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Original Article

Breastfeeding Status and Infectious Diseases among Children Aged 6–23 Months in Indonesia

Abstract

Introduction: Infectious diseases remain public health issues in Indonesia. However, there remains a knowledge gap on whether breastfeeding can prevent infectious diseases in young children. This study examined the relationship between current breastfeeding and child infections in Indonesia. **Methods:** Data were derived from the 2017 Indonesia Demographic and Health Survey by including 5158 children aged 6–23 months. The dependent variables were diarrhea, fever, and acute respiratory infection (ARI). The main exposure of interest was the current breastfeeding status. Covariates included factors at the child, maternal, household, health care, and community levels. **Results:** Around 20%, 38%, and 4% of children experienced diarrhea, fever, and ARI, respectively. Current breastfeeding status was protective against diarrhea (adjusted odds ratio [AOR] = 0.74, 95% confidence interval [CI] = 0.61–0.89) but not related to fever (AOR = 0.95, 95% CI = 0.82–1.11) and ARI (AOR = 1.01, 95% CI = 0.70–1.47). Other factors related to diarrhea included female children, older maternal age, maternal higher education, improved drinking water source, and living in Sulawesi. Living in Sumatera and Sulawesi were linked to fever. Higher birth orders and improved toilet facilities were associated with ARI. **Conclusion:** The findings indicate different levels of factors affecting child infections. Thus, integrating breastfeeding promotions with water, hygiene, and sanitation interventions may help prevent infectious diseases in young children.

Keywords: *Acute respiratory infection, breastfeeding, children, diarrhea, feeding, fever*

Bunga A. Paramashanti[1], Esti Nugraheny[1], Suparmi Suparmi[1], Tin Afifah[1], Wahyu Pudji Nugraheni[1], Sinta Dewi Lestyoningrum[1], Tumaji Tumaji[1], Ning Sulistiyowati[1], Siti Masitoh[1], Herwinda Kusuma Rahayu[2], Effatul Afifah[3]

[1]Research Center for Public Health and Nutrition, National Research and Innovation Agency, Bogor, [2]Department of Nutrition, Faculty of Health Sciences, Universitas Alma Ata, [3]Department of Public Health, Alma Ata Graduate School of Public Health, Universitas Alma Ata, Yogyakarta, Indonesia

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ORCID:
Bunga A Paramashanti's
https://orcid.org/0000-0001-6066-2039

Address for correspondence:
Dr. Bunga A. Paramashanti, Research Center for Public Health and Nutrition, Jalan Raya Jakarta-Bogor KM 46, Bogor 16194, West Java, Indonesia.
E-mail: pshanti.bunga@gmail.com

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Introduction

Improving child survival remains crucial despite significant success in reducing child mortality in the past decades. The sustainable development goals call for reducing the under-five mortality rate (UFMR) to 25 per 1000 live births or fewer by 2030.[1] In 2019, the UFMR was 37.7 deaths per 1000 live births globally and 14.3 per 1000 live births in East Asia and the Pacific.[2] In Indonesia, the UFMR was 19.8 per 1000 live births in 2021. However, disparities exist across the subnational level, ranging from 12.0 in Jakarta to 49.0 per 1000 live births in Papua.[3]

The international consensus has stipulated that disease, including infection, is one of the leading causes of death. The immediate cause of child death in most diarrhea cases is due to dehydration, whereas acute respiratory infection (ARI) affects not only the respiratory tract but also systemic due to infection, inflammation, and reduced lung function.[4] However, there are more complex chains in the child death causes. For example, malnutrition could hold a predisposing role to child death caused by infections.[5] Around 49.2% of child mortality is due to infections, including lower respiratory infections (13.9%) and diarrhea (9.1%).[6] In Indonesia, the diarrhea prevalence among under-fives remained stagnant between 2012 and 2017 (14%), with higher proportions occurring among 6–11 months (19%) and 12–23 months (20%) children. The ARI prevalence was 4% in 2017, slightly lower than in 2012 (5%). In addition, the fever prevalence was around 31% between 2012 and 2017, with children aged 6–23 months being more susceptible.[7]

Infectious diseases, including diarrhea, fever, and ARI remain public health problems, not only contributing to child deaths but also undernutrition. Infection has been recognized as the immediate cause of child malnutrition.[8] There has been an association between infectious diseases

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and stunting, wasting, and underweight,[9,10] suggesting that frequent and persistent infections increase child undernutrition risks.[10] The relationship between infections and nutrition is likely bidirectional. While infection can affect the nutritional status, the nutritional status can alter the host's response to infection.[9]

Earlier national-level studies found that infectious illnesses, such as diarrhea and ARI were determined by individual (e.g., child's sex and maternal education), household (e.g., water, hygiene, and sanitation [WASH] services), and community (e.g., geographic region) factors. Infant and young child feeding also contributed to the occurrence of infections.[11-14] However, there were inconsistent results across these studies.

Efforts have been made to reduce infectious diseases, including improving WASH, immunization, and nutrition.[12] Regarding nutrition, breastfeeding is particularly important since it has nutritional, immunological, and hygienic advantages that could lower child infections.[9] Early breastfeeding initiation and exclusive breastfeeding were protective against infections, including diarrhea, ARI, pneumonia, and urinary tract infections.[12] However, existing research typically used exclusive breastfeeding as the predictor of infectious diseases during the first 6 months of life.[13] While infections typically occur among children aged 6–23 months,[7] there is a lack of evidence on whether breastfeeding can prevent infectious diseases during that period. Therefore, this study aims to determine the relationship between current breastfeeding and infections (diarrhea, fever, and ARI) among Indonesian children aged 6–23 months.

Methods

Data source and study population

We used the most updated national survey in Indonesia, the 2017 Indonesia Demographic and Health Survey. Following a two-stage stratified sampling design, the survey applied probability proportional to size to select primary sampling units (PSU). The PSU was stratified by rural–urban villages with implicit stratification in each stratum by sorting the PSU based on the category of wealth index. Twenty-five households were then selected systematically from each PSU.[7] Our analysis involved a total of 5158 ever-married women aged 15–49 years whose last-born child was aged 6–23 months.

Ethical consideration

The 2017 DHS was ethically approved by The Institutional Review Board of ICF International (FWA00000845). We used publicly available data with de-identified information; thus, ethical approval was exempted.

Dependent variables

The dependent variables were infections in the past 2 weeks preceding the survey, including (1) diarrhea, (2) fever, and (3) ARI. These outcomes followed the survey questions to the child's mother regarding diarrhea, fever, and ARI (a cough accompanied by short, rapid breathing and/or difficult breathing).[7] All measures were binary: yes (if experiencing) or no (if not experiencing).

Independent variables

The independent variables were current breastfeeding and complementary feeding practices. Current breastfeeding was the state where a child was breastfed during the last 24 h before the survey. Complementary feeding practices were minimum dietary diversity (MDD), minimum meal frequency (MMF), and minimum acceptable diet (MAD) during the last 24 h preceding the survey. The MDD was food consumption from at least five of eight food groups: (1) grains, roots, and tubers, (2) legumes and nuts, (3) dairy products, (4) flesh foods, (5) eggs, (6) Vitamin A-rich fruits and vegetables, (7) other fruits and vegetables, and (8) breast milk. The MMF for breastfed children was when a child received solid, semi-solid, or soft foods at least twice a day (6–8 months) or at least three times a day (9–23 months), whereas for non-breastfed children as if they received solid, semi-solid, or soft foods at least four times a day (6–23 months). The MAD was when a child met the MDD and MMF.[7,15]

Other potential predictors

Our analyses included several potential predictors that were considered confounding variables, as follows:

- Child factors: Age in months, sex (male and female), birth order (1–2, 3–4, and ≥4), and birth weight (<2500 g and ≥2500 g)
- Maternal factors: Age in years (<25, 25–34, and ≥35), education (none or incompleted primary, completed primary, completed secondary, and completed higher education), working status (not working and working), weekly access to media, including television, radio, and newspaper (no and yes), weekly Internet access (no and yes), and involvement in healthcare-related decision-making (not involved and involved)
- Household factors: Paternal age in years (<25, 25–34, and ≥35), paternal education (none or incompleted primary, completed primary, completed secondary, and completed higher education), household wealth (poorest, poorer, middle, richer, and richest), toilet facility (unimproved and improved), source of drinking water (unimproved and improved), the number of household members (<5 and ≥5), and the number of children under-fives (1, 2, and ≥3). Household wealth was estimated based on household assets, including ownership of infrastructures and amenities, using principal component analysis.[16] Sources of drinking water were categorized into improved (e.g., piped water, tube well or borehole, and rainwater) and unimproved (e.g., unprotected dug well, unprotected spring, and river). The type of toilet was grouped into

improved (e.g., private facilities and public facilities) and unimproved (e.g., river, pond, and yard)[17]

- Health-care factors: The number of antenatal care visits (<6, ≥6), place of delivery (nonhealth facilities and health facilities), and the postnatal checkup within 2 months (no and yes)
- Community factors: Living residency (rural and urban) and region (Java and Bali, Sumatera, Kalimantan, Sulawesi, and Eastern Indonesia).

Statistical analysis

We conducted descriptive statistics to describe the study variables. We performed univariate logistic regression to examine the association between each predictor and infection variable measured by crude odds ratios (COR). Variables with $P < 0.25$ were entered into multiple logistic regression to create a full baseline model. The P value cutoff of 0.25 was set to determine variables known as important factors that would not be identified with a traditional P value cutoff of 0.05.[18] We kept breastfeeding and complementary feeding practices as fixed variables regardless of their significance since they were independent variables of interest. We reported adjusted odds ratios (AORs) in the final model. All analyses were done using Stata version 17.0 (StataCorp, College Station, TX, USA), adjusted for the complex survey design using "svy" commands.

Results

The prevalence of diarrhea, fever, and ARI were 19.8%, 37.8%, and 4.2%. The proportion of current breastfeeding, MDD, MMF, and MAD were 69.8%, 53.2%, 70.9%, and 41.0%, respectively. As shown in Table 1, the mean age of children was 14.5 ± 5.1 months. Most children were male (51.8%) and first- or second-born children (68.0%). Most mothers were aged 25–34 years (52.3%) and completed primary school (46.5%). The majority of households had improved toilet facilities (84.2%) and improved sources of drinking water (91.5%).

Table 2 reported COR and AOR of diarrhea, fever, and ARI, respectively. Children who were currently breastfed were 1.35 times less likely to get diarrhea than those not currently breastfed. Girls were 1.25 times less likely to experience diarrhea than boys. Children whose mothers were aged 25–34 years and aged >35 years had 29% and 39% lower odds of getting diarrhea than those whose mothers were aged <25 years. Mothers who completed higher education had 42% lower odds of having children with diarrhea than those with no formal education. Children who had improved sources of drinking water were 1.39 less likely to have diarrhea than those with unimproved sources of drinking water. Children who lived in Sulawesi had 38% greater odds of diarrhea than in Java and Bali.

Residing in Sumatera (AOR: 1.36; 95% confidence interval [CI]: 1.13–1.63) and Sulawesi (AOR: 1.62; 95% CI: 1.29–2.03) were the only factors associated with fever. Children with birth orders of >4 were 2.28 more likely to get ARI than those with lower birth orders. Children with improved toilet facilities were associated with 1.64 lower odds of experiencing ARI than those with unimproved toilet facilities.

Discussion

The proportion of children aged 6–23 months experiencing diarrhea and fever in the last 2 weeks was 19.8% and 37.8%, respectively, or higher than children under-fives in Indonesia which was 14% and 31%, respectively.[7] The ARI prevalence among 6–23-month children was similar to those under five at around 4%.[7] Current breastfeeding status, female children, maternal age >25 years, higher maternal education, and improved source of drinking water were protective factors against diarrhea, whereas residing in Sulawesi was associated with a higher risk of diarrhea. Living in Sumatera and Sulawesi put the children at a greater risk of fever. Children whose birth order of >4 tend to experience ARI, whereas those with improved toilet facilities were less likely to experience ARI. The findings can provide recommendations for policymakers, particularly in Indonesia and Southeast Asian countries that have similar trends in diarrhea and ARI.

This study found that current breastfeeding was protective against diarrhea. Previous studies showed similar results with most breastfeeding outcomes, including current breastfeeding,[11] ever breastfeeding,[19] early initiation of breastfeeding, and exclusive breastfeeding.[13] Earlier research revealed that breastfeeding continuation protected against gastrointestinal illnesses, regardless of whether they received exclusive or nonexclusive breastfeeding.[20] Conversely, early cessation of breastfeeding was linked to diarrhea.[21]

Breastfeeding could lower the risk of diarrhea in several ways: (1) eliminating the exposure to diarrheal-causing pathogens through contaminated nonhuman milk or bottle feeding,[16] (2) stimulating passive immunity in the gastrointestinal tract,[16] (3) immunoglobulin A, lactoferrin, and oligosaccharides that particularly preventing enteropathogens, including *Campylobacter, Salmonella*, and *Escherichia coli*,[11,21] (4) preventing diarrhea by enhancing the nutritional status,[16] and (4) determining the microbiome diversity.[21] Early breastfeeding termination could decrease microbiome diversity, which may interfere with early immune development, leading to diarrhea.[21] Thus, promoting optimal breastfeeding practices throughout the infancy and childhood period is key to controlling diarrhea.

Following a previous cohort study,[20] current breastfeeding status was not significantly related to fever and ARI. Meanwhile, another cohort study showed a significant result in the lower respiratory tract but not upper respiratory tract infection.[22] Breastfeeding

Table 1: Characteristics of children aged 6-23 months in Indonesia

Variables	*n*	% or mean+SD
Child factors		
Age (in months)	5158	14.52+5.10
Sex		
Male	2712	51.8
Female	2446	48.2
Birth order		
1-2	3325	68.0
3-4	1490	27.2
>4	343	4.8
Birth weight		
<2500	666	10.2
>2500	4492	89.8
Maternal factors		
Age (in years)		
<25	1188	22.8
25-34	2709	52.3
>=35	1261	24.9
Education		
None or incompleted primary school	353	5.8
Completed primary school	2198	46.5
Completed secondary school	1581	30.6
Completed higher education	1026	17.1
Working status		
Not working	2744	55.9
Working	2407	44.1
Weekly access to media		
No	851	14.2
Yes	4307	85.8
Weekly access to internet		
No	2999	56.3
Yes	2152	43.7
Decision making in healthcare		
Not involved	281	5.2
Involved	4877	94.8
Household factors		
Father's age (in years)		
<25	439	8.4
25-34	2403	46.8
>=35	2189	44.8
Father's education		
None or incompleted primary school	424	6.7
Completed primary school	2017	43.6
Completed secondary school	1784	34.9
Completed higher education	810	14.8
Household wealth		
Poorest	1396	19.6
Poorer	1048	19.4
Middle	1006	21.7
Richer	872	19.3
Richest	836	20.0
Toilet facility		
Unimproved facility	968	15.8
Improved facility	4189	84.2
Drinking water source		
Unimproved	520	8.5
Improved	4638	91.5
Number of household members		
<=5	2899	61.0
>5	2259	39.0
Number of children under fives		
1	3319	69.1
2	1519	26.4
>=3	320	4.5
Healthcare factors		
ANC visits		
<6	1179	18.9
>=6	3847	81.1
Place of delivery		
Non-health facilities	1158	16.9
Health facilities	3999	83.1
Postnatal checkup within 2 months		
No	1618	30.2
Yes	3378	69.8
Community factors		
Living residency		
Rural	2586	50.8
Urban	2572	49.2
Region		
Java and Bali	1617	56.5
Sumatera	1351	22.6
Kalimantan	451	5.9
Sulawesi	779	7.1
Eastern Indonesia	960	7.9

Contd...

roles against infections may differ between ARI and gastrointestinal infections. While immunoglobulins from breast milk provide direct and timely protection against microorganisms localized in the gastrointestinal tract, ingested immunoglobulins should be absorbed through the intestinal mucosa and transported to other areas through the bloodstream to protect from infections localized in other sites.[23] The nonsignificant results suggested the possibility of disease symptom misclassifications and parental recall bias.[20,22] However, the effect of current breastfeeding in this study might not cover the duration of breastfeeding or whether breastfeeding might have been stopped due to ARI or fever. Thus, future research and programs should consider all aspects of breastfeeding and infections, including the nature of how breastfeeding may protect against infection, durations, frequencies, or whether there is a change in maternal breastfeeding behavior during child infections.

Girls were less likely to experience diarrhea than boys, as shown in Ethiopia[24] and India.[25] The risk difference could be related to cultural and pathophysiological mechanisms.

Table 2: The association of breastfeeding status and with diarrhea, fever, and ARI among children aged 6-23 months in Indonesia

Variables	Diarrhea			Fever			Acute respiratory infection		
	AOR	**95% CI**	***P***	**AOR**	**95% CI**	***P***	**AOR**	**95% CI**	***P***
Breastfeeding									
Currently breastfeeding									
No	Ref			Ref			Ref		
Yes	0.74	0.61-0.89	0.002	0.95	0.82-1.11	0.533	1.01	0.70-1.47	0.944
Child factors									
Sex									
Male	Ref			Ref			Ref		
Female	0.80	0.67-0.96	0.015	0.96	0.83-1.11	0.572	0.89	0.63-1.24	0.490
Birth order									
1-2							Ref		
3-4							1.15	0.71-1.86	0.573
>4							2.28	1.10-4.76	0.027
Maternal factors									
Age (in years)									
<25	Ref			Ref			Ref		
25-34	0.71	0.58-0.88	0.002	1.06	0.88-1.27	0.527	1.45	0.94-2.22	0.092
>=35	0.61	0.47-0.79	<0.001	0.96	0.78-1.19	0.731	0.86	0.46-1.61	0.632
Education									
None or incompleted primary	Ref			Ref			Ref		
Completed primary	0.94	0.66-1.35	0.749	0.99	0.73-1.36	0.977	0.86	0.48-1.57	0.626
Completed secondary	0.91	0.61-1.34	0.620	0.81	0.59-1.12	0.206	1.01	0.52-1.93	0.988
Completed higher education	0.58	0.37-0.89	0.014	0.72	0.51-1.01	0.059	1.02	0.48-2.16	0.954
Toilet facility									
Unimproved facility	Ref						Ref		
Improved facility	0.78	0.59-1.02	0.068				0.61	0.40-0.94	0.024
Drinking water source									
Unimproved	Ref			Ref			Ref		
Improved	0.72	0.54-0.95	0.020	0.85	0.66-1.11	0.229	0.83	0.50-1.38	0.466
Healthcare factors									
Postnatal checkup within 2 months									
No				Ref					
Yes				1.25	1.07-1.47	0.006			
Community factors									
Region									
Java and Bali	Ref			Ref			Ref		
Sumatera	1.17	0.94-1.46	0.164	1.36	1.13-1.63	0.001	0.94	0.63-1.41	0.771
Kalimantan	1.25	0.89-1.74	0.195	1.05	0.81-1.34	0.729	0.95	0.53-1.69	0.861
Sulawesi	1.38	1.03-1.85	0.032	1.62	1.29-2.03	<0.001	0.95	0.59-1.55	0.846
Eastern Indonesia	1.12	0.84-1.50	0.435	1.03	0.81-1.31	0.808	0.66	0.39-112	0.120

ARI, Acute Respiratory Infection; COR, crude odds ratio; AOR, adjusted odds ratio; p, P value; CI, confidence intervals; Ref, reference

Caregivers may allow boys to play outside the house, whereas they are more protective of girls. Consequently, boys have greater exposure to unsanitary surroundings than girls.[24] Boys could be more prone to diarrhea because of pathophysiologic sex differences in disease transmissibility, infectivity, and immunity. However, the mechanisms remained unknown.[25] There have been limited studies investigating the relationship between the child's sex and infectious diseases. Further research is needed to better understand boy–girl differences regarding nutritional, health, and environmental exposures and their relationship with infections.

Following previous studies,[11,19] older mothers had a lower risk of having children with diarrhea than younger mothers. Older mothers might be more knowledgeable since they were more experienced and exposed to various information from different resources.[19] Older mothers might have more opportunities to be more educated, emotionally mature, and financially stable,[26] contributing to better child care and feeding practices.

As shown in Ethiopia[19] and Nigeria,[27] children whose mothers had higher levels of education were found to have the lowest rates of diarrhea. Maternal education was linked to maternal awareness of child health status. Highly educated mothers tend to have more knowledge about diarrhea prevention, including good hygiene, appropriate infant and young child feeding, clean environments, and the consequences of unhealthy living.[11,27] They also tend to seek health-care services and practice better personal health behavior.[27] While higher educational levels could explain better knowledge and practices, improving maternal knowledge through community-based health education may help promote child health and care practices, in addition to formal education.

Following a Benin study,[14] this study found that an improved source of drinking water was linked to a reduced risk of diarrhea. Clean and safe drinking water could prevent intestinal infections, including diarrhea, since the water has undergone treatment processes that remove most pathogenic organisms, such as bacteria, viruses, and parasites.[28] Conversely, water contaminated by human or animal waste may contain bacteria and parasites. Thus, improving household access to clean and safe drinking water sources may reduce disease transmission between individuals.

Children living in Sulawesi tend to experience diarrhea and fever than those in Java and Bali. Children who lived in Sumatera were at higher risk of fever than children in Java and Bali. Geographical and environmental variations attributable to air and water quality, where the shortage of safe and adequate water supply and low air quality might increase the pathogen spectrum of infections.[29] Sumatera is prone to haze and toxic air pollution from forest fires and burning land. This condition puts children at risk due to their rapid breathing and undeveloped immune system.[30] The other reasons could be due to cultural aspects that affect the risk of childhood illnesses, including traditional beliefs and community practices to access health services. Thus, local-specific policies are essential to prevent problems at the regional level and minimize regional differences in child infectious diseases. Policymakers and public health actors should advance health equity across different subnational levels, including equitable access to health-care facilities, skilled health workers, and access to improved WASH services.

Following a study in India,[31] higher birth orders were associated with ARI. Children with higher birth orders, particularly those in poor families, are likely to live in overcrowding households. This condition may put them at a greater risk of direct person-to-person disease transmission[32] and being exposed to indoor pollution, such as biomass cooking fuels from the kitchen and tobacco smoke.[31] Thus, the use of a separate kitchen and liquid petroleum gas cooking is crucial to reduce indoor pollution,[31] approaches that require household economic improvement and government support. Enhancing maternal and family knowledge and awareness on how to minimize ARI transmissions (e.g., covering coughs and sneezes, frequent handwashing) and the risks of being exposed to cigarette smoke may help prevent ARI. In addition, our study supports the importance of family planning in improving child health outcomes.

This study showed that improved toilet facilities were linked to a decreased risk of ARI, as shown in Sub-Saharan Africa.[33] Several respiratory viruses can come from feces, in which their infection can be spread by splashing water or feces.[34] While handwashing with soap after the toilet can prevent ARI,[35] unimproved toilet facilities may not be accompanied by handwashing stations with clean water and soap nearby. Besides, the availability of improved toilet facilities reflects household living conditions, particularly sanitation, which is essential in determining the spread of ARI.[33] The provision of improved toilet facilities may enhance sanitation situations at the household level.[33] Therefore, nutrition-sensitive approaches integrating nutrition and WASH or social protection interventions to improve household sanitation conditions may be beneficial in preventing ARI.

Limitations

We could not draw a causal inference since we used cross-sectional data. We could not conclude whether breastfeeding and other variables caused child infections or vice versa. Besides, this study might have recall bias since breastfeeding, complementary feeding, and infection variables were based on the mother's memory, affecting the results between feeding practices and infections. Thus, future research should consider using longitudinal or community trial studies to investigate the potential mechanism between infections and their risk factors and to overcome the limitations of maternal recalls. In addition, the duration and frequency of infections should be considered.

Conclusion

Different factors influence diarrhea, fever, and ARI. Our study underscores the importance of continued breastfeeding promotions to prevent infections, particularly diarrhea. It is critical to design suitable programs to prevent and control different types of infections based on child characteristics and specific settings where they live. Policymakers and public health managers should consider integrating a package of interventions combining child health information, education, and communication programs, and the promotions of breastfeeding, complementary feeding, and WASH practices into the existing health system implemented by national and subnational authorities, particularly outside Java and

Bali where health-care services, health and environmental infrastructures, and education system remain challenging.

Authors' contributions

Concept and design: Bunga A Paramashanti, Esti Nugraheny. All authors contributed to the development of the concept and design.

Acquisition of data and interpretation of data: Bunga A Paramashanti, Esti Nugraheny.

Drafting and revising the article: all authors.

Final approval of the article: all authors.

Data availability statement

The data that support the findings of this study are available from the corresponding author (Bunga A. Paramashanti) upon reasonable request.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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