

## META-ANALYSIS FACTOR OF HAND WASHING HABITS AND EXCLUSIVE BREASTFEEDING WITH DIARRHEA BETWEEN 2017-2021 IN INDONESIA

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### Abstract

**Introduction:** Diarrhea is an endemic disease that causes extraordinary events (pandemic) and is often accompanied by death in Indonesia. Previous reports showed that children who practice poor hand washing or without using soap and running water are 2.175 times more likely to experience diarrhea. It was also discovered that exclusive breastfeeding can form antibodies and other nutrients that protect babies from infections such as diarrhea. Therefore, this study aimed to analyze the most influential factors between hand washing habits and exclusive breastfeeding on the incidence of diarrhea in Indonesia. **Methods:** This study used a meta-analysis method. **Results and Discussions:** The results showed that the pooled PR value of the hand washing habit variable  $e1.06 = 2.886$  (95% CI 0.87 - 1.24) was greater than the exclusive breastfeeding  $e0.53 = 1.698$  (95% CI 0.36 - 0.70). The data were obtained from articles and journals with a cross-sectional study design. Based on the results of the meta-analysis, people who did not apply proper hand washing habits are 2,886 times more at risk of diarrhea. Furthermore, babies who were not exclusively breastfed were 1,698 times more likely to have diarrhea than those who received exclusive breastfeeding. **Conclusion:** The results showed that the most influential factor between the two variables was the hand washing habit variable.

## INTRODUCTION

Diarrhea is an endemic disease that can cause Extraordinary Events and is often accompanied by death in Indonesia (1). According to the 2018 health profile data, there were 10 outbreaks of diarrhea in 8 provinces and 8 districts or cities with a total of 765 sufferers and 36 deaths (1), with the highest case of approximately 7,203 in East Java in Surabaya City (2). It was also discovered that the prevalence of diarrhea occurred in West Java Province with a total of 186,809 cases (3). The proportion of the causes of post-neonatal death due to diarrhea from 29 days to 11 months in the country was 12.1%. Based on 2019 data, pneumonia and diarrhea are still the main problems causing 979 and 746 deaths in the group of children aged 29 days to 11 months, respectively (4). In 2020, the leading cause of death among children below 5 (12 – 59 months) is diarrhea (5), with a total of 12 cases in Sidoarjo (6).

The incidence of diarrhea is mostly caused by poor sanitation conditions, bad hand washing habits, non-compliance with requirements, and the non-fulfillment of exclusive breastfeeding from mothers to children. This habit can reduce the incidence of diarrhea, specifically after defecating and urinating, before feeding children, and after eating. A previous study stated that the hand washing habit before preparing food can reduce the incidence of diarrhea (7). Children who are used to poor hand washing or without using soap and running water are 2.175 times more likely to experience the disease (8). Diarrhea is common in respondents who do not wash their hands with clean water and soap after defecating, throwing out toddlers' stools, and eating. This is because the water used for hand washing comes from creeks, therefore, several respondents assumed that the use of water only is sufficient (9). Babies who are exclusively breastfed almost do not suffer from diarrhea (9).

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Among newborns, exclusive breastfeeding has a protective power that is 4 times greater against the incidence of diarrhea compared to breastfeeding accompanied by a bottle of formula milk (10). Investigations showed that exclusively breastfed babies tend to be healthier and are optimally assisted in the development of the nervous system and brain (11). This is because formula can increase the risk of infections in the urinary and digestive tract, as well as the baby's ears. Meanwhile, one of the efforts that can be carried out to prevent diarrhea among babies is to practice exclusive breastfeeding for at least 6 months and continue for 2 years old (11).

Breast milk is different from formula types and other liquids that can be contaminated during the manufacturing process. For babies, exclusive breastfeeding has the potential to prevent microorganisms contamination that causes diarrhea. It also maintains good nutrition, increases the immune system, enhances emotional closeness between mother and baby, and can form antibodies and other nutrients (12). The prevalence of toddlers who are not exclusively breastfed is 1.514 times greater (13). Therefore, this study aims to determine the strength of the relationship or the magnitude of the difference between hand-washing habits and exclusive breastfeeding variables.

## METHODS

This study used the meta-analysis method by combining two or more similar reports to achieve a combination of quantitative data with the same hypothesis to obtain a conclusion. The summarizing technique was obtained from various results quantitatively by searching for a summary value or effect size. The literature used is related to hand washing habits and exclusive breastfeeding with the incidence of diarrhea in Indonesia. Moreover, secondary data, scientific articles, and journals were also used. The main data sources were from different journals and articles obtained from electronic databases.

The database used was Google Scholar (2017-2021) and the keywords were "Diarrhea", "hand washing habits", "exclusive breastfeeding", "diarrhea with exclusive breastfeeding", and "diarrhea with hand washing habits". The population is in form of national articles that have a relationship with the study objectives. The selected articles and journals examine the factors of hand washing habits and exclusive breastfeeding with the incidence of diarrhea in Indonesia.

The meta-analysis method is objective and can estimate the effect size quantitatively and its significance. However, it is difficult to conclude because

the combination of several investigations from different articles and journals does not always have the same quality. There are also limitations of the data collected, frequent publication bias, and the characteristics of various subjects. The steps for selecting journals and articles using the meta-analysis method are stated below.

## Search Articles and Journals

There is a need to use keywords through the PICOS method for analyzing journals and articles. The PICOS method is an acronym for population or problem, intervention or indicators, comparison, outcome, and study design. In this study, the problem is diarrhea, the indicator is hand washing habits and exclusive breastfeeding, and the design is meta-analysis. A statistical analysis that combines the results from various scientific reports is called Meta-analysis.

## Data Collection Method

After collecting data, the next step is to select articles and journals based on inclusion and exclusion criteria. The article that will be reviewed are written in the Indonesian language and the subjects were hand washing habits and exclusive breastfeeding with diarrhea incidence. The search was conducted by combining keywords on Google Scholar and the publication year of the data collected is from 2017 to 2021. After a search has been carried out, the next step is to filter according to the abstract review. In the screening process, it is also necessary to select complete articles and exclude those that are not in full-text condition. Furthermore, re-screening was carried out to select articles with a cross-sectional study design.

## Data Type

The secondary data used were from selected articles and journals that have been filtered. The dependent variable was the incidence of diarrhea in Indonesia, while the independent variables were hand washing habits and exclusive breastfeeding. All the studies showed a positive effect between the two variables with diarrhea incidents. A total of 20 full-text articles, while only 10 that qualify for inclusion criteria were selected. The method of meta-analysis is similar to a rapid and systematic review, while the workflow is identical to the literature review. The first step is to formulate questions and determine the study objectives, followed by the identification of relevant literature, the building of strategy, and the filtering of various relevant journals. The third step is to extract and consolidate study-level data. The fourth step is assessment and data

preparation, including calculating the size of the relevant journal, evaluating heterogeneity, and selecting a meta-analysis model. The fifth step is to synthesize data and calculate summary measures as well as confidence intervals. The sixth step is exploration, and the last stage is analyzing results and providing recommendations for future work.

**Data Analysis Techniques**

The 4 stages of conducting data meta-analysis. The first stage is data abstraction. The data obtained from each article and journal information were changed and inputted with the same or uniform table format. This includes the year of publication, exposure, location, study design, and the outcome of each study.

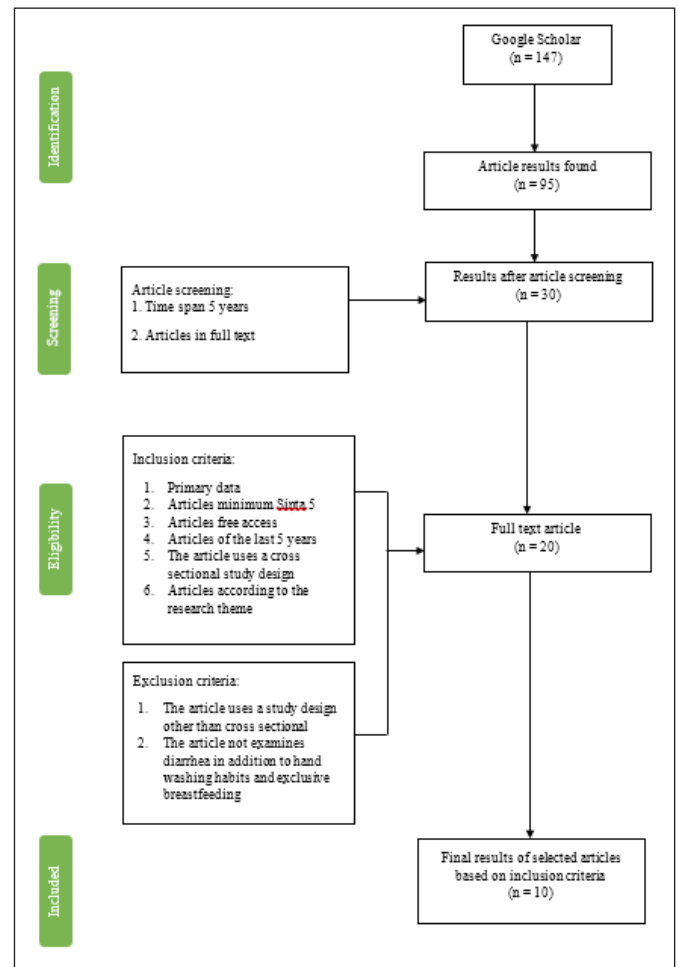
The second is data analysis. The data were analyzed using a fixed effect model or random effect model with JASP software, which was used to carry out meta-analysis data. The results of processing the received data will be presented in form of a forest plot graph, which describes the combined effect size of each of the variables.

The third is the publication bias test. The funnel plot technique is used to identify publication bias in this study. The final stage is the sensitivity test. Sensitivity tests were carried out to prove that the meta-analysis results were relatively stable to changes. This test compared the results of the fixed effect model method with that of the random effects model. Subsequently, some articles that have been collected were extracted and synthesized to obtain data that meet the study objectives. The data are compiled, analyzed, and used for problem-solving materials, where a meta-analysis will be carried out. The flow diagram (prism) of data collection is shown in Figure 1.

After the articles and journals were obtained, a meta-analysis of the data using 10 research articles was carried out. This was conducted to obtain the pooled odds ratio estimate by using the Mentel-Haenszel method for the fixed effect analysis model and the Der Simonian-Laind method for the random effects model. When the p-value of heterogeneity in the variation between variables is greater than 0.05, it is homogeneous, however, a lesser p-value indicates heterogeneity. The analytical model used is the fixed and random effect model. The meta-analysis used to calculate the prevalence ratio (PR) value is as follows:

The variable is a risk factor between hand washing habits and exclusive breastfeeding with the incidence of diarrhea when the PR value is above 1 and the confidence interval range is not more than 1. Meanwhile, the variable is a protective factor when the

PR value is less than 1 and the confidence interval range is not more than 1. The variable has no relationship with the incidence of diarrhea when the PR value = 1 and the range of confidence intervals is not more than 1.



**Figure 1. Prisma Flow Diagram Analysis of Hand Washing Habits and Exclusive Breastfeeding with Diarrhea Incidence in Indonesia**

**RESULTS**

**Meta-Analysis of Hand Washing Habits with the Incidence of Diarrhea in Indonesia**

Based on Table 1 heterogeneity test in Table 1 and Table 2, the p = 0.001, and the value is smaller than 0.05. This means that the variance between studies is heterogeneous, therefore, a random effect model was used. According to the results of the forest plot in Figure 2 (a), the pooled PR value is  $e^{1.06} = 2.886$  (95% CI 0.87 – 1.24). This showed that the factor of people who do not properly apply hand washing habit has a 2.886 times greater risk of experiencing the incidence of diarrhea compared to those who applied the habit properly.

**Table 1. Heterogeneity Test Meta-Analysis of Handwashing Habits with Diarrhea Incidence in Indonesia**

	Q	df	p
Omnibus test of Model Coefficients	125.08	1	< .001
Test of Residual Heterogeneity	42.98	9	< .001

Note : p-values are approximate

**Table 2. Egger’s Test Meta-Analysis of Hand Washing Habits with Diarrhea in Indonesia**

Egger’s test	Z	p-value
	-5.0595	<0.001

The funnel plot results as shown in Figure 3 (a) indicated that many black circles are outside the triangle line. Egger’s test was used to determine asymmetry.

The egger test in Table 3 and Table 4 obtained a p-value of <0.001, which is smaller than 0.05, this means that publication bias is indicated.

The results of the forest plot in Figure 2 (a) showed that the factor of people who do not apply the hand washing habit properly has a 2.886 times greater risk of experiencing the incidence of diarrhea.

**Table 3. Heterogeneity Test Meta-Analysis of Exclusive Breastfeeding with the Incidence of Diarrhea in Indonesia**

	Q	df	p-value
Omnibus test of Model Coefficients	36.830	1	< 0.001
Test of Residual Heterogeneity	2.694	9	0.975

Note : p-values are approximate

**Table 4. Egger’s Test Meta-Analysis of Exclusive Breastfeeding with Diarrhea in Indonesia**

Egger’s test	Z	p-value
	-1.2100	0.226

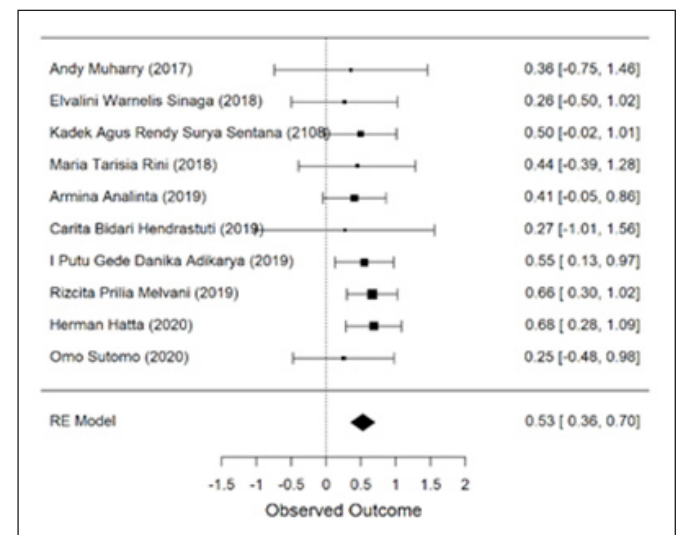
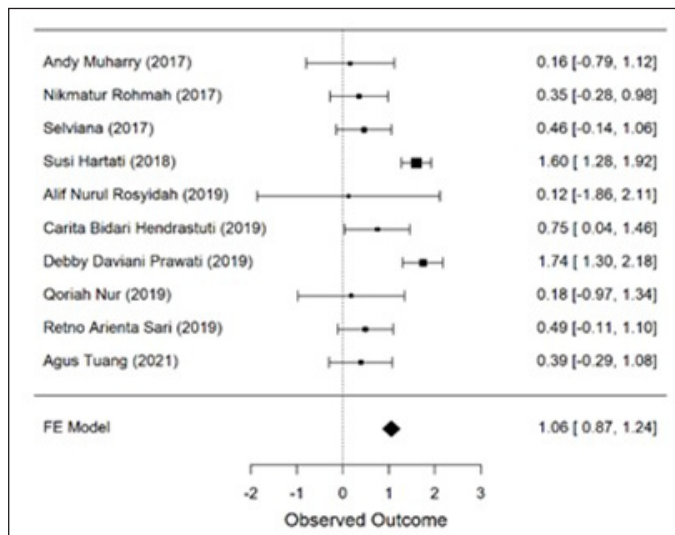
**Meta-Analysis of Exclusive Breastfeeding Factors with Diarrhea in Indonesia**

Based on Table 5, the p-value = 0.975 is greater than 0.05, this indicated that the variation between the variables is homogeneous. Therefore, the analysis uses a fixed effect model. From the results of forest plot point (B) in Figure 2, the pooled PR value is  $e^{0.53} = 1.698$  (95% CI 0.36 – 0.70). This indicated that infants who are not exclusively breastfed will be 1.698 times more at risk of developing diarrhea.

**Table 5. Comparative Sensitivity Test of Pooled PR Random Model and Fixed Model**

Research Variable	n	Heterogeneity (p-value)	Fixed Effect Model		Random Effect Model	
			PR	95% CI	PR	95% CI
Hand Washing Habit with Diarrhea Incidence	10	0.001	2.886	0.87-1.24	2.095	0.33 – 1.15
Exclusive Breastfeeding with Diarrhea Incidence	10	0.975	1.698	0.36 – 0.70	1.698	0.36 – 0.70

Figure 3 (b) showed that the funnel plot results are all black circles inside the triangle line. Meanwhile, the asymmetry proceeded with Egger’s test as stated in Table 4 and the p-value obtained is 0.226, which means that publication bias is not indicated.



**Figure 2. Forest Plot of Handwashing Habits and Exclusive Breastfeeding with Diarrhea in Indonesia**

(a) Handwashing Habits with Diarrhea; (b) Exclusive Breastfeeding Factors with Diarrhea

RE Model or FE Model Represents Prevalence Ratio Values and Shows 95% CI Value.

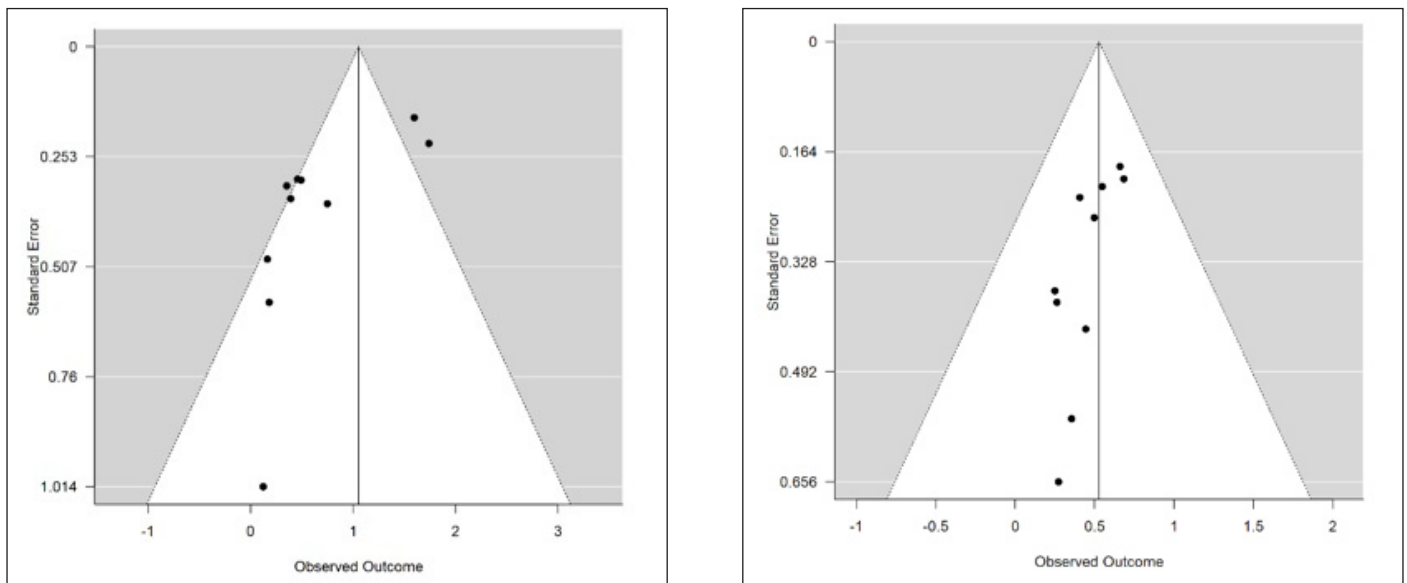


Figure 3. (a) Funnel Plot of Handwashing Habits and Exclusive Breastfeeding with Diarrhea in Indonesia (a) Handwashing Habits with Diarrhea (b) Exclusive Breastfeeding Factors with Diarrhea

**Sensitivity Test of Handwashing Habits and Exclusive Breastfeeding with Diarrhea in Indonesia**

The sensitivity test is used for identifying heterogeneity, proving that the results of the meta-analysis are relatively stable, and interpreting the quality effects of a study. From the comparison of pooled PR fixed and random models as shown in Table 5, the results indicated that the most influential factor between the variables was the hand washing habit. This was because the pooled PR value of the hand washing habit variable  $e^{1.06} = 2.886$  (95% CI 0.87 - 1.24) was greater than the exclusive breastfeeding  $e^{0.53} = 1.698$  (95% CI 0.36 – 0.70).

The results of the forest plot in Figure 2 (b) showed that infants who are not exclusively breastfed will be 1.698 times more at risk of developing diarrhea. This showed that 59.5% of babies suffer from diarrhea from incomplete breastfeeding. This is in line with other studies which stated that 12 or 30.8% of infants also experience the disease.

**DISCUSSION**

**Meta-Analysis of Hand Washing Habits with the Incidence of Diarrhea in Indonesia**

The people who do not apply the hand washing habit properly have a 2.886 times greater risk of experiencing diarrhea. The habit of using soap properly can reduce the incidence of diarrhea by approximately 45% because it kills germs on the hands, resulting in they do not enter the body with the food eaten. Based on previous reports, it was discovered that 77% of respondents who do not wash the hands with soap before eating can trigger diarrhea, and 38 (18%) residents were reported to have the disease (14). Washing hands with soap and clean running water, specifically after

defecating, and disposing of children’s feces, as well as before preparing food and feeding children has been shown to reduce the incidence of diarrhea by 47% (15). A total of 44.6% of respondents had a poor habit and 19.6% experienced diarrhea in the last 3 months (16). It was reported that 26.7% of respondents had diarrhea due to poor hand washing (17). Therefore, efforts are being made to enhance proper hand washing, which is carefully and seriously carried out for approximately 20 seconds (18). One of the significant causes of diarrhea among children is poor hand washing habits, where 35.4% or 34 toddlers experienced this disease (19).

Diarrhea is a critical disease among toddlers when it is not prevented and treated immediately. It can occur due to several factors such as improper hand washing, littering, defecating in rivers, lack of knowledge, and open defecation (20). In a previous report, 6 respondents experienced diarrhea due to poor behavior, while no participants had the disease because of good habits (21). This showed that there is a significant relationship between the habit of washing hands with soap and the incidence of diarrhea. The availability of facilities is an important factor to support clean and healthy living behavior in schools (22). The appropriate use of soap is the most effective and easy way to prevent outbreaks of diseases such as typhus, diarrhea, or even bird flu. This is because several infectious diseases are caused by low and bad hygiene as well as healthy behavior problems. Hand washing with soap and running water are more effective in removing dirt and fine dust from the skin surface and reducing the number of disease-causing microorganisms such as bacteria, viruses, and various other parasites that are on both hands (21).

Poor behavior can be caused by the lack of health workers' role in providing counseling related to hand washing with soap. The availability of facilities other than in the school canteen, class, and home is still very minimal. Although bacterial contamination tends not to disappear, it can be prevented using running water and using soap to destroy and remove microorganisms (23). Male children who experience diarrhea are more common than females because they carry out activities outside the home. This disease generally occurs in school-age children because of the habit of buying snacks on the roadside or carelessness and the lack of washing hands before eating. Furthermore, schools do not provide adequate hand-washing facilities, and only some children understand the definition, benefits, purpose, and steps for washing hands with soap and running water correctly (24). There are ten steps of proper hand washing for at least 40-60 seconds. First, wet both palms using clean running water, apply soap and rub the palms together. Subsequently, rub the back of the hand and between fingers alternately, as well as both palms and the inside of the fingers in an interlocked position. This is followed by the rubbing of the back of the fingers into the palm with the interlocked fingers and rubbing the thumb alternately in a circular way. Also, rub the fingers' tips or the bottom of the nails into the palms of the hands. The soapy hands are washed with clean running water and finally dried using a tissue or cloth that can only be used once (25).

Personal hygiene factor is one of the causes of the high incidence of diarrhea in children (26). This showed that there is a need to promote hand washing with soap after using the toilet and defecating, before eating, during, and after preparing food (25). A total of 27 students or 30% are often absent from school due to diarrhea and abdominal pain within 3 months. There are students of RA Nurul Qur'an who do not want to wash their hands before eating. It was discovered that the school has not given detailed teaching on proper hand washing to students because teachers do not know the appropriate steps (27). There is a relationship between the behavior of hand washing with soap and the incidence of diarrhea. When this habit is good, the risk of getting diarrhea is only small, while it is larger or more severe when the behavior is bad (28).

#### **Meta-Analysis of Exclusive Breastfeeding Factors with Diarrhea in Indonesia**

Children who are not exclusively breastfed will be 1.698 times more at risk of developing diarrhea. This is because exclusive breastfeeding protects against diarrhea-specific morbidity and mortality in infants during the first 2 years of life (29). Another study also stated

that mothers who do not exclusively breastfeed their babies have a 4.8 times higher chance of experiencing the disease. This is because the variable is mostly associated with the incidence of diarrhea in infants aged 6-24 months (30). It was reported that among 15 (75%) of 32 respondents, diarrhea is the second cause of death for children below 5 years old (31). The age group of children under 5 who experience diarrhea is dominated by 1-2 years with 64 (55.2%) children, followed by the >2-3, >4- 5, and >3-4 years groups with 23 (19.8%), 16 (13.8%), and 13 (11.2%), respectively (32). Approximately 10-17 times more immune are in the colostrum in breast milk, which protects babies from diarrhea.

Breast milk contains lactose which increases the growth of good bacteria in the body, namely *Lactobacillus bifidus* which fights pathogenic bacteria such as *Salmonella*, *E. Colli*, and *Shigella*. The milk also contains several lysozymes which can destroy bad bacteria (31). Colostrum in breast milk contains many components that can increase the immune response in infants, including secretory immunoglobulin A (sIGA), lactoferrin, and human milk oligosaccharide (HMO). The protein content such as lysozyme and lactoferrin also have antimicrobial effects. The content in breast milk in form of probiotics can reduce the presence of pathogenic bacteria through a competitive mechanism in the baby's digestive tract (33). Furthermore, 31 subjects, or 34.4% of children experienced acute diarrhea due to incomplete breastfeeding. This is because breast milk contains various bioactive components that can prevent babies from experiencing diarrhea. Immunoglobulin A can activate the complement system by alternative pathways with macrophages to phagocytose various kinds of germs that enter (34). It was also reported that 17 babies or 54.8% had diarrhea during the last 6 months, which caused underdevelopment of the immune system (35).

#### **Sensitivity Test of Handwashing Habits and Exclusive Breastfeeding with Diarrhea in Indonesia**

Among the variables of exclusive breastfeeding and hand-washing habits, the most influential factor was the hand-washing habit variable. The results showed that breast milk contains colostrum which is very useful for babies. It also has immune substances, specifically immunoglobulin A (IgA) that protects babies from various infectious diseases such as diarrhea. Furthermore, the milk has a laxative effect that helps babies at the beginning of defecation, where colostrum protects the digestive tract from various strange substances that enter the body. There is a difference between exclusive breastfeeding and formula milk in the incidence of diarrhea in infants due to the intake of different nutrients.

The percentage history of recurrent diarrhea was more common in respondents with nutrition from formula milk compared to those from exclusive breastfeeding. This is because the baby is still 6 months old and the digestive system is not yet perfect. Babies who are exclusively breastfed will automatically get anti-infective immunity and is the best natural food because the composition is suitable for growth and development, as well as protecting babies from various diseases, including diarrhea (36). It also reduces the incidence of acute diarrhea to milder episodes and increases the ability of the immature baby's immune system. Breast milk is readily available and is practically free of pathogenic microorganisms. In fetal babies and newborns, the immune system is available but immature, therefore, the baby gets immunoglobulin G, which is transferred from the mother through the placenta. Since the level of immunoglobulin G will decrease during the first 6 to 12 months of birth, exclusive breastfeeding is needed to increase body immunity (37). Female children with acute diarrhea are more susceptible to diarrhea (32). Exclusive breastfeeding without additional food and drink during the first 0-6 months of birth can protect toddlers from the dangers of bacteria and other organisms that cause diarrhea. Breast milk can also be used as a therapy for acute diarrhea because it can easily be digested by the baby's digestive tract. It also contains digestive enzymes which enhance complete absorption by the baby's intestines (28).

Diarrhea in infants can be caused by behavioral factors, namely the early administration of complementary foods to breast milk, which accelerates contact with germs. The use of milk bottles and the improper hand washing habit among mothers also increase the risk of developing diarrhea. The incidence of the disease can be caused by errors in feeding the baby, such as the administration of food other than breast milk before the age of 4 months. Through this habit, babies lose the opportunity to get immune substances that are only obtained from breast milk. They are also exposed to food that has been contaminated with bacteria when it is consumed through unsterile eating and drinking utensils. Breast milk provides passive protection for the baby's body to deal with pathogens. The milk contains several anti-inflammatory components which function is not widely known. Therefore, babies who received exclusive breastfeeding are less likely to get sick, specifically in the early stages of life (38).

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#### CONCLUSION

Based on the results of a meta-analysis of the variable hand washing habits, it is known that people who do not apply the habit properly have a 2.886 times greater risk of experiencing diarrhea. Meanwhile, the exclusive breastfeeding variables showed that infants who do not receive exclusive breastfeeding are 1,698 times more at risk of developing diarrhea.

The results of the sensitivity test showed that the most influential factor between all variables was the hand washing habit variable. This was because the pooled PR value of the hand washing habit variable  $e^{1.06} = 2.886$  (95% CI 0.87 - 1.24) was greater than the exclusive breastfeeding, which is  $e^{0.53} = 1.698$  (95% CI 0.36 - 0.70).

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