



Determinants of Wasting Among Children Aged 6–23 Months in Indonesia

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ABSTRACT

Wasting is a form of malnutrition that is a significant concern globally, including in Indonesia. It has a detrimental impact on children's health, the quality of human resources, and a country's overall development. This study aims to examine the prevalence and risk factors associated with wasting in children aged 6–23 months in Indonesia. The study design is cross-sectional, utilizing secondary data from the 2022 Indonesian Nutrition Status Survey. Data collection was conducted throughout Indonesia between March and December 2022. The sample size for this study was 70,414 children aged between 6 and 23 months. Bivariate analysis (χ^2 test) was employed to determine the relationship between dependent and independent variables. Furthermore, multivariate analysis utilized logistic binary regression tests to ascertain the adjusted odd ratio (aOR) risk value. The results of this study indicate that the prevalence of children aged 6–23 months in Indonesia is 7.63%, with wasting. The following factors have been identified as being at high risk of wasting: boys, children aged 12-23 months, birth weight <2500 grams, birth length <48 cm, history of exclusive breastfeeding, consumption of empty calorie drinks, history of infectious diseases, inappropriate/complete immunizations, lack of use of health services, inappropriate drinking water sources and very poor family status. Wasting is associated with several factors. Consequently, identifying these factors is of significant importance in the context of intervention efforts to prevent and address malnutrition, including wasting, in Indonesia.

INTRODUCTION

Malnutrition is a nutritional disorder characterized by abnormal physiological conditions resulting from a deficiency, excess, or imbalance of energy, protein, and other nutrients.¹ Amongst children under the age of five, one of the most prevalent nutritional issues is wasting. World Health Organization (WHO) defines wasting as a weight-for-height z-score (WHZ) > -3 SD or -2 SD.²

Wasting has emerged as one of the most significant global concerns in relation to malnutrition. According to the United Nations International Children's Emergency (UNICEF) Fund, WHO and World Bank Group, by 2022, 6.8% of children worldwide will suffer from wasting, while 2.1% of children will be severely wasted.³ In Indonesia, the prevalence of wasting, as determined by the Indonesian Nutrition Status Survey (INSS) in 2021, was 7.1% of children experiencing wasting. In 2022, there was an increase in the prevalence of wasting in Indonesia, with 7.7% of children exhibiting wasting conditions.⁴

Wasting is a form of acute malnutrition that results from recent weight loss due to inadequate nutritional intake and disease.⁵ The cause of wasting or other nutritional deficiencies is caused by direct and indirect factors.⁶ According to the conceptual framework of malnutrition developed by UNICEF in 1990, wasting is caused by direct, indirect, and underlying factors. Direct causes of wasting include nutritional intake and infectious diseases. Indirect factors that contribute to wasting include access to food, childcare, and environmental health. In addition, socioeconomic status, culture, and political circumstances are underlying factors.⁷

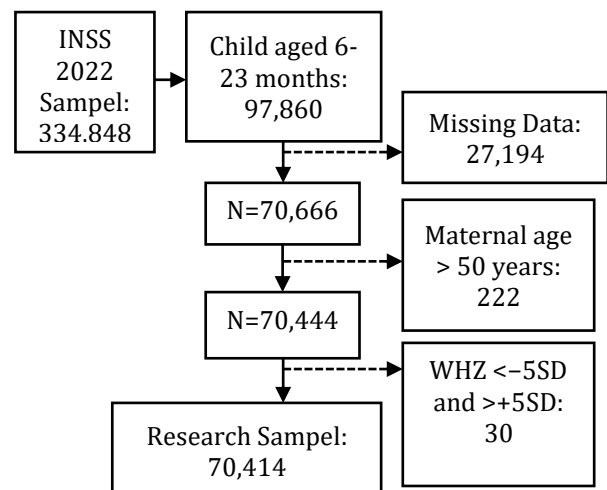
Malnutrition, particularly wasting, is a significant concern in children under the age of five. Children who are wasted at this age are at risk of weakening their immune system, making them susceptible to disease and increasing their susceptibility to mortality and morbidity.^{8,9} Wasting can also lead to impaired cognitive, motor and speech skills in children.¹⁰ In addition to endangering children's health, it also threatens the quality of human resources and the eco-

nomonic capacity of both individuals and countries.¹¹

However, research on the prevalence and risk factors of wasting in the age group of less than 2 years in a national scope remains limited. The age group of less than two years is included in the first 1000 days of life, during which the health of children has a significant impact on their growth and development and future health.¹² Furthermore, the Indonesian government has set a target of reducing the prevalence of stunting and wasting by 14% and 7%, respectively, by 2024.¹³ To achieve this, it is essential to identify and address the risk factors associated with malnutrition, including wasting, at an early age. This study aims to assess the prevalence and risk factors of wasting in children aged 6-23 months in Indonesia.

MATERIAL AND METHOD

The design of this study was a cross-sectional study, utilizing secondary data from the Indonesian Nutrition Status Survey (INSS) 2022, conducted by the Indonesian Ministry of Health since 2019. Data collection employed a stratified two-stage sampling method, with a population of households with children < 5 years of age in March-December 2022. The sample encompassed 334,848 children from 34 provinces in Indonesia. In the present study, a sample of 70,414 children with criteria, aged 6-23 months, with complete data and no outliers (WHZ < -5 SD, $> +5$ SD, and maternal age > 50 years).



Source: Primary Data, 2024

Figure 1. Sampling Flow

The dependent variable in this study was the incidence of wasting in children aged 6 to 23 months, categorized as wasting/normal. The variable of wasting was obtained from WHZ <-2 SD², calculated by WHO Anthro v3.2.2 software. The independent variables included child age, child sex, birth weight, birth length, dietary diversity, EBF history, empty calorie drink consumption, infection history, food security, EBFI, complementary feeding practices, immunization, health service utilization, drinking water source, sanitation, maternal age, maternal education and socioeconomic status.

Child age is categorized into 6-11 months and 12-23 months. Birth weight was categorized as children born >2500 grams and <2500 grams. Birth length was categorized as >48 cm and <48 cm. Food security was categorized as acceptable, borderline and poor. Drinking water sources and sanitation are categorized as proper and no proper. Maternal age was categorized as <20 years, 20-35 years and >35 years. Maternal education was categorized according to the mother's level of formal education, including no school, primary school, junior high school, senior high school and college. Socioeconomic status was categorized as upper class, upper middle class, middle class, lower middle class and lower class. Meanwhile, other variables were categorized as yes/no.

The statistical analysis was conducted using the SPSS application, version 26 (IBM, Armonk, NY, USA). A descriptive analysis was conducted to ascertain the frequency and percentage of each variable. Furthermore, a bivariate analysis of χ^2 test was conducted as Model I to determine the association and risk (crude odds ratio; cOR) between dependent variables and independent variables. Variables that had a $p < 0.25$ in Model I were included in the multivariate analysis. Multivariate analysis employed a binary logistic regression test with a backward stepwise method and a $p < 0.05$ value as Model II. A multivariate analysis was conducted to ascertain the significant adjusted odds ratio (aOR) between the independent variables and the dependent variable. The study was conducted in accordance with the ethical standards set forth by the Health Research Ethics Commission, Diponegoro University, with approval No. 081/EC/KEPK/FK-UNDIP/III/2024.

RESULTS

Table 1 presents the characteristics of children, households and socio-demographics, along with the frequency and percentage of each variable. The results of this study indicate that the prevalence of wasting among children aged 6-23 months in Indonesia was 7.63%. This result is lower than that of stunted (16.31%) and underweight (12.11%) children. Additionally, Table 1 demonstrates that there are more boys than girls. A total of 66.4% of children were aged between 12 and 23 months. In this study, 4.6% of children had a birth weight <2500 g, and 17.7% had a birth height <48 cm. Meanwhile, 45.9% of children do not consume a diverse range of foods and 16.3% did not have an EBF history. Furthermore, children who consumed empty calorie drinks were 40.3% and approximately 39% of children aged 6-23 months had an infectious history.

In this study, 91.5% of children did not receive EBFI at birth. Meanwhile, 13.2% of children did not receive appropriate complementary feeding practices. In addition, 74.8% of children did not receive appropriate immunization, and approximately 18.9% of children and mothers did not utilize health services. Furthermore, 62.2% of children lived with inadequate drinking water sources, and 11.5% lived with inadequate sanitation conditions. Children aged between six and 23 months were more likely to have mothers aged between 20 and 35 years old (75.1%) and mothers with a high school education (41.3%). Furthermore, 20.1% of children lived in families with a socioeconomic status classified as lower class.

Table 2 presents the results of the association between child gender, age, birth weight, birth length, EBF history, empty calorie drinks consumption, infectious history, complementary feeding practices, immunization, health service utilization, drinking water source, sanitation, maternal education and socioeconomic status and the incidence of wasting in children aged 6-23 months in Indonesia.

In contrast, the multivariate analysis revealed that child gender, child age, birth weight, birth length, EBF history, empty calorie beverage consumption, infectious history, immunization, health services utilization, drinking water source, and socioeconomic status were associ-

ated with wasting among children aged 6-23 months in Indonesia.

Male (aOR = 1,34; 95% CI = 1,26 - 1,41), children aged 12-23 months (aOR = 1,30; 95% CI = 1,22 - 1,39) and children with a birth weight <2500 grams (aOR = 1,88; 95% CI = 1,68 - 2,10) had a higher risk of wasting. Similarly, children with a birth length <48 cm (aOR = 1,25; 95% CI = 1,16 - 1,34), children with an EBF history (aOR = 1,44; 95% CI = 1,33 - 1,57) and children with consumption of empty calorie drinks (aOR = 1,06; 95% CI = 1,00 - 1,12) had a higher risk of wasting. An infectious history (aOR = 1,19; 95% CI = 1,12 - 1,26), inadequate/complete immunization (aOR = 1,14; 95% CI = 1,07 - 1,22) and non-use of health services (aOR = 1,20; 95% CI = 1,12 - 1,28) were also associated with a risk of wasting. In addition, drinking water source (aOR = 1,10; 95% CI = 1,03 - 1,16) and lower class family status (aOR = 1,73; 95% CI = 1,57 - 1,90) were among the factors associated with a high risk of wasting (Table 2).

Table 1. Characteristics of Children Aged 6 - 23 Months in Indonesia based on INSS 2022

Variable	N = 70,414	%
Nutritional Status		
Wasting	5377	7.64
Stunting	11484	16.31
Underweight	8527	12.11
Child Gender		
Female	34110	48.44
Male	36304	51.56
Child Age (Months)		
6 - 11	23688	33.64
12 - 23	46726	66.36
Birth Weight (Gram)		
> 2500	67144	95.36
< 2500	3270	4.64
Birth Length (cm)		
> 48	57980	82.34
< 48	12434	17.66
Dietary Diversity		
Diverse	38106	54.12
Not diverse	32308	45.88
EBF History		
No	11462	16.28
Yes	58952	83.72

Variable	N = 70,414	%
Empty Calorie Drinks Consumption		
No	42024	59.68
Yes	28390	40.32
Infection History		
No	42949	60.99
Yes	27465	39.01
Food Security		
Acceptable	69925	99.31
Borderline	388	0.55
Poor	101	0.14
EBFI		
No	64459	91.54
Yes	5955	8.46
Complementary Food Practices		
No	9316	13.23
Yes	61098	86.77
Immunization		
Yes	17778	25.25
No	52636	74.75
Health Services Utilization		
Yes	57073	81.05
No	13341	18.95
Drinking Water Sources		
Proper	26590	37.76
No Proper	43824	62.24
Sanitation		
Proper	62302	88.48
No Proper	8112	11.52
Maternal Age		
< 20 years	2201	3.12
20-35 years old	52879	75.10
> 35 years old	15334	21.78
Maternal Education		
College Graduates	15230	21.49
High School Graduates	29115	41.35
Junior High School Graduates	14285	20.29
Elementary School Graduates	9657	13.71
No School	2227	3.16
Socioeconomic Status		
Upper Class	14013	19.90
Upper Middle Class	14144	20.09
Middle Class	13891	19.73
Lower Middle Class	14173	20.15
Lower Class	14173	20.13

Source: Indonesian Nutrition Status Survey (INSS), 2022

Table 2. Bivariate and Multivariate Analysis of Wasting Determinants

Variable	Model I		Model II	
	cOR (95%CI)	p-value	aOR (95%CI)	p-value
Child Gender				
Female	1	-	1	-
Male	1.30 (1.23 - 1.38)	<0.001	1.34 (1.26 - 1.41)	< 0.001
Child Age (Months)				
6 - 11	1	-	1	-
12 - 23	1.31 (1.23 - 1.39)	<0.001	1.30 (1.22 - 1.39)	< 0.001
Birth Weight (Gram)				
> 2500	1	-	1	-
< 2500	2.00 (1.80 - 2.22)	<0.001	1.88 (1.68 - 2.10)	< 0.001
Birth Length (Cm)				
> 48	1	-	1	-
< 48	1.37 (1.28 - 1.46)	<0.001	1.25 (1.16 - 1.34)	< 0.001
Dietary diversity				
Diverse	1	-	-	-
Not diverse	1.02 (0.97 - 1.08)	0.479	-	-
EBF History				
No	1	-	1	-
Yes	1.37 (1.26 - 1.49)	<0.001	1.44 (1.33 - 1.57)	< 0.001
Empty Calorie Drinks Consumption				
No	1	-	1	-
Yes	1.07 (1.01 - 1.13)	0.021	1.06 (1.00 - 1.12)	0.042
Infection History				
No	1	-	1	-
Yes	1.22 (1.15 - 1.29)	<0.001	1.19 (1.12 - 1.26)	< 0.001
Food Security				
Acceptable	1	-	-	-
Borderline	0.90 (0.61 - 1.34)	0.615	-	-
Poor	1.18 (0.60 - 2.35)	0.631	-	-
EBFI				
No	1	-	-	-
Yes	1.02 (0.92 - 1.13)	0.711	-	-
Complementary Food Practices				
No	1	-	-	-
Yes	1.36 (1.24 - 1.49)	<0.001	-	-
Immunization				
Yes	1	-	1	-
No	1.18 (1.11 - 1.26)	<0.001	1.14 (1.07 - 1.22)	< 0.001
Health Services Utilization				
Yes	1	-	1	-
No	1.14 (1.06 - 1.22)	<0.001	1.20 (1.12 - 1.28)	< 0.001
Drinking Water Sources				
Proper	1	-	1	-
No Proper	1.04 (0.98 - 1.10)	0.165	1.10 (1.03 - 1.16)	0.002
Sanitation				
Proper	1	-	-	-
No Proper	1.13 (1.04 - 1.23)	0.004	-	-
Mother's Age				
< 20 years	1	-	-	-
20-35 years old	0.94 (0.80 - 1.10)	0.436	-	-
> 35 years old	1.10 (0.93 - 1.30)	0.263	-	-
Maternal Education				
College Graduate	1	-	-	-
High School Graduates	1.27 (1.17 - 1.37)	<0.001	-	-
Junior High School Graduates	1.25 (1.14 - 1.36)	<0.001	-	-

Variable	Model I		Model II	
	cOR (95%CI)	p-value	aOR (95%CI)	p-value
Elementary School Graduates	1.35 (1.22 – 1.48)	<0.001	-	-
No School	1.34 (1.14 – 1.58)	<0.001	-	-
Socioeconomic Status				
Upper Class	1	-	1	-
Upper Middle Class	1.45 (1.31 – 1.59)	<0.001	1.46 (1.33 – 1.61)	<0.001
Middle Class	1.56 (1.42 – 1.72)	<0.001	1.58 (1.43 – 1.74)	<0.001
Lower Middle Class	1.61 (1.46 – 1.77)	<0.001	1.62 (1.47 – 1.78)	<0.001
Lower Class	1.73 (1.57 – 1.90)	<0.001	1,73 (1.57 – 1.90)	<0.001

Source: Indonesian Nutrition Status Survey (INSS), 2022

DISCUSSION

In this study, the prevalence of wasting in children aged 6-23 years in Indonesia was 7.63%. The prevalence of wasting in children aged 6-23 months in this study is not much different from the results of the 2022 INSS prevalence in children under 5 years, which is 7.7% of children.⁴ This small difference in prevalence suggests that there are still many determinants of wasting in children under 2 years of age, especially in the 6-23 months age group. This is because these age groups are included in the first 1000 days of life, where the conditions of children from the womb to the age of 2 have a major impact on their future growth, development and health.¹²

This study also showed that child sex, child age, birth weight, birth length, EBF history, empty calorie drinks consumption, infectious history, immunization, of health services utilization, drinking water source and socio-economic status were significantly associated with wasting. Previous studies conducted in Bangladesh and some parts of Ethiopia have shown similar results.^{1,14-17} These results show the prevalence and determinants of wasting, which may help inform policy makers to reduce or prevent malnutrition, especially wasting, and thus produce children with better nutritional status.

The results of studies conducted in several South Asian countries indicate that boys are at a higher risk of malnutrition than girls.¹⁸ In this study, the risk of malnutrition was found to be 1.34 times greater for boys than for girls. From a biological, hormonal, and immunological perspective, boys are more susceptible to wasting.¹⁹ This is due to the fact that the nutritional requirements of boys are greater than those of girls. Consequently, if the nutritional requirements are inadequate, boys will experience

nutritional deficits at an earlier age, resulting in wasting.²⁰ Furthermore, the cultural context within the family or region can influence the mother's knowledge, which in turn affects the feeding and parenting patterns between boys and girls.²¹ Boys who receive inappropriate feeding or parenting patterns from their parents may be at an increased risk of developing wasting.^{22,23}

The findings of this study indicate that there is a significant correlation between the age of the child and the occurrence of wasting. Specifically, children within the age range of 12-23 months exhibited a 1.30-fold increased risk of wasting in comparison to children within the age range of 6-11 months. Additionally, findings from studies conducted in The Gambia and Bangladesh revealed that children within the age range of 12-23 months were also at risk of wasting.^{11,22} These observations collectively suggest that wasting may be associated with the age of the child.²⁴ This increase occurs because older children require more energy and nutrients, which breastfeeding alone is unable to fulfil. Therefore, complementary foods must be introduced to ensure the child's energy and nutritional needs are met. A poor transition to complementary feeding practices can also lead to diarrhoea, which can result in malnutrition.²⁵ Furthermore, older children have greater interaction with the environment, increasing their risk of becoming infected with diseases caused by a poor environment.²⁶

Birth weight and birth length in this study had a significant associated with wasting. Children born with low birth weight (LBW) and a short birth length exhibit 1.88 times and 1.25 times increased risk of developing wasting, respectively. Previous research has indicated that children with low birth weight and birth length may be at an increased risk of malnutrition,

including wasting, stunting, and underweight.¹⁹ Birth length and birth weight are interrelated, as children born with a short body will have a low body weight.²⁷ The birth length of a child is linked to malnutrition, as the length of the birth body is one of the crucial indicators of the beginning of the child's growth and development.²⁸ Similarly to birth length, birth weight is an indicator of child growth and development. Children with a birth weight below the average can experience slower growth and decreased immunity, which increases their susceptibility to infectious diseases and malnutrition, such as wasting.²⁹

EBF is the primary source of food that is optimal for children's growth and development, as well as boosting the child's immune system. It is recommended that infants be exclusively breastfed from birth to 6 months without the addition of other foods or drinks.^{15,30} Children who did not have an EBF history were found to have a greater risk of wasting than those who had an EBF history up to 6 months of age.¹ In contrast to what we found in this study, children who had an EBF history were at risk of wasting. This may be attributed to the suboptimal quality of the child's dietary intake and diet. The respondents were children aged 6 to 23 months, at which age complementary foods other than breast milk have been introduced. Inadequate quality of intake and diet can impede child growth and development and increase the risk of infectious diseases.

Previous research has shown that children who consume food of poor quality or do not follow nutritional guidelines are at risk of developing malnutrition and immune disorders, which can lead to the development of infectious diseases.^{31,32}

This study indicates a correlation between the consumption of empty calorie drinks and the incidence of wasting. Consuming empty-calorie drinks does not provide sufficient energy and nutrients for the growth and development of children. Those who consume such beverages solely for the purpose of satisfying hunger do not provide the energy required for the body to carry out essential internal and external organ functions.³³ In addition, especially food and drink habits with high sugar content can cause overweight/obesity, diabetes, cardiovascular disease, and even death.³⁴ However, other

studies have indicated that consumption of empty-calorie drinks may serve as a substitute for breast milk intake or other nutritious foods.³⁵ Consequently, further research is required to elucidate the relationship between the consumption of empty-calorie drinks and the incidence of waste.

Infectious diseases are often associated with malnutrition. This study shows that the infection history is one of the factors that has a relationship with the incidence of wasting in children aged 6 – 23 months in Indonesia. Previous studies have indicated that children with a history of infectious diseases, including diarrhea, ARI, pneumonia, measles, pulmonary TB, and worms, are at a greater risk of developing wasting.^{16,17,36-39} Infectious diseases can have a detrimental impact on children's health, leading to a loss of appetite and body fluids, imbalances in electrolytes and nutrients, decreased absorption (malabsorption), and metabolic disorders.^{21,36} One of the strategies that can be employed to safeguard children from infectious diseases is to ensure that they receive the appropriate immunization, which increases their immunity and enables them to produce antibodies that further combat or protect the body from infectious diseases.⁴⁰ Immunization in this study is also one factor affecting the incidence of wasting. Children who are not immunized risk wasting appropriately more than children who receive immunizations. These findings are consistent with those of previous studies conducted in Thailand, which have demonstrated that children who have not received the recommended immunizations are at an increased risk of developing malnutrition, including wasting.⁴¹ Children who are not immunized are more likely to experience recurrent diseases that can be prevented through immunization, such as diarrhea, respiratory infections, and other infections that can lead to malnourishment.^{42,43} This is because it is considered that immunization is able to protect children from infectious diseases by developing an immune system that can prevent children from experiencing malnutrition.⁴²

Health services utilization in this study shows an associated with wasting. Health services utilization in children can support and assist mothers in maintaining their children's health and growth.⁴⁴ This research shows that mothers

and children who do not utilize health services have a 1.2 times greater risk of children experiencing waste. Research conducted in Ghana revealed that health services utilization could reduce the incidence of malnutrition, such as wasting, stunting, and underweight.⁴⁵ This is because mothers' participation in activities organized by health services can provide knowledge and education to influence decision-making in the family regarding feeding children.⁴⁵ Furthermore, the utilization of health services can facilitate the identification of children with growth failure at an early age, thereby facilitating the implementation of interventions designed to improve the nutritional status of children.⁴⁶

This study indicates a correlation between the drinking water source and the prevalence of wasting. Families lacking a reliable drinking water source are at a higher risk of having children with wasting. Similar to these results of the studies conducted in Myanmar show that children who experience wasting live with families with inadequate drinking water sources.⁴⁷ Inadequate drinking water sources can increase a child's risk of exposure to infectious diseases, resulting in wasting. This is because inadequate drinking water sources are easily contaminated by microorganisms, such as *E. coli*.⁴⁸ The consumption of contaminated drinking water sources is what causes children to be exposed to infectious diseases, thus affecting the nutritional status of children who are at risk of malnutrition, such as wasting.⁴⁷

Socioeconomic status is one of the factors associated with the incidence of wasting in children aged 6–23 months. Children living with families in the lowest socioeconomic bracket have a significantly elevated risk of experiencing wasting. Similarly, studies conducted in Bangladesh show that very poor families are at greater risk of having children who are wasting than wealthy families.²² Wealthier families can afford better health care costs and additional nutritious food, ensuring a healthier living environment.^{15,20} Conversely, families with low economic status may experience a lack of access to nutritious food, are easily exposed to recurrent infections, and lack adequate access to water, sanitation, and good hygiene conditions. This can have a detrimental effect on children's growth and result in malnutrition.²⁵

CONCLUSION AND RECOMMENDATION

The prevalence of children aged 6-23 months in Indonesia who experience wasting is 7.63%. A significant relationship has been identified between the incidence of wasting and several factors, including child gender (male), age 12-23 months, children born short, LBW, EBF history, consumption of empty calorie drinks, infection history, immunization, absence of healthcare utilization, inadequate drinking water sources, and socioeconomic status. Identifying such risk factors is crucial for preventing and managing malnutrition, such as wasting, in Indonesia. It is, therefore, imperative that policymakers intervene comprehensively. Such interventions can be implemented by increasing public awareness of malnutrition in each generation. In addition, the government must be able to provide ongoing nutrition and health education to girls and women to prevent the occurrence of short births and LBW. It is because children are born with a low birth length, and LBW is the dominant factor for malnutrition, such as wasting. On the other hand, the government needs to support and build the capacity of health cadres to play an optimal role in preventing and managing malnutrition. Equitable health facilities should also be provided to the city and the village community.

AUTHOR CONTRIBUTIONS

RTEK drafted this paper with contributions from all authors. RTEK, AS and AM conceptualized and designed the study. RTEK analysis of the results and manuscript writing. AS and AM reviewed, edited and provided additional analysis and discussion. All authors have read and approved the manuscript. RTEK = R. Trikorianto E. Koritelu; AS = Ahmad Syauqy; AM = Ani Margawati.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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