Risk Factor of Child Diarrhea in Indonesia: A Systematic Review

Fabiola Cathleen, M. Faza Soelaeman, Christine Lieana
Faculty of Medicine, University of Indonesia, Depok, Indonesia

ABSTRACT

Bakcground: Diarrhea is the leading cause of death among children worldwide, including in Indonesia. However, there is no scientific research on the most common risk factors for diarrhea among children in Indonesia. A systematic literature review was conducted to highlight the most predisposing risk factors of diarrhea based on the epidemiological triangle, in order to improve preventive measures by society to reduce the incidence of childhood diarrhea. **Methods:** A systematic review of observational studies without limitation of year of publication was performed in 2023 based on PRISMA protocol. **Results:** A total of 2607 studies were identified from the Pubmed database, only 9 studies were extracted and assessed using the STROBE method. The risk factors were divided into 3 categories: environmental, host and other, to follow the rule of the epidemiologic triangle of disease. The highest odds ratios were found for the factor "child defecation in open places" (OR=10.47) from the environmental category and for the factor "child eating by hand" (OR=5.6) from the host category. Lower maternal education from the host category was also influential (OR=1.52). **Conclusion:** Improper public disposal of child feces, child behavior of eating with hand and low maternal education are the most significant contributing risk factors of child diarrhea in Indonesia.

Keywords: Childhood diarrhea, Indonesia, risk factors, systematic review.

ABSTRAK

Latar Belakang: Diare merupakan penyebab kematian utama pada anak di dunia, termasuk di Indonesia. Akan tetapi, belum ada penelitian ilmiah mengenai faktor risiko yang paling berpengaruh terhadap angka kejadian diare anak di Indonesia. Dilakukan tinjauan pustaka sistematis untuk mengetahui faktor risiko diare anak yang paling utama berdasarkan Segitiga Epidemiologi untuk meningkatkan usaha pencegahan masyarakat agar dapat menurunkan angka kejadian diare anak. **Metode:** Tinjauan pustaka sistematis atas studi observasional berdasarkan kaidah PRISMA dilakukan pada tahun 2023. **Hasil:** Melalui *database* Pubmed, diperoleh 2.607 studi, 9 studi memenuhi syarat untuk diambil data dan dinilai menurut kaidah STROBE. Faktor risiko yang ditemukan dikelompokkan menjadi 3 kategori, yaitu lingkungan, pejamu, dan lainnya, sesuai kaidah Segitiga Epidemiologi. *Odds ratio* terbesar pada faktor pembuangan feses di ruang terbuka (OR=10,47) dari kategori lingkungan dan faktor kebiasaan anak makan dengan tangan (OR=5,6) dari kategori pejamu. Edukasi ibu rendah dari kategori pejamu juga berpengaruh (OR=1,52). **Simpulan:** Pembuangan feses anak di tempat terbuka, kebiasaan anak makan menggunakan tangan, dan edukasi ibu rendah merupakan 3 faktor risiko diare anak utama di Indonesia. Fabiola Cathleen, M. Faza Soelaeman, Christine Lieana. Faktor Risiko Diare pada Anak di Indonesia: Tinjauan Sistematik.

Kata Kunci: Diare anak, Indonesia, faktor risiko, tinjauan sistematik.

INTRODUCTION

Diarrhea is one of the most common health problems among children, especially in developing countries. At least 1.7 billion cases of diarrhea occur annually worldwide.[1] In 2016, 525,000 children under 5 years of age died from diarrhea, making diarrhea the second leading cause of death.[1] Diarrhea kills more children than AIDS, malaria, measles, or all three diseases combined.[1] In Indonesia, diarrhea is the leading cause of child mortality, accounting for 31.4% of child deaths.[2]

According to the World Health Organization's disability adjusted life year (DALYs) measure, the overall burden of diarrhea exceeds that of any type of digestive neoplasm. DALYs estimate the impact of a disease on the total number of years of life lost due to death combined with years spent in disability. The DALY value for diarrhea is 2.69, much higher than colorectal neoplasms (0.43), liver neoplasms (0.38), or even esophageal neoplasms with a value of only 0.06.[3] This reflects the enormous impact of diarrhea on a person's life, yet diarrhea is sidelined by the community. This leads to a lack of understanding of preventive measures.

A national systematic literature review of risk factors associated with diarrhea in children under 5 years of age in Indonesia based on the epidemiological triangle has never been conducted. This systematic literature review provides data for a new strategy to reduce the incidence of diarrhea and even eliminate diarrhea in children under 5 years of age.

Alamat Korespondensi email: *fazasoelaeman@gmail.com*

Methods

This systematic literature review was based on the PRISMA method and a collection of observational studies that addressed risk factors associated with childhood diarrhea in Indonesia. Observational studies were selected as the source of this study because they are the most appropriate to differentiate the association between each risk factor and the occurrence of childhood diarrhea at the national level. A total of 2607 studies were identified from the Pubmed database. A total of 2572 studies that did not meet the inclusion criteria and 26 studies that met the exclusion criteria were excluded. Final 9 studies with a total of 198,959 participants were used for this systematic review. The selection procedure is described in Figure 1. The available data from each publication were processed using STROBE (Strengthening the Reporting of Observational Studies in Epidemiology).[4] STROBE is used to indicate the quality of each study. This systematic literature review was a qualitative study.

Results

According to the STROBE assessment, the reporting quality of the studies was insufficient. The STROBE scores are shown in **Table 1**. The median score of the STROBE assessment was 16.23 (12.7-18.8), indicating moderate quality. The best study based on STROBE assessment was the study designed by Agustina (2013), with a score of 18.8 out of 22 (maximum score). The main weaknesses were bias and generalizability. The details of the STROBE assessment are shown in **Figure 2**. The studies were conducted in different areas of Indonesia, 2 in Sumatra, 3 in Java, 1 in Bali, 1 in Kalimantan, 1 in Sulawesi, and 1 in Papua (**Figure 3**). The studies were divided into major variables, which consisted of host variables and environmental variables. We found that host variables contributed to 44% of the risk factors for diarrhea, while environmental variables contributed to 39% of the risk factors for diarrhea.

The most discussed risk factors for childhood diarrhea in the available studies and the most problematic in Indonesia are sanitation and family background. In terms of sanitation, the most significant risk factor was open defecation (OR: 10.47). For family background, the most significant risk factor was low maternal education (OR: 1.52). Other risk
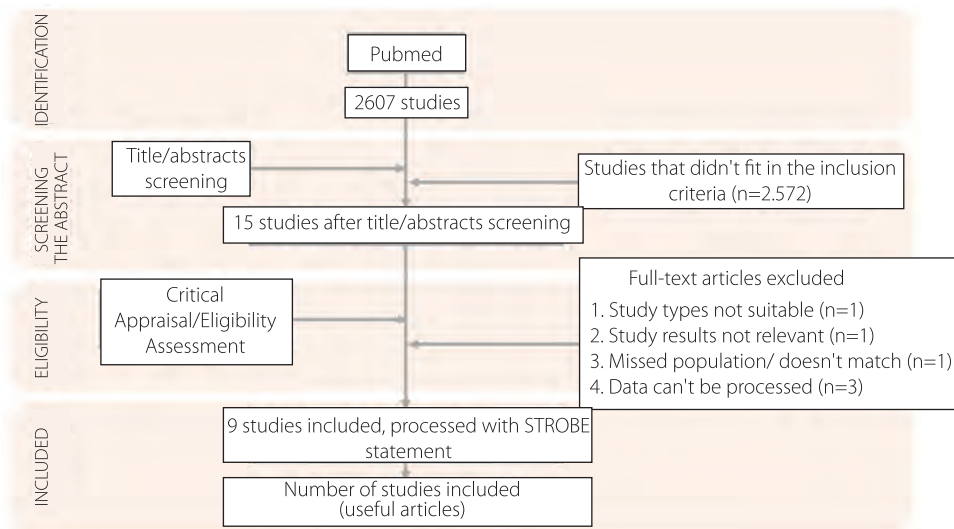

Figure 1. Study selection process based on the PRISMA statement.

Figure 2. Quality assessment by the STROBE checklist.

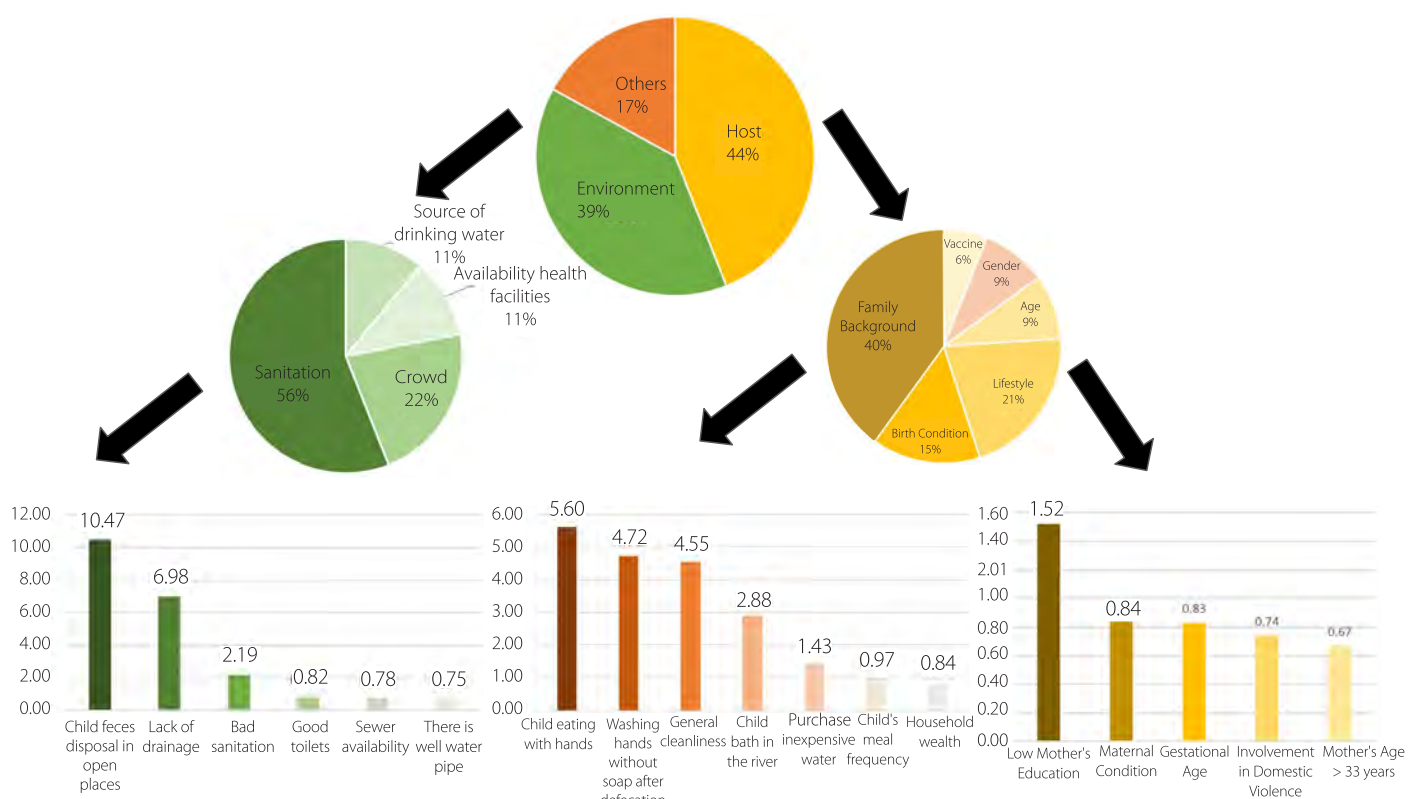**Figure 3.** Distribution of study location.

Figure 4. Distribution of variables.

factors with high odds ratios were the absence of a septic system (OR: 6.98) and children's habit of eating with their hands (OR: 5.6). Protective factors for childhood diarrhea in Indonesia included feeding frequency (OR: 0.97), household economic conditions (OR: 0.844), maternal decision-making power (OR: 0.84), maternal age > 33 years (OR: 0.65), resistance to household violence (OR: 0.74), better toilet conditions (OR: 0.82), availability of sanitary drains (OR: 0.78), and availability of water pipes in the house (OR: 0.748).

Discussion
The three most significant factors contributing to the incidence of diarrhea among children in Indonesia were fecal disposal in public places, children using their hands to eat, and low maternal education.

1. Fecal Disposal in Public Places
According to Aulia H (1994), children who dispose feces in public places are at least 10 times more likely to get diarrhea than children who dispose feces in toilets. Children are more likely to get diarrhea if their mothers or caregivers also dispose feces in open areas. This can be explained by the fact that pathogens (such as Shigella, Salmonella,

Vibrio, and Campylobacter) in feces can contaminate the environment and food. In addition, Agustina (2013) also found that the presence of a sewer that was associated with the incidence of diarrhea in children; only 1 out of 29 houses with a sewer had children suffering from diarrhea.

2. Children Using Hands to Eat
Aulia (1994) also found that children who could feed themselves were 5.6 times more likely to have diarrhea than those who could not. This is because children prefer to use their hands rather than cutlery. Agustina (2013) also found a 4.55 times higher risk of diarrhea among children with poor food hygiene habits. The study also found that among children with poor food hygiene habits, 60% did not use soap to wash their hands. This habit increases the risk of diarrhea in children, as supported by a study by Watson (2014), who found that children who washed their hands without soap after defecation had a 4.77 times higher risk than those who used soap.

3. Low Maternal Education
Semba (2009) states that mothers with no formal education and only 1-6 years of formal education have up to 1.43 and 1.26

times higher risk of children with diarrhea, respectively, compared to mothers with more education. Komarulzaman (2016) also showed that good maternal education acts as a protective factor.

Hopefully, communities, especially mothers, will be more aware of these factors to prevent childhood diarrhea, which is still one of the highest causes of child mortality in Indonesia. Educating mothers can serve as a long-term solution not only to prevent childhood diarrhea, but also to improve the overall health and growth of children. The results of this study are expected to provide the basis for the development of a specific program to prevent childhood diarrhea in Indonesia.

Conclusion
This systematic literature review was based on PRISMA guidance. A total of 9 studies from the Pubmed database with 198,595 participants were used; data were extracted and assessed for quality with the STROBE method.

Results showed that inappropriate disposal of children's feces in public places, children's habit

of eating with their hands, and low maternal's education were the top 3 factors associated with the occurrence of childhood diarrhea in Indonesia. These results are expected to be used to improve the knowledge and ability of the community to prevent childhood diarrhea, and encourage the Indonesian government to launch a comprehensive program to prevent childhood diarrhea.

Conflict of Interest
None declared

REFERENCES

1. WHO. Diarrhoeal disease: World Health Organization [Internet]. 2017. Available from: http://www.who.int/en/news-room/fact-sheets/detail/diarrhoeal-disease.

2. RI D. Riset Kesehatan Dasar. Depkes Official Website: Departemen Kesehatan RI; 2008.

3. WHO. Disease burden and mortality estimates: World Health Organization [Internet]. 2018. Available from: http://www.who.int/healthinfo/global_burden_disease/estimates/en/ index1.html.

4. Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. The strengthening the reporting of observational studies in epidemiology (strobe) statement: Guidelines for reporting observational studies. Internat J Surg. 2014;12:1495-9.

5. Cronin AA, Sebayang SK, Torlesse H, Nandy R. Association of safe disposal of child feces and reported diarrhea in Indonesia: need for stronger focus on a neglected risk. Int J Environ Res Public Health 2016;13(3):310.

6. Komarulzaman A, Smits J, de Jong E. Clean water, sanitation and diarrhoea in Indonesia: Effects of household and community factors. Glob Public Health 2017;12(9):1141-55.

7. Agustina R, Shankar AV, Ayuningtyas A, Achadi EL, Shankar AH. Maternal agency influences the prevalence of diarrhea and acute respiratory tract infections among young Indonesian children. Matern Child Health J. 2015;19(5):1033-46.

8. Salim H, Karyana IP, Sanjaya-Putra IG, Budiarsa S, Soenarto Y. Risk factors of rotavirus diarrhea in hospitalized children in Sanglah Hospital, Denpasar: A prospective cohort study. BMC Gastroenterol. 2014;14:54.

9. Sima LC, Desai MM, McCarty KM, Elimelech M. Relationship between use of water from community-scale water treatment refill kiosks and childhood diarrhea in Jakarta. Am J Trop Med Hyg. 2012;87(6):979-84.

10. Agustina R, Sari TP, Satroamidjojo S, Bovee-Oudenhoven IM, Feskens EJ, Kok FJ. Association of food-hygiene practices and diarrhea prevalence among Indonesian young children from low socioeconomic urban areas. BMC Public Health 2013;13:977.

11. Semba RD, de Pee S, Kraemer K, Sun K, Thorne-Lyman A, Moench-Pfanner R, et al. Purchase of drinking water is associated with increased child morbidity and mortality among urban slum-dwelling families in Indonesia. Int J Hyg Environ Health. 2009;212(4):387-97.

12. Aulia H, Surapaty SC, Bahar E, Susanto TA, Roisuddin, Hamzah M, et al. Personal and domestic hygiene and its relationship to the incidence of diarrhoea in south Sumatera. J Diarrhoeal Dis Res. 1994;12(1):42-8.

13. Watson L, Shibata T, Ansariadi A, Maidin A, Nikitin I, Wilson J. Understanding modifiable risk factors associated with childhood diarrhea in eastern Indonesian urban setting. Internat J Health Promotion and Education [Internet]. 2014. Available from: https://www.tandfonline.com/doi/abs/10.1080/14635240.2014.951491

Table. Characteristics and findings of included studies.

Author, Year	Study Design	Origin	Sample Size	Age	Outcome	Analysis Method	STROBE Score
Cronin AA, *et al.* 2016[4]	Cross-sectional	Indonesia	4,909	<24 Months	Female gender (OR = 1.93) Birth size smaller than average (OR = 2.31) Birth size average to very large (OR = 1.38) Woman's education secondary or lower (OR = 1.52) Sanitation unimproved (OR = 2.19) Unimproved water source (OR = 1.59) Soap availability (OR = 1.45)	Logistic regression	12.7
Komarulzaman A, *et al*l. 2017[5]	Cross-sectional	Indonesia	33,399	<5 years	Piped water in dwelling (OR = 0.748) Point of use water treatment (OR = 1.11) Improved toilet (OR = 0.826) Gender girl (OR = 0.795) Child's age (OR = 1.264) Mother's education (OR = 0.979) Household wealth (OR = 0.844) Living in urban areas (0.87) Improved sanitation coverage (OR = 0.83) Health facilities coverage (OR = 0.816) Vaccination coverage (OR = 0.865) Economic development (OR = 0.865) Mother's decision power (OR = 0.93)	Bivariate and multivariate logistic regression	17.6

Agustina R, *et al.* 2015[6]	Cross-sectional	Indonesia	18,865	<5 years	Mother's access to health care (OR = 1.27) Delivered at institution and assisted by healthcare professionals (OR = 0.88) Parity <2.6 (OR = 1.13) Gave No. feeding in the first 3 days of child life (OR = 0.85) Child eat >3 times a day (OR = 0.97) Child's stool dispossed properly (OR = 0.88) Mother decide alone or with husband on visits to family/friends (OR = 0.84) Couple decide on daily purchase (OR = 0.77) Mother decide on own health care (0.75) Never justified domestic violence (OR – 0.74)	Bivariate and multivariate logistic regression	15.2
Salim H, *et al.* 2014[7]	Prospective cohort	Denpasar	656	<5 tahun	Sex male (OR 1.2)	Chi square	16.6
Sima LC, *et al.* 2012[8]	Cohort	Koja, Tanjung Priok, Pejanten Timur	1.000	1 – 4 years	**In Northern urban slum area** Bottled water (RR = 0.45) Water kiosk (RR = 0.49) Combination (RR = 0.61) **In Southern periurban area** Bottled water (RR = 0.89) Water kiosk (RR = 0.98) Combination (RR = 1.03)	Chi square, T-test, poission regression	17.2
Agustina R, *et al.* 2013[9]	Cross-sectional	Jatinegara	274	12 – 59 months	Age ≤2 years (OR = 2.93) Age ≤3 years (OR = 2.69) Received complete immunization (OR = 0.35) Family size ≥6 person (OR = 2.27) Under-five children living under same roof >1 (OR = 2.78) Existence and less dirty sewage (OR = 0.16) Overall poor food-hygiene practice in age ≤2 (OR = 4.55)	Chi square, bivariate and multivariate logistic regression	18.8
Semba RD, *et al.* 2009[10]	Cross-sectional	Jakarta, Surabaya, Semarang, Makassar, Palembang	139,231	0 – 59 months	Purchase inexpensive water (OR = 1.43) Maternal age 25 – 28 (OR = 0.81) Maternal age 29 – 32 (OR = 0.7) Maternal age 33+ (OR = 0.65) Maternal education 0 years (OR = 1.46) Maternal education 1 – 6 years (OR = 1.23) 5 or more individuals eating from same kitchen (OR = 1.04)	Chi square, fisher's exact test, bivariate and multivariate logistic regression	15.4
Aulia H, *et al.* 1994[11]	Case Control	District Rambutan, South Sumatra	322	0 – 3 years	Child feces disposal in open places (OR 10.47) Not having drain (OR = 6.98) Child eating with hand (OR = 5.6) Not having televission (OR = 3.22) Child bathing in river (2.88) Mother's place of defecation in open place (2.56)	Chi square	17.4
Watson L, *et al.* 2014[12]	Case Control	Makassar	303	<5 years	Unimproved source of drinking water (OR = 3.83) Washing hands without soap after defecation (OR = 4.72)	Chi square, T-test, fisher's exact test, bivariate and multivariate logistic regression	15.2