



## ORIGINAL ARTICLE

# EPIDEMIOLOGY OF ROTAVIRUS INFECTION IN CHILDREN UNDER FIVE YEARS IN DR. SOETOMO HOSPITAL, SURABAYA (2015-2019)

*Gambaran Epidemiologi Kasus Infeksi Rotavirus Pada Balita di RSUD Dr. Soetomo Pada Tahun 2015-2019*

Aisah Nur Ana Bilah<sup>1</sup>, Zayyin Dinana<sup>2</sup> , Aussie Tahta Maharani<sup>2</sup>, Anisa Lailatul Fitria<sup>2</sup> , Juniastuti<sup>3</sup> , Alpha Fardah Athiyyah<sup>4</sup> , Andy Darma<sup>4</sup> , I Gusti Made Reza Gunadi Ranuh<sup>4</sup> , Subijanto Marto Sudarmo<sup>4</sup> , Laura Navika Yamani<sup>1</sup> 

<sup>1</sup>Division of Epidemiology, Department of Epidemiology, Biostatistics, Population Studies and Health Promotion, Faculty of Public Health, Universitas Airlangga, Surabaya, 60115, Indonesia, [aisahanabilah@gmail.com](mailto:aisahanabilah@gmail.com), [laura.navika@fkm.unair.ac.id](mailto:laura.navika@fkm.unair.ac.id)

<sup>2</sup>Research Center on Global Emerging and Re-emerging Infectious Disease, Institute of Tropical Disease, Universitas Airlangga, Surabaya, 60115, Indonesia, [zayyin@staf.unair.ac.id](mailto:zayyin@staf.unair.ac.id), [aussie.tahta.m@staf.unair.ac.id](mailto:aussie.tahta.m@staf.unair.ac.id), [anisa.lailatul.fitria@fkm.unair.ac.id](mailto:anisa.lailatul.fitria@fkm.unair.ac.id)

<sup>3</sup>Department of Microbiology, Faculty of Medicine, Universitas Airlangga, Surabaya, 60132, Indonesia, [junsf@fk.unair.ac.id](mailto:junsf@fk.unair.ac.id)

<sup>4</sup>Department of Child Health, Soetomo Academic General Hospital and Department of Child Health, Faculty of Medicine, Universitas Airlangga, Surabaya, 60132, Indonesia, [alpha-f-a@fk.unair.ac.id](mailto:alpha-f-a@fk.unair.ac.id), [andy.darma@fk.unair.ac.id](mailto:andy.darma@fk.unair.ac.id), [rezagunadi@gmail.com](mailto:rezagunadi@gmail.com), [subijantoms@gmail.com](mailto:subijantoms@gmail.com)

Corresponding Author: Laura Navika Yamani, [laura.navika@fkm.unair.ac.id](mailto:laura.navika@fkm.unair.ac.id), Division of Epidemiology, Department of Epidemiology, Biostatistics, Population Studies and Health Promotion, Faculty of Public Health, Universitas Airlangga, Surabaya, 60115, Indonesia

## ARTICLE INFO

### Article History:

Received, April, 17<sup>th</sup>, 2024

Revised form, May, 25<sup>th</sup>, 2024

Accepted, August, 27<sup>th</sup>, 2024

Published online, September, 15<sup>th</sup>, 2024

### Keywords:

Acute Diarrhea;

Rotavirus;

Children;

Epidemiology

### Kata Kunci:

Diare Akut;

Rotavirus;

Balita;

Epidemiologi

## ABSTRACT

**Background:** Diarrhea is the first cause of death for children under five years of age worldwide. In Indonesia, diarrhea cases due to rotavirus infection tend to be detected throughout the year. **Purpose:** The study was to determine the epidemiology of diarrhea cases due to rotavirus infection of pediatric patients in Dr. Soetomo Hospital, Surabaya based on the variables of person, place, and time. **Methods:** This type of research uses both descriptive and quantitative methods. The samples used were cases of rotavirus infection in toddlers in Dr. Soetomo Hospital, Surabaya in 2015–2019. **Results:** From 2015 to 2019, there were about 110 cases (31.98%) of acute diarrhea caused by rotavirus infection at Dr. Soetomo Hospital, Surabaya. The findings revealed that the majority of rotavirus infections (42.73%) occurred in children aged 6-11 months followed 12-23 months (35.45%) and were male (56.36%). The highest cumulative incidence was observed in August 2018 and February 2019, with a value of 1.0. Rotavirus infection was most common among children living in Gubeng sub-District, with 19 cases (17.27%). **Conclusion:** Epidemiological studies of rotavirus infection by person, place, and time reveal the distribution

**How to Cite:** Bilah, A. N. A., Dinana, Z., Maharani, A. T., Fitria, A. L., Juniastuti, J., Athiyyah, A/ F., Darma, A., Ranuh, I. G. M. R. G., Sudarmo, S. M., & Yamani, L. N. (2024). Epidemiology of rotavirus infection in children under five years in Dr. Soetomo Hospital, Surabaya (2015-2019). *Jurnal Berkala Epidemiologi*, 12(3), 255–262. <https://dx.doi.org/10.20473/jbe.v12i32024.255-262>

of disease cases and enable targeted interventions to respond to the disease.

©2024 Jurnal Berkala Epidemiologi. Published by Universitas Airlangga. This is an open access article under [CC-BY-SA](#) license

### ABSTRAK

**Latar Belakang:** Diare merupakan penyebab pertama kematian anak dibawah lima tahun seluruh dunia. Di Indonesia, kasus diare akibat infeksi rotavirus cenderung terdeteksi sepanjang tahun. **Tujuan:** Untuk mengetahui epidemiologi kasus diare akut pada pasien anak akibat infeksi rotavirus di RSUD Dr. Soetomo, Surabaya berdasarkan variabel orang, tempat, dan waktu. **Metode:** Penelitian ini menggunakan jenis penelitian deskriptif dengan metode kuantitatif. Sampel yang digunakan adalah kasus infeksi rotavirus pada balita di RSUD Dr. Soetomo, Surabaya pada tahun 2015-2019. **Hasil:** Pada tahun 2015 hingga tahun 2019, terdapat sekitar 110 kasus (31,98%) diare akut yang disebabkan oleh infeksi rotavirus di RSUD Dr. Soetomo Surabaya. Temuan menunjukkan bahwa infeksi rotavirus terbanyak (42,73%) terjadi pada anak usia 6-11 bulan, diikuti 12-23 bulan (35,45%) dan berjenis kelamin laki-laki (56,36%). Angka kejadian kumulatif tertinggi adalah 1,0 pada bulan Agustus 2018 dan Februari 2019. Infeksi rotavirus paling banyak terjadi pada anak-anak yang tinggal di area Gubeng, yaitu sebanyak 19 kasus (17,27%). **Simpulan:** Studi epidemiologi infeksi rotavirus berdasarkan orang, tempat, dan waktu mengungkap distribusi kasus penyakit dan kemungkinan intervensi yang ditargetkan untuk merespons penyakit tersebut.

©2024 Jurnal Berkala Epidemiologi. Penerbit Universitas Airlangga. Jurnal ini dapat diakses secara terbuka dan memiliki lisensi [CC-BY-SA](#)

## INTRODUCTION

Rotavirus (RV) belongs to the Reoviridae family and is one of the major pathogens responsible for acute diarrheal illness in children worldwide (1,2). Globally, rotavirus infection is the leading cause of diarrheal mortality, accounting for 19.11% of cases in 2019. The highest mortality rate was observed in children under five years of age (3). It is estimated that rotavirus infection is responsible for 128,515 deaths annually in children under five years of age, with the majority occurring in lower-middle-income countries. In comparison to high-income countries (HICs), children in low- and middle-income countries (LMICs) experience a more significant number of deaths from diarrhea (2,4). In 2013, over 90% of child deaths from rotavirus infection occurred in 72 low- and middle-income countries (5). Prevalence in Southeast Asian countries varies, but in recent years, the number of deaths from rotavirus infection has decreased. This is due to increased rotavirus vaccine coverage and rising incomes that have improved living standards in developing countries (6–8).

Clinical manifestations of rotavirus infection include non-bloody liquid diarrhea, short periods of vomiting, and fever, which are associated with a limited inflammatory response (9). Risk factors for rotavirus infection in children include age, premature birth, low birth weight, malnutrition, socioeconomic disadvantage, impaired immunity, and co-infection with enteropathogenic bacteria, which have been identified in previous studies (2,10). Increased rotavirus transmission in developing countries can be attributed to population growth and inadequate sanitation, particularly in sewage contamination or polluted river water (4). Meteorological conditions indirectly yet significantly influence the epidemiology of human rotavirus infection. The seasonal patterns of rotavirus infection display regional variations and are also influenced by local meteorological conditions (6).

The Indonesian Basic Health Research (2018) revealed that the prevalence of diarrhea in children under 5 years of age reached 11,0 percent, caused mainly by infection. Diarrhea due to rotavirus infection in Indonesia is most common among children aged 12–23 months (12). Rotavirus is responsible for 2% of deaths from all causes in

Indonesia's children under 5 years of age (13). Cases of diarrhea due to rotavirus infection in Indonesia tend to be detected throughout the year (6). In East Java Province, the prevalence of diarrhea in children under 5 years old increased (2013 – 2018). Out of the 38 districts in East Java, Surabaya has the highest case rate (14). The number of diarrhea cases tends to increase and is still high, especially diarrhea due to rotavirus infection in children under 5 years old. This study aims to describe the epidemiology of acute diarrhea cases due to rotavirus infection in Surabaya in 2015–2019 based on person, place, and time variables.

## METHODS

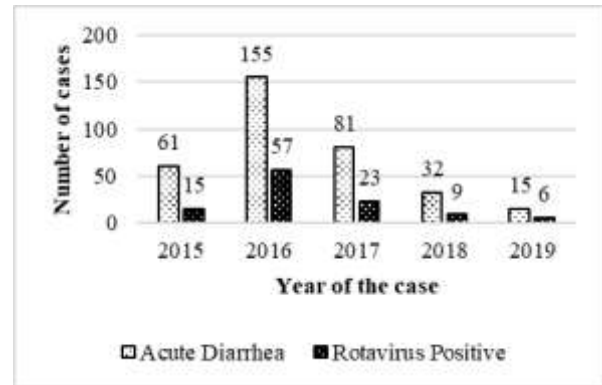
Three hundred forty-four stool samples were collected from patients with acute diarrhea at RSUD Dr. Soetomo Surabaya between September 2015 and April 2019. The study's inclusion criteria were children under five years of age with acute diarrhea who had provided informed consent. Acute diarrhea is the occurrence of loose stools  $\geq 3$  times a day that lasts less than 14 days. Demographic data collected included age, gender, and address.

A nurse at RSUD, Dr Soetomo, collected a stool sample and sent it to the Viral Diarrhea Laboratory, Institute of Tropical Disease, Universitas Airlangga. Then, the rotavirus was screened using the immunochromatography test method using a dipstick "Eiken" Rota kit (Eiken Chemical, Co., Tokyo, Japan). Rotavirus detection was using reverse transcription Polymerase Chain Reaction (RT-PCR) method.

This research is descriptive and quantitative. The data were managed using Microsoft Excel 2016 and presented in tables and graphs. The study protocol was approved by the ethics committees of the government-owned hospital (No. 188) and Universitas Airlangga in Indonesia (Number 099/KEP/2022).

## RESULTS

Of the 344 cases of acute diarrhea in children under 5 years old, 110 cases (31.98%) were acute diarrhea due to rotavirus infection in Dr. Soetomo Hospital, Surabaya, in 2015–2019. The following is the distribution of acute diarrhea cases and rotavirus infections by year:

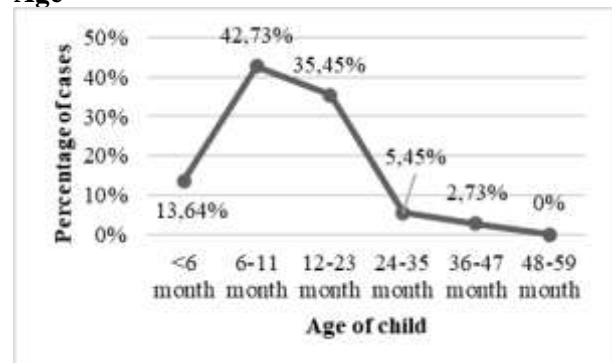


Source: Secondary Data in Viral Diarrhea Laboratory, Institute of Tropical Disease, 2015-2019

**Figure 1.** Distribution of Acute Diarrhea and Rotavirus Infection cases by year in Dr. Soetomo Hospital, Surabaya in 2015-2019

### Based on Person

#### Age



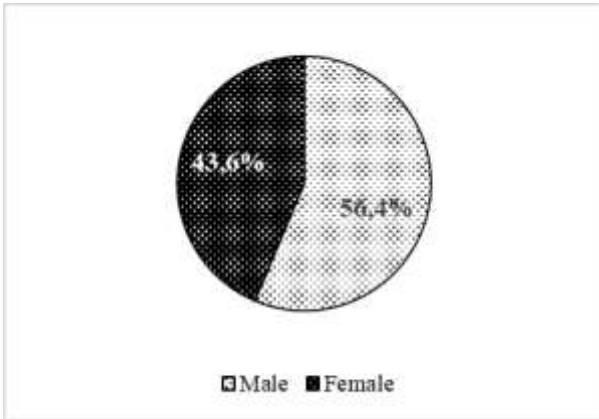
Source: Secondary Data in Viral Diarrhea Laboratory, Institute of Tropical Disease, 2015-2019

**Figure 2.** Distribution of Rotavirus Infection cases by Age in Dr. Soetomo Hospital, Surabaya in 2015-2019

The sample age was divided into six categories: 6 months, 6–11 months, 12–23 months, 24–35 months, 36–47 months, and 48–59 months. Of the total sample, 47 cases of rotavirus infection were at the age of 6–11 months (42.73%), followed by 12–23 months (35.45%). There were no cases at 48–59 months (0%).

#### Gender

Cases of rotavirus infection based on gender were most common in males, with a percentage of 56.36% (62 cases), while cases in females amounted to 43.64% (48 cases).



Source: Secondary Data in Viral Diarrhea Laboratory, Institute of Tropical Disease, 2015-2019

**Figure 3.** Distribution of Rotavirus Infection Cases by Gender in Dr. Soetomo Hospital, Surabaya 2015-2019

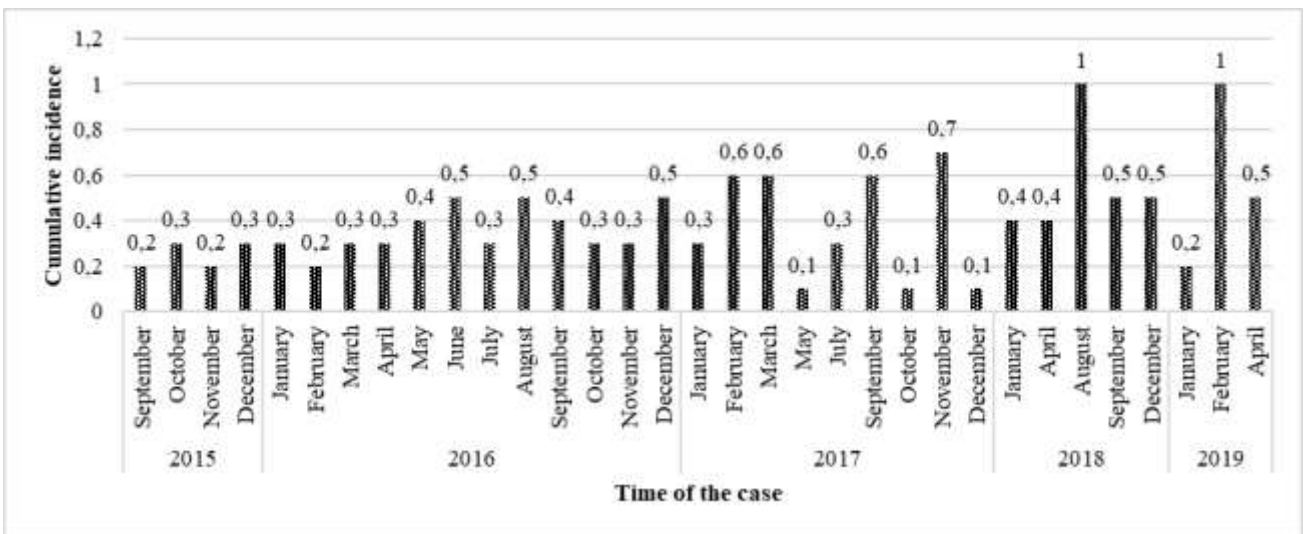
**Based On Time**

Based on Figure 1, the most cases of rotavirus infection based on the year of occurrence were in

2016, namely 57 cases (51.82%). The lowest number of cases was in 2019 (5.45%). Figure 4 shows that the highest cumulative number of rotavirus cases in August 2018 and February 2019 was 1,0 per 100,000 population. The lowest cumulative rate was 0,1 in May, October, and December 2017.

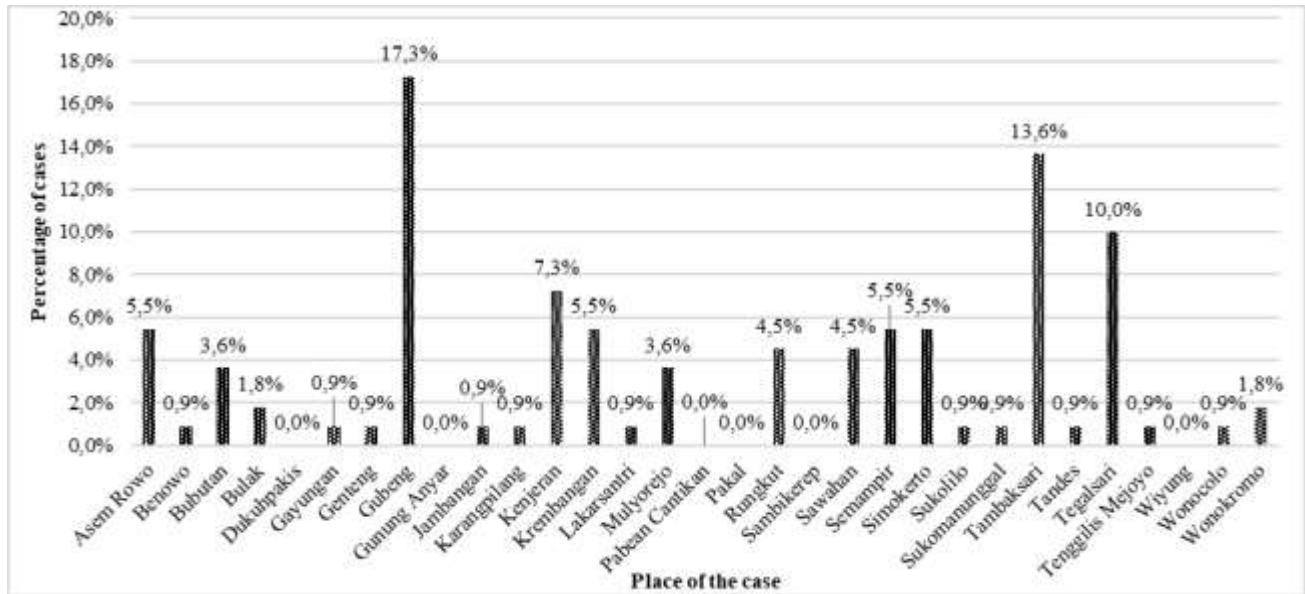
The following is the distribution of rotavirus infection cases in Dr. Soetomo Hospital, Surabaya, in 2015-2019 based on time (Figure 4):

The highest number of rotavirus infection cases occurred in the Gubeng sub-district, with a percentage of 17.27% (19 cases). The lowest percentage of cases was 0.91% (1 case), which occurred in 11 sub-districts, namely Benowo, Gayungan, Genteng, Jambangan, Karangpilang, Lakarsantri, Sukolilo, Sukomanunggal, Tandes, Tenggilis Mejoyo, and Wonocolo. Sub-districts that did not have rotavirus infection cases were Dukuh Pakis, Gunung Anyar, Pabean Cantikan, Pakal, Sambikerep, and Wiyung.



Source: Secondary Data in Viral Diarrhea Laboratory, Institute of Tropical Disease, 2015-2019

**Figure 4.** Distribution of Rotavirus Infection Cases by Time in Dr. Soetomo Hospital, Surabaya 2015-2019



Source: Secondary Data in Viral Diarrhea Laboratory, Institute of Tropical Disease, 2015-2019

**Figure 5.** Distribution of rotavirus infection cases by residence place of pediatric patients in Dr. Soetomo Hospital Surabaya from 2015 to 2019

## DISCUSSION

This study reported that the prevalence of rotavirus-infected diarrhea in children under 5 years old at Dr. Soetomo Hospital from 2015 to 2019 was 31.98% (110/344 cases). Athiyah et al (15) confirmed that the prevalence of rotavirus infection in toddlers in Java, Indonesia, was 31.70%. Meanwhile, other studies reported higher prevalence rates of 55.40%, 57%, and 57.80%, respectively. These studies indicate that the prevalence of rotavirus infection in Indonesian toddlers remains high (16–18). Cases of rotavirus infection in Indonesia tend to be detected throughout the year (6).

In this study, rotavirus infection is most prevalent among children aged 1-2 years old, with the highest incidence occurring in the 6-11 months age group (42.73%) and the 12-23 months age group (33.45%). Ugboko et al (19) also stated that the prevalence of diarrhea in children is reported to be highest in the under-24 months age group, with a subsequent decline in incidence with increasing age. It is important to note that children over the age of 2 possess antibodies to rotavirus that persist into adulthood, resulting in a decline in the incidence of rotavirus infection after this age (20).

The WHO (2021) recommends the immunization of infants to control rotavirus infection cases. This recommendation is crucial for countries with high rotavirus diarrhea mortality rates, as MOH (2023) noted. The Indonesian government has included rotavirus immunization in

the national immunization program since 2023. RV immunization is administered orally at 0.5 ml (5 drops) when the infant is 2, 3, and 4 months old, as the Indonesia Ministry of Health recommended in 2023. At present, there is no specific treatment for rotavirus infection. Consequently, vaccination represents an efficacious strategy for preventing infection, potentially reducing child mortality from rotavirus infection (20,21).

This study found that 56.36% of rotavirus infections occurred in male children, while 43.64% occurred in female children. Boys experienced more rotavirus infections than girls. Research suggests boys may be more susceptible to acute diarrhea due to their higher micronutrient requirements and increased outdoor activities in specific environments (22,23).

In children under two, rotavirus is the most frequently identified pathogen in the rainy, dry, or rainy/dry seasons (6). This study found that the highest incidence of rotavirus-induced diarrhea occurred in August and February. This indicates that the occurrence of rotavirus-induced diarrhea in our study between 2015 and 2019 was unaffected by seasonal changes. Research conducted by Athiyah et al (15) in Indonesia between 2010-2019 revealed that rotavirus infections were detected year-round without any seasonal peaks. According to the available data, the incidence of rotavirus infections does not exhibit a discernible annual pattern in Indonesia.

Nevertheless, in Singapore and Malaysia, the incidence of infection peaks during the rainy season

(6). A further study has demonstrated that the incidence of rotavirus infections is often highest during the rainy season in tropical regions. This may be attributed to the contamination of enteric viruses, including rotaviruses, in water during the rainy season (25). Rainfall has been identified as a contributing factor in the prevalence of rotavirus infection in children under five (26). Meteorological conditions indirectly but significantly impact the epidemiology of rotavirus infection in humans (6).

The highest incidence of acute diarrhea is concentrated in tropical regions with limited access to clean water, adequate sanitation, and hygiene (27). The study found that out of 110 samples, the most rotavirus infections occurred in Gubeng District, with 19 cases (17.27%). Gubeng sub-district has not been classified as a Community-Based Total Sanitation (Sanitasi Total Berbasis Masyarakat/ STBM) village because it only fulfills 2 out of the 5 pillars of STBM. The Health Profile of Surabaya City in 2019 reports that all sub-districts in Surabaya have implemented STBM (14). However, the city has not yet achieved the status of an STBM village due to only fulfilling two out of the five pillars, namely Stop Open Defecation (Stop Buang Air Besar Sembarangan/SBS) and Handwashing with Soap (Cuci Tangan Pakai Sabun/CTPS). The three pillars of Household Drinking Water and Food Management, Household Waste Safety, and Household Liquid Waste Safety are not being fulfilled (13). The incidence of diarrhea is affected by poor environmental sanitation and unhealthy behaviors such as disposing of feces in public places and using the same water tap for washing and as a source of drinking water (23). Furthermore, the disposal of waste and the provision of toilet facilities that are not hygienic can also result in children developing diarrhea (19).

The transmission of rotavirus infection occurs via the fecal-oral route, whereby the virus can survive for several days to weeks in the environment. Rotavirus can be transmitted through contaminated objects and oral contact with the face, with an incubation period of 2-4 days (19). The decline in rotavirus infection among children under five can be attributed to improved hygiene and sanitation, environmental enhancements, and healthy behaviors (6,28,29). Preventing and controlling rotavirus infection cases can be achieved by providing rotavirus vaccination and implementing clean and healthy living behaviors.

### Research Limitation

This study is expected to provide an overview of rotavirus infection cases in toddlers at RSUD Dr. Soetomo Surabaya so that it can be used as a reference for implementing rotavirus vaccination. However, it should be noted that the study only describes cases within the hospital setting and, therefore, cannot be used to describe cases in the broader population of Surabaya City. The coverage area and time frame limit this study. Future studies should be able to detect rotavirus infection with a broader area boundary, thus describing the total cases in the entire population of Surabaya City. Additionally, routine and continuous recording is necessary for the monitoring of cases of rotavirus infection in children under five years.

### CONCLUSION

The incidence of rotavirus infection cases among children under 5 years old with acute diarrhea at Dr. Soetomo Hospital was common from 2015 to 2019. The most prevalent was in the 6-11 months age group and more common in males. The highest incidence of rotavirus infection occurred in August 2018 and February 2019, with a cumulative incidence rate of 1,0 per 100.000 population. The highest rate of rotavirus infection at Dr. Soetomo Hospital is among the pediatrics residing in Gubeng District.

### CONFLICT OF INTEREST

The authors declare that this study has no competing interest, and we confirm the accuracy of this result.

### AUTHOR CONTRIBUTIONS

All authors contributed to the research. ANAB and LNY contributed to the study's conception. ZD, ATM, and ALF acquired and analyzed the data. ANAB, ZD, ATM, ALF, JJ, AFA, and LNY wrote the manuscript. All authors have reviewed and approved the final version of the manuscript.

### ACKNOWLEDGMENTS

This study was supported by the Laboratory of Viral Diarrhea, Institute of Tropical Disease, Universitas Airlangga, and Research Center of Global Emerging and Re-emerging Infectious Disease, Universitas Airlangga.

## REFERENCES

1. Donato CM, Bines JE. Rotaviruses and rotavirus vaccines. *Pathogens*. 2021 Jul;10(8):959.
2. Sadiq A, Khan J. Rotavirus in developing countries: molecular diversity, epidemiological insights, and strategies for effective vaccination. *Front Microbiol*. 2024 Jan;14.
3. Du Y, Chen C, Zhang X, Yan D, Jiang D, Liu X, et al. Global burden and trends of rotavirus infection-associated deaths from 1990 to 2019: an observational trend study. *Virol J*. 2022 Oct;19(1):166.
4. Omatola CA, Olaniran AO. Rotaviruses: from pathogenesis to disease control—a critical review. *Viruses*. 2022 Apr;14(5):875.
5. Badur S, Öztürk S, Pereira P, AbdelGhany M, Khalaf M, Lagoubi Y, et al. Systematic review of the rotavirus infection burden in the WHO-EMRO region. *Hum Vaccin Immunother*. 2019 Nov;15(11):2754–68.
6. Lestari FB, Vongpunsawad S, Wanlapakorn N, Poovorawan Y. Rotavirus infection in children in Southeast Asia 2008–2018: disease burden, genotype distribution, seasonality, and vaccination. *J Biomed Sci*. 2020 Dec;27(1):66.
7. Truong DTT, Kang J-M, Tran NTH, Phan LT, Nguyen HT, Ho TV, et al. Rotavirus genotype trends from 2013 to 2018 and vaccine effectiveness in southern Vietnam. *Int J Infect Dis*. 2021 Apr;105:277–85.
8. Debellut F, Clark A, Pecenka C, Tate J, Baral R, Sanderson C, et al. Re-evaluating the potential impact and cost-effectiveness of rotavirus vaccination in 73 Gavi countries: a modelling study. *Lancet Glob Heal*. 2019 Dec;7(12):e1664–74.
9. Zweigart MR, Becker-Dreps S, Bucardo F, González F, Baric RS, Lindesmith LC. Serological humoral immunity following natural infection of children with high burden gastrointestinal viruses. *Viruses*. 2021 Oct;13(10):2033.
10. Schollin Ask L. Global and Swedish review of rotavirus vaccines showed considerable reductions in morbidity and mortality. *Acta Paediatr*. 2021 Dec;110(12):3161–9.
11. Rojas M, Dias HG, Gonçalves JLS, Manchego A, Rosadio R, Pezo D, et al. Genetic diversity and zoonotic potential of rotavirus A strains in the southern Andean highlands, Peru. *Transbound Emerg Dis*. 2019 May;tbed.13207.
12. Health Research and Development Agency. *Riskesdas Report 2018*. Jakarta: Lembaga Penerbit Badan Penelitian dan Pengembangan Kesehatan; 2019.
13. Pawarta WSS, Sukardi W, Wahab A, Soenarto Y. Prevalence and clinical characteristics of rotavirus diarrhea in Mataram, Lombok, Indonesia. *Paediatr Indones Orig Artic*. 2016;56(2).
14. Surabaya City Health Office. *Surabaya City Health Profile 2019*. 2020.
15. Athiyyah AF, Utsumi T, Wahyuni RM, Dinana Z, Yamani LN, Soetjipto, et al. Molecular epidemiology and clinical features of rotavirus infection among pediatric patients in East Java, Indonesia during 2015-2018: Dynamic changes in rotavirus genotypes from equine-like G3 to typical human G1/G3. *Front Microbiol*. 2019;10(MAY).
16. Wahyuni RM, Utsumi T, Dinana Z, Yamani LN, Juniastuti, Wuwuti IS, et al. Prevalence and distribution of rotavirus genotypes among children with acute gastroenteritis in areas other than Java Island, Indonesia, 2016-2018. *Front Microbiol*. 2021 May;12:672837.
17. Nirwati H, Donato CM, Mawarti Y, Mulyani NS, Ikram A, Aman AT, et al. Norovirus and rotavirus infections in children less than five years of age hospitalized with acute gastroenteritis in Indonesia. *Arch Virol*. 2019 Jun;164(6):1515–25.
18. Adhiningsih YR, Athiyyah AF, Juniastuti J. Acute Diarrhea in children under-5 years at Tanah Kali Kedinding Primary Health Care Surabaya. *J Ilm Kesehat*. 2019 Dec;1(2):96–101.
19. Ugboke HU, Nwinyi OC, Oranusi SU, Oyewale JO. Childhood diarrhoeal diseases

- in developing countries. *Heliyon*. 2020 Apr;6(4):e03690.
20. Yuan L, Lum GGA, Zhao J, Li W. Epidemiology of acute rotavirus diarrhea among hospitalized children under five years of age in Hefei, China, During 2015 - 2018. *Jundishapur J Microbiol*. 2020 Oct;13(7).
  21. Muhsen K, Omar M. Rotavirus. in: *molecular medical microbiology*. Elsevier; 2024. p. 2321–38.
  22. Shabella G, RIngoringi HP, Noor MS. Clinical manifestations and hematological profiles of toddlers with acute diarrhea at RSD Idaman Banjarbaru in 2020-2021. *Homeostasis*. 2022;5(3):509–18.
  23. Setyawan DA, Setyaningsih W. Epidemiological study with a spatial analysis approach on risk factors related to the incidence of diarrhea in children in Karangmalang District, Sragen Regency. Surakarta: Tahta Media Group; 2021.
  24. Mulyani NS, Prasetyo D, Karyana IPG, Sukardi W, Damayanti W, Anggraini D, et al. Diarrhea among hospitalized children under five: A call for inclusion of rotavirus vaccine to the national immunization program in Indonesia. *Vaccine*. 2018 Dec;36(51):7826–31.
  25. Ureña-Castro K, Ávila S, Gutierrez M, Naumova EN, Ulloa-Gutierrez R, Mora-Guevara A. Seasonality of rotavirus hospitalizations at Costa Rica's National Children's Hospital in 2010–2015. *Int J Environ Res Public Health*. 2019 Jun;16(13):2321.
  26. Vita Amanda S, Laura Navika Yamani, Zayyin Dinana, Aussie Tahta Maharani, Erni Astutik, Noerfitri N. Correlation Between climate variations and rotavirus diarrhea in under-five children in Sidoarjo District year 2016 – 2019. *J Kesehat Lingkungan*. 2023 Jul;15(3):174–82.
  27. Farfán-García AE, Imdad A, Zhang C, Arias-Guerrero MY, Sánchez-Álvarez NT, Iqbal J, et al. Etiology of acute gastroenteritis among children less than 5 years of age in Bucaramanga, Colombia: A case-control study. Senok A, editor. *PLoS Negl Trop Dis*. 2020 Jun;14(6):e0008375.
  28. Reiner RC, Wiens KE, Deshpande A, Baumann MM, Lindstedt PA, Blacker BF, et al. Mapping geographical inequalities in childhood diarrhoeal morbidity and mortality in low-income and middle-income countries, 2000-17: Analysis for the Global Burden of Disease Study 2017. *Lancet*. 2020 Jun;395(10239):1779–801.
  29. Santika NKA, Efendi F, Rachmawati PD, Has EMM, Kusnanto K, Astutik E. Determinants of diarrhea among children under two years old in Indonesia. *Child Youth Serv Rev*. 2020;111:104838.