUSSION

This study used secondary data from the Health Outcome Survey (HOS) conducted in Aceh Province in 2023 with a sample size of 4,234 children aged 0-59 months. The following are the results of univariate analysis that displays the number and percentage of the frequency distribution of environmental and sociodemographic factors with the incidence of diarrhea among children under five in Aceh Province.

Table 1 shows that children aged 25-59 months (65.4%) with male gender (51.1%) and majority living in rural areas (64.0%) had access to unsafe drinking water (58.8%), safe sanitation (86.3%), unsafe trash management (80.3%), unsafe waste management (87.0%), unsafe drinking water treatment (64.8%) and did not experience diarrhea (96.8%).

The results of bivariate analysis showed the association of environmental and sociodemographic factors with the incidence of diarrhea in children under five years of age in Aceh Province with the risk level (OR) and 95% confidence interval. Table 2 shows that environmental factors including access to drinking water, sanitation, trash management, waste management, drinking water treatment were not significantly associated with the incidence of diarrhea in children under five years of age. In sociodemographic factors, gender and place of residence were not significantly associated with the incidence of diarrhea in children under five. However, the age of children under five had a significant association with the incidence of diarrhea among children under five in Aceh Province (p -value = 0.028; OR = 1.634; 95% CI = 1.051-2.539). This explains that children aged 0-24

months will have a 1.634 times greater risk of diarrhea in children under five compared to children aged 25-59 months. In this population, the researcher is 95% confident that the age of the child is a risk factor for the incidence of diarrhea in children aged 0-24 months in Aceh Province with a range between 1.051-2.539 (Table 2).

Table 1. Results of the Frequency Distribution of Environmental and Sociodemographic Factors with the Incidence of Diarrhea in Toddlers in Aceh Province (N=4232)

Variables	Total	Percentage (%)
Incidence of diarrhea		
Diarrhea	135	3.2
No Diarrhea	4099	96.8
Access to drinking water		
Unsafe	2490	58.8
Safe	1744	41.2
Sanitation		
Unsafe	579	13.7
Safe	3655	86.3
Trash management		
Unsafe	3399	80.3
Safe	835	19.7
Waste management		
Unsafe	3684	87
Safe	550	13
Drinking water treatment		
Not Safe	2744	64.8
Safe	1490	35.2
Toddler age		
0-24 months	1464	34.6
25-59 months	2770	65.4
Gender of children under five		
Female	2070	48.9
Male	2164	51.1
Place of residence		
Rural	2709	64.0
Urban	1525	36.0

The results of bivariate analysis on the variable of access to drinking water with the incidence of diarrhea in toddlers showed a non-significant relationship related to access to drinking water with the incidence of diarrhea in toddlers in Aceh Province. This is in accordance with research conducted in Jayapura that access to drinking water has no relationship with the incidence of diarrhea in children under five years of age (Magdalena et al., 2019). The same thing was also conveyed by Dinni Asmini Munawaroh, *et al* (2024) that access to drinking water is not a risk factor for diarrhea in toddlers (Munawaroh et al. 2024). However, this contrasts with research in Boyolali Regency that there is a relationship between the source of drinking water consumed and the incidence of diarrhea in toddlers (Umiati, 2021). Unprotected water sources such as wells that are not covered and are outside can lead to the incidence of diarrhea in children under five years of age (Nurpauji et al. 2015). The percentage of access to safe drinking water in Aceh Province is 41.2% (Health Development Policy Agency of the Ministry of Health of the Republic of Indonesia 2023). This means that access to drinking water in Aceh Province has shown good achievements, besides that most respondents also process drinking water by cooking before consumption.

Table 2. Results of Bivariate Analysis of Environmental and Sociodemographic Factors with the Incidence of Diarrhea in Toddlers in Aceh Province in 2023

Variables	Incidence of Diarrhea				Total		OR (95% CI)	P-value
	Diarrhea		No Diarrhea					
	n	%	n	%	N	%		
Access to drinking water								
Unsafe	74	3	2416	97	2490	100	0.836	0.468
Safe	61	3.5	1683	96.5	1744	100	(0.515-1.357)	
Sanitation								
Unsafe	19	3.2	560	96.8	579	100	1.003	0.993
Safe	117	3.2	3538	96.8	3655	100	(0.539-1.864)	
Trash management								
Unsafe	103	3	3296	97	3399	100	0.751	0.381
Safe	33	4	802	96	835	100	(0.396-1.427)	
Waste management								
Unsafe	117	3.2	3567	96.8	3684	100	0.948	0.863
Safe	18	3.3	532	96.7	550	100	(0.514- 1.748)	
Drinking water treatment								
Unsafe	82	3	2662	97	2744	100	0.835	0.477
Safe	54	3.6	1436	96.4	1490	100	(0.508-1.373)	
Age of children under five								
0-24 months	62	4.2	1402	95.8	1464	100	1.610	0.032*
25-59 months	74	2.7	2696	97.3	2770	100	(1.037-2.500)	
Gender								
Female	64	3.1	2006	96.9	2070	100	0.948	0.808
Male	71	3.3	2093	96.7	2164	100	(0.618-1.456)	
Place of residence								
Rural	89	3.3	2621	96.7	2710	100	1.079	0.769
Urban	46	3	1478	97	1524	100	(0.649-1.796)	

Notes: OR= Odds Ratio, CI= Confident Interval,* (significant = p-value <0.05)

The results of bivariate analysis on the sanitation variable with the incidence of diarrhea in children under five showed no significant correlation between sanitation and the incidence of diarrhea in children under five in Aceh Province. This is in line with research in Sidoarjo Regency that sanitation is negatively correlated with the incidence of diarrhea in children under five years of age (Al and Rusydy 2024). Another study in Tanjung Lago Village also stated a negative relationship between environmental sanitation and the incidence of diarrhea in children under five years of age (Hakim et al., 2018). This contrasts with a study in Ethiopia that significantly associated the use of latrines and the use of pits as a method of waste disposal with the incidence of diarrhea in children (Eshete et al., 2020). Unsafe disposal of feces leads to pollution of soil and water sources which provide opportunities for vectors to thrive (Wijaya and Kartini 2020). However, the HOS data states that the proportion of gooseneck latrine use in Aceh Province is 95.0% and most already have septic tanks (Health Development Policy Agency of the Ministry of Health of the Republic of Indonesia 2023). The use of gooseneck latrines with septic tanks as a flow location for feces has been shown to minimize the development of diarrheal disease vectors in toddlers (Maywati et al. 2023). So this supports the absence of a relationship between sanitation and the incidence of diarrhea among children under five in Aceh Province.

The results of bivariate analysis on the variable of trash management with the incidence of diarrhea among children under five showed a non-significant relationship

between trash management and the incidence of diarrhea among children under five in Aceh Province. In line with research in Sedah Kidul Village where household waste management is negatively correlated with the incidence of diarrhea (Wardatul Raihan and Mahmudiono 2022). Similarly, there was no significant correlation between household trash management and the incidence of diarrhea among children under five years old in Tangerang City and Banjar District (Oktaviani et al. 2023; Purnama et al. 2022). However, some studies show a contrast, where trash management affects the incidence of diarrhea in children under five years of age (Kurniawati et al., 2021). Poor trash management causes water and soil pollution which will affect health (Bayu et al., 2024). Unsafe trash management causes more diarrhea, because trash can be a source of life for insects carrying pathogenic microorganisms that can spread various infections to humans (Nurlaila and Susilawati 2022; Oktora 2018). Another thing that can trigger diarrhea in children under five is the personal hygiene (hand washing behavior) of the mother or caregiver (Clasen et al., 2014). Germs that cause diarrhea will be lost by water that falls to the ground if the mother or caregiver has a good hand washing behavior before coming into contact with the child (Setyobudi, Pribadiani, and Listyarini Dyah 2020)..

The results of bivariate analysis on the variable of waste management with the incidence of diarrhea in toddlers stated that there was no relationship between waste management and the incidence of diarrhea in toddlers in Aceh Province. This is in accordance with previous research which explains the negative influence related to household wastewater management with diarrhea cases in toddlers (Husaini et al., 2019). Good domestic waste management uses closed channels and has a discharge flow location to a septic tank so that it does not cause puddles that can become a breeding ground for vectors (Iryanto et al. 2022).. Proper waste management will create a healthy environment and avoid various health problems caused by the environment including diarrhea (Eshete et al., 2020). However, the results of univariate analysis in Aceh Province show that unsafe waste management in Aceh Province is 87.0% and the majority of bathroom and kitchen waste disposal sites are channeled directly into sewers, rivers or streams (Health Development Policy Agency of the Ministry of Health of the Republic of Indonesia 2023). This means that most households still do not have good waste management because the sewage flow is left open, causing puddles, clogged garbage/trash and unpleasant odors that become a source of transmission (Sari, Oktariza, and Kirana 2023).

The results of bivariate analysis on the variable of drinking water treatment with the incidence of diarrhea in toddlers showed insignificant results between drinking water treatment with the incidence of diarrhea in toddlers in Aceh Province. In accordance with research in India, which mentions household household water treatment is not significant for the occurrence of acute diarrhea in children under five years of age (Getachew et al., 2018). Transmission of diarrhea can occur fecally-orally, including through drinking water that is polluted or contaminated with microorganisms (Munawaroh et al. 2024). Drinking water treatment by cooking or boiling at a temperature of 100 degrees is effective in killing germs, including germs that cause diarrhea (Puhi et al., 2023). Other studies also stated that the results of microbiological examination of cooked drinking water did not show the presence of microbiological contamination (Hasanah et al., 2023). So that drinking water treatment is very important in minimizing the increase in cases of diarrhea in toddlers.

The results of biavariate analysis on the variable age of children under five with the incidence of diarrhea in children under five showed a significant correlation related to the age of children under five with the incidence of diarrhea. This explains that the age of toddlers 0-24 months has a 1.610 greater risk of experiencing diarrhea than the age of 25-59 months. These results are in line with the research of Dian Perwita Sari and Budyanra (2017)

which states that the chance of diarrhea in children aged 0-24 months is 1.327 times higher than children aged over 25 months (Sari and Budyanra 2017). Children aged 0-24 months are predominantly at risk for diarrhea compared to children aged 25-59 months because at that age their immune system is still limited so that disease infections are easier to enter (World Health Organization, 2024b). At the age of less than two years, some children are no longer breastfed, causing their immunity to decrease and infectious diseases can attack (World Health Organization, 2024a). Infants' digestive tract defenses are not yet well developed, making them susceptible to diarrhea. Later, the immune system in older children will be better, so it can reduce the level of infectious diseases (Anita Margaret Wibisono et al., 2020)(Anita Margaret Wibisono et al., 2020) (Anita Margaret Wibisono et al. 2020). The younger the age of children under five, the greater the risk of diarrhea, in addition to the immune factor that is not yet optimal, it can also be caused by personal hygiene from the mother or caregiver so that the incidence of diarrhea in children with young age is quite high (Noventi et al. 2023; Sari and Budyanra 2017).

The results of biavariate analysis on the variable of child gender with the incidence of diarrhea in toddlers stated that there was no relationship between gender and the incidence of diarrhea in toddlers in Aceh Province. This is in line with research in Jambi City that there is no relationship between the sex of the child and the incidence of diarrhea in children under five years of age (Fitriani et al., 2020). Other studies show a contrast where there is a relationship between the sex of the child and the incidence of diarrhea in toddlers in Indonesia (Eka Susanti, Novrikasari, and Sunarsih 2016). This shows that children under five with male and female gender have almost the same risk of developing diarrhea. Diarrhea can affect anyone regardless of gender (Fitriani et al., 2020). Research in Sidoarjo Regency states that the incidence of diarrhea in boys and girls has almost the same percentage, so gender shows no relationship with diarrhea in toddlers (Rohmah and Syahrul 2017).

The results of bivariate analysis on the variable of residence with the incidence of diarrhea in children stated that there was no relationship between residence and the incidence of diarrhea in toddlers in Aceh Province. This is in line with research in Lampung, that there is no relationship between the type of residence with the incidence of diarrhea in children (Nopriansyah et al. 2024). Other studies were also conducted by Maimuna Bashir Ali (2024) and *Tazkiya Tsabita Salma, et al* (2024) that between residence and the incidence of diarrhea in children under five years old had a negative relationship (Ali 2024; Salma et al. 2024). This contrasts with the results of the analysis of the Indonesian Demographic Health Survey (2016) which states that there is a relationship between place of residence and the incidence of diarrhea in children under five years of age in Indonesia (Eka Susanti et al., 2016). In Indonesia, disparities in access to and quality of health services occur in several regions where the majority of the population lives in rural areas, except for the Java-Bali region (the majority of the population is in urban areas), causing people not to use health services in rural areas (Laksono et al. 2023). This inequality of residence is influenced by infrastructure and resources in rural areas. In Myanmar, the quality of health services and the availability of health resources in rural areas are still very minimal, resulting in one doctor having to handle many patients compared to urban areas. This causes the availability of health services and the quality of health facilities to be higher in urban areas than in rural areas (Lwin et al., 2020).

Although most of the variables in the study were not associated with the incidence of diarrhea among children under five. However, the performance of environmental factors should still be implemented in maintaining household health from various threats of

diseases caused by the environment. The advantage of this study is that it uses large-scale data so that the results of the analysis are more representative and the generalization of the results of the study is stronger. However, this study also has limitations because it only looks at indirect variables of the causes of diarrhea in children under five, while there are many factors that can cause the incidence of diarrhea in children under five, so further research is needed on other risk factors that can affect the incidence of diarrhea in children under five.

CONCLUSION

Sociodemographic factors, especially the age of toddlers, showed an association with the incidence of diarrhea in toddlers in Aceh Province in 2023, where children aged 0-24 months will be at risk of 1.634 times greater incidence of diarrhea in toddlers compared to children aged 25-59 months. For this reason, it is hoped that the cross-sectoral cooperation of health providers in the region will increase the role of posyandu through integrated health counseling on the growth and development of children under five and education on clean and healthy living behaviors in the household environment.

ACKNOWLEDGEMENT

Thanks are given to those who have collaborated in collecting SKI data in Aceh Province and the Information Data Center of the Ministry of Health, which has given permission and facilitated researchers in requesting HOS 2023 data. The author is also grateful for the assistance provided by the academic community of the Faculty of Public Health, University of Indonesia as well as family and friends who always provide support and motivation in completing this article.

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- Analysis of Environmental and Sociodemographic Factors with the Incidence of Diarrhea in Toddlers in Aceh Province in 2023 (Rabiatul Adawiah & Dewi Susanna)*

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