Hand Washing Habits using Soap is Most Influential Factor Occurrence of Diarrhea in Infants 6-12 Months Old

Dewi Purwaningsih[1], Oky Rahma Prihandani[2], Kanti Ratnaningrum[3]
[1]Medical Study Program, Faculty of Medicine, Universitas Muhammadiyah Semarang
[2]Departement of Pediatric, Faculty of Medicine, Universitas Muhammadiyah Semarang
[3]Departement of Tropical Disseas, Faculty of Medicine, Universitas Muhammadiyah Semarang
*Corresponding author: kantiratna@unimus.ac.id

ABSTRACT
Diarrhea is defined as a condition that causes sufferers to defecate repeatedly with a soft, liquid, or paste-like consistency. The level of frequent bowel movements in people with diarrhea in one day is 3 times or more, with mucus or blood or not both. One of the risk factors for diarrhea is child factors, such as the way of birth and a history of exclusive breastfeeding in infants. Babies born vaginally and have a history of exclusive breastfeeding will result in differences in the gut microbiota which can be one of the factors causing diarrhea in infants. In addition to these factors, hand washing habits are also a cause of diarrhea. This study aims to analyze the risk factors from the child aspect that can increase the risk of diarrhea in infants 6-12 months old. An observational study with a cross sectional design and consecutive sampling technique at coverage areas of warungasem Public Health center (Puskesmas Warungasem), Batang Regency, Central Java Province. Infants count data obtained from infants count registers Puskesmas Warungasem & primary data was obtained through interviews using a questionnair. Analyzed bivariate data using chi square test and multiple data using logistic regression test. From 69 infants, it was found that the way of birth, history of exclusive breastfeeding, and hand washing habits using soap were associated with occurrence of diarrhea in infants 6-12 months old (p=0.007; p=0.004; p=0.024) at coverage areas of Puskesmas Warungasem, Batang Regency. Hand washing habits using soap is the most influential factor in occurrence of diarrhea in infants 6-12 months old at coverage areas of Puskesmas Warungasem, Batang Regency.

Keywords: Method of birth, exclusive breastfeeding, hand washing habits, diarrhea, infants.

INTRODUCTION

Diarrhea is defined as a condition that makes the sufferer defecate repeatedly with a soft, liquid, or paste-like consistency. The frequency of defecation in patients with diarrhea in one day is three or more times, with mucus or blood or neither.[1] Diarrheal disease, especially in infants and toddlers, is still a major health problem in Indonesia, due to the high morbidity and mortality rates in diarrheal disease.[2]

In Indonesia every year there are 100,000 children under five who lose their lives due to diarrhea disease or on average in one day there are 273 children under five who lose their lives due to diarrhea.[3] In Central Java, diarrhea in infants and toddlers accounts for the top 5 causes of outbreaks. In 2012, there were 116,763 children under five who experienced diarrhea, and in 2013 there was an increase of 128,324 diarrhea events in children under five.[4]

The causes of diarrhea can influenced by bacterial, parasitic, and viral infections.[5] Risk factors that can cause diarrheal disease include toddler, mother, environment, and sociodemographic.[6]

From the moment a baby is born, the baby will begin contact and exposure to the external environment that can disrupt the balance and development of normal microflora in the baby's gut. Several studies have shown that the development of normal gut flora after birth will play an important role in the development of innate and adaptive systems.[7]

During the vaginal birth process, the baby will be directly exposed to a complex set of microbes. This statement is proven because there are similarities between the microbes present in the gut of neonates and the mother's vagina.[1] Microbes that are often found are *Prevotella sp*. and *Lactobacillus sp*.[8] Several studies have shown that infants born by caesarean section have different patterns of gut microbiota development compared to infants born vaginally.[9] Infants born by caesarean section will be exposed to bacteria on the mother's skin and will be exposed to the environment including health workers who assist in delivery. During the first week of life the diversity of gut microbiota in caesarean-born infants is much lower and much less likely to be populated by Bifidobacterium and Bacteroides.[10] The microbiota found in caesarean-born infants include *Staphylococcus sp., Clostridium sp., Corynebacterium sp.,* and *Propionobacterium sp*.[8] If there is an imbalance in the microbiota of the gastrointestinal tract early in the infant's life, it will be associated with the development of several diseases in the future. These include infectious diseases (such as diarrhea and ARI).[10]

Breast milk has various benefits for infants and toddlers, one of which is to reduce infectious diseases such as diarrhea. Breast milk contains glycans which contain oligosaccharides. This oligosaccharide content will later provide the role of a natural immunological mechanism that can help prevent babies from getting infectious diseases. In addition, breast milk can also reduce the risk of ARI disease. Breast milk is also very useful for the baby's physical, mental, emotional and psychological growth. The onset of lactation has a tremendous impact on the baby. In addition, IMD and exclusive breastfeeding are major factors that can lead to a reduction in infant morbidity and mortality. A study in Vietnam in 2012 stated that infants with exclusive breastfeeding for up to 6 months can reduce the severity of diarrheal disease.[3]

In addition to these factors, there is also another factor, namely hand washing habits using soap. Hand washing behavior using soap with running water is an effective healthy behavior to stop the spread of diseases, such as ARI, diarrhea, and avian influenza. The chain of disease transmission through hands can be stopped by hand washing with soap, which is easy to do and does not require a lot of time and money.[11]

Based on the background results above, researchers are interested in analyzing risk factors from the child's aspect that can increase the risk of diarrhea in infants aged 6-12 months old at coverage areas of Puskesmas Warungasem, Batang Regency.

METHOD

This research method is analytic observational with cross sectional design. This study was conducted in the working area of the Warungasem Health Center, Batang Regency, Central Java Province. The sample was calculated using the lemeshow formula. The samples were infants aged 6-12 months at coverage areas of Puskesmas Warungasem Batang Regency with inclusion criteria: infants are active in posyandu activities, the baby's mother can communicate well, while the exclusion criteria: infants with low birth weight ≤ 2500 gr, infants who have a history of galactosemia, formula milk allergy, and lactose intolerance, infants who are undergoing chemotherapy treatment, infant mothers have infectious diseases through breast milk, such as HIV. In this study, data collection was carried out using a questionnaire instrument obtained through direct interviews. All respondent characteristics were analyzed

using chi square test and multiple logistic regression test. This study has been approved by the Health Research Ethics Commission (KEPK) of the Faculty of Medicine, Muhammadiyah University of Semarang with the issuance of EC number 015/EC/KEPK-FK/UNIMUS/2022.

RESULT

Table 1. Characteristics of respondent

Characteristics	N (%)
MOTHER'S CHARACTERISTICS	
Age (yo)	
17–25	19 (27.5)
26-35	34 (49.3)
>35	16 (23.2)
Education	
Elementary School Junior	14 (20.3)
High School	28 (40.6)
Senior High School	20 (29.0)
College	7 (10,1)
Job	
Government employees	0 (0.0)
Private sector employees	7 (10.1)
Laborers	6(8.7)
Fisherman	0 (0.0)
Trader	1 (1.4)
Housewife	55 (79.7)
Family Income Based on Regional Minimum Wage	35 (50.7)
≤ Rp. 2.129.117,00	34 (49.3)
≥ Rp. 2.129.117,00	
Hand Washing Habits Using Soap	
Often	55 (79.7)
Less	14 (20.3)
Environmental Sanitation	49 (71.0)
Clean	20 (29.0)
Less	
INFANTS CHARACTERISTICS	
Infant age (months old)	36 (52.2)
6 - 8	33 (47.8)
9 - 12	
Gender	
Male	35 (50.7)
Female	34 (49.3)
CHARACTERISTICS BASED ON DIARRHEA OCCURRENCE	
Occurrence of Diarrhea	48 (69.6)
No	21 (30.4)
Yes	
Birth Method	
Vaginal	44 (63.8)
Caesarean	25 (36.2)
History of exclusive breastfeeding	
Yes	46 (66.7)
No	23 (33.3)

Table 1 shows the characteristics of respondents at coverage areas of Puskesmas Warungasem, Batang Regency, the majority of mothers were between the ages of 26-35 years old as much as 49.3%. The majority of mothers' education in this area is junior high school graduates as much as 40.6%. The majority of mothers' occupation is as housewives as much as 79.7%. For family income based on the regional minimum wage for 2021 in Batang Regency, in one month the majority of respondents' income is less than the regional minimum wage as much as 50.7%. The majority of mothers in this area often practice hand washing using soap, 79.7%. The majority of respondents' infants were 6-8 months old, 52.2%. The majority of infants were male, 50.7%. Environmental sanitation of respondents, 71.0% had a clean environment. A total of 30.4% experienced diarrhea within the last month. The majority of infants were born vaginally, 63.8%, and the majority of infants had a history of exclusive breastfeeding, 66.7%.

Table 2. Analysis of Risk Factors for Diarrhea in Infants 6-12 Months Old

Variable	Occurrence of Diarrhea		Total	p	RP (CI 95%)
	No n (%)	Yes n (%)	n (%)		
Birth Method					
Vaginal	38 (86.4)	6 (13.6)	44 (100.0)	0.000	2.159
Caesarean	10 (40.0)	15 (60.0)	25 (100.0)		(1.317-3.539)
History of exclusive breastfeeding					
Yes	38 (82.6)	8 (1.4)	46 (100.0)	0.002	1.900
No	10 (43.5)	13 (56.5)	23 (100.0)		(1.170-3.084)
Environmental Sanitation					
Clean	39 (79.6)	10 (20.4)	49 (100.0)	0.011	1.769
Less	9 (45.0)	11 (55.0)	20 (100.0)		(1.068-2.930)
Hand Washing Habits Using Soap					
Often	44 (80.0)	44 (80.0)	55 (100.0)	0.000	2.800
Less	4 (28.6)	4 (28.6)	14 (100.0)		(1.210-6.477)

Table 2 shows that out of 44 infants born vaginally, 86.4% did not experience diarrhea. Whereas in 25 infants with caesarean birth, 60.0% experienced diarrhea. From the analysis test results obtained p = 0.000, which means there is a significant relationship between the method of birth with the occurrence of diarrhea at coverage areas of Puskesmas Warungasem, Batang Regency. Based on the table, the value of RP = 2.159 (CI 95% 1.317-3.539) was obtained, which means that caesarean birth is a risk factor for increasing the occurrence of diarrhea in infants, namely infants with caesarean birth have a risk of experiencing diarrhea 2.1 times higher than infants with vaginal birth. Of 46 infants with a history of exclusive breastfeeding, 82.6% did not experience diarrhea. Whereas in 23 infants with a history of not exclusive breastfeeding, 56.5% experienced diarrhea. From the analysis test results obtained p = 0.002, which means that there is a significant relationship between exclusive breastfeeding history and occurrence Based on the table, the value of RP = 1.900 (CI 95% 1.170-3.084) is obtained, which means that infants with a history of not exclusive breastfeeding are a risk factor that can increase the occurrence of diarrhea in infants, namely infants with a history of not exclusive breastfeeding have a 1.9 times higher risk of experiencing diarrhea when compared to infants who have a history of exclusive breastfeeding. Of 49 respondents who had clean environmental sanitation, 79.6% did not experience diarrhea. Whereas in 20 respondents who had less clean environmental sanitation, there were 55.0% experiencing the incidence of diarrhea. From the results of the analysis test obtained p = 0.011, which means there is a significant relationship between environmental sanitation and the incidence of diarrhea. Based on the table, the value of RP = 1.769 (CI 95% 1.068-2.930) means that environmental sanitation is a risk factor that can increase the occurrence of diarrhea in infants, namely infants with environmental sanitation that is less clean have a 1.8 times higher risk of experiencing diarrhea when

compared to infants who have clean environmental sanitation. Of 55 respondents with the habit of washing hands frequently using soap, 80.0% did not experience diarrhea. While 14 respondents had a habit of washing hands using soap less, 71.4% experienced diarrhea. Based on the analysis test obtained p = 0.000, which means there is a significant relationship between the habit of washing hands using soap with the occurrence of diarrhea. Based on the table, the value of RP = 2,800 (CI 95% 1,210-6,477) shows that the habit of washing hands using soap is a risk factor for increasing the occurrence of diarrhea in infants, namely respondents who have a habit of not washing hands using soap will have a 2.8 times higher risk of experiencing diarrhea in infants when matched with respondents who often wash their hands using soap.

Table 3. Multivariate Analysis

Variable	p	RP (CI 95%)
Birth Method	0.007	7.601 (1.774-33.134)
History of Exclusive Breastfeeding	0.004	10.891 (2.143-55.352)
Environmental Sanitation	0.391	2.225 (0.358-13.829
Hand Washing Habits Using Soap	0.024	11.555 (1.386-96.336)

Table 3 shows the results of the logistic regression test found that the variable of birth method has a p value = 0.007, meaning that the birth method of the infants has an influence on the occurrence of diarrhea in infants. Based on the table, the value of RP = 7.601 (CI 95% 1.774-33.134) shows that infants with caesarean birth have a 7.6 times higher chance of experiencing diarrhea in infants. Variable history of exclusive breastfeeding shows the results of the p value = 0.004, meaning that exclusive breastfeeding has an influence on the occurrence of diarrhea in infants. Based on the table, the value of RP = 10.891 (CI 95% 2.143-55.352) indicates that infants with a history of not exclusively breastfed have a 10.9 times higher chance of experiencing diarrhea in infants. Environmental sanitation variables do not affect the occurrence of diarrhea p = 0.391. Based on the table, the value of RP = 2.225 (CI 95% 0.358-13.829) indicates that the environmental sanitation of respondents is not a risk factor for the occurrence of diarrhea in infants. The variable of hand washing habits using soap has an influence on the occurrence of diarrhea in infants p = 0.024. The value of RP = 11.555 (CI 95% 1.386-96.336) indicates that respondents with a habit of washing hands using soap are 11.5 times less likely to experience infant diarrhea. The most influential variable on the occurrence of diarrhea in infants 6-12 months old at coverage areas of Puskesmas Warungasem, Batang Regency is the habit of washing hands using soap (p = 0.024).

DISCUSSION

Relationship between mode of birth and Diarrhea Occurrence Rate.

Based on the results of the study, there was a significant relationship between the mode of birth and the incidence of diarrhea. This study is not in line with research conducted by Askar, et al in 2020 in West Java with the results found that the effect of caesarean birth can protect infants from the occurrence of diarrhea. Askar, et al argue that this happens because infants with caesarean birth are not exposed to bacteria or viruses, especially such as *E.Coli* which is the main cause of diarrhea.[12]

This study is in line with the theory that explains if the way the baby is born will affect the development of microbiota in the gastrointestinal tract which will have an impact on the long-term health of the

baby.[9] The first major exposure of newborns to microbes occurs at birth and is influenced by the mode of birth. In infants with vaginal birth, the skin, nasopharynx, intestines, and oral cavity of newborns are inhabited by *Lactobacillus spp* which are similar to the mother's vagina. Whereas babies who are born by caesarean are dominated by a collection of *Streptococcus, Propionibacteria,* or *Staphylococcus*.[13] Babies with caesarean birth are more exposed to bacteria in the hospital environment or medical personnel who handle, so babies with this birth method have lower natural bacteria when compared to babies born vaginally. Caesarean-born babies also tend to have higher colonies of Escherichia coli and *Clostridium difficile*.[7] This can affect the long-term health of the baby. Infants with caesarean births are at higher risk of various diseases, one of which is diarrheal disease.[14]

Relationship between Exclusive Breastfeeding History and Diarrhea Occurrence Rate

Based on the results of the study, it was found that there was a significant relationship between exclusive breastfeeding history and the incidence of diarrhea. This study is in line with several previous studies which stated that there was a significant relationship between exclusive breastfeeding history and the incidence of diarrhea in Surabaya City,[3] Puskesmas Piyungan Yogyakarta,[15] Puskesmas Padang Bulan Medan,[16] and Jatinangor.[17] Arista's research explained that infants with exclusive breast milk intake were closely related to the incidence of diarrhea. The study stated that diarrhea experienced by infants with exclusive breast milk intake was not accompanied by dehydration.[15] Research by Rohmah, et al explained that exclusive breastfeeding is closely related to the level of maternal knowledge.[17]

Breast milk is a liquid that comes out and is produced by the mother's breast for her child.[18] It contains immunologic content that functions as an anti-microbial, such as SIgA, oligosaccharides, and bifidus factors. The high content of SIgA in breast milk has a role as a first-line antibody in the baby's body. In infants with a history of exclusive breastfeeding, SIgA levels can be found 3 times higher than in infants with formula milk consumption. SIgA can inhibit the attachment of pathogenic microbiota to the epithelial cells of the gastrointestinal tract by binding the pathogenic microbiota in the mucus so as to control the microbiota in the baby's gut.[14] SIgA contained in breast milk is not the same as antibodies in general, because SIgA contained in breast milk can fight pathogens without causing inflammation that can cause injury to healthy tissues.[19]

Infants with breast milk intake will have a higher dominance of Bifidobacterium colonies and lactic acid bacteria compared to infants with formula milk intake. This dominance is influenced by the composition of breast milk which is high in bifidogenic factors, such as oligosaccharides. Oligosaccharides are carbohydrates that can promote Bifidobacterium and are the most nutritional component after lactose and fat.[7,14] Bifidobacterium are microbiota contained in breast milk that dominate the gastrointestinal microbiota of infants who are exclusively breastfed and can affect the health of infants in the future. Growth factors contained in breast milk can increase the colonization of healthy microbiota that can inhibit the attachment of pathogenic microbiota in the gastrointestinal tract. Thus, the baby's gastrointestinal tract, which is dominated by a collection of healthy microbiota, will have better resistance so that it can prevent the baby from being infected with a disease, such as diarrhea.[10] However,

there are some mothers who choose to be reluctant to provide exclusive breast milk intake to their babies. Factors causing mothers not to provide breast milk intake until the age of 6 months include inexperienced mothers, maternal age, lack of family support, lack of knowledge and attitudes, socio-cultural factors, and maternal nutritional status.[20]

Relationship between Environmental Sanitation and Diarrhea Occurrence Rate

Based on the results, there was a significant relationship between environmental sanitation and the occurrence of diarrhea at coverage areas of Puskesmas Warungasem, Batang Regency. This study is in line with previous research conducted at Puskesmas Bahu Manado,[21] and Sidorejo Village, Puskesmas Sering Medan North Sumatra Province.[22]

Basic environmental sanitation includes the availability of clean water sources, the availability of landfills, disposal of human feces, and wastewater management.[11] According to research conducted by Shanty Annisa in 2014, the results of the unavailability of clean water facilities for respondents resulted in 4.92 times higher infants experiencing diarrhea. Good water is water that is free from pathogens and cooked to boiling (at 1000C) and meets the requirements of clean water.[23] Based on the Minister of Health Regulation No. 32 of 2017 states that healthy drinking water must meet biological, physical, and chemical requirements. These requirements include water that is not cloudy, tasteless, colorless, does not contain toxic chemical compounds, neutral pH and does not contain pathogenic bacteria, such as E. Coli.[24]

Wastewater discharge is a factor that can cause water pollution if discharged without management into a body of water. This wastewater can cause disease if living things consume it because it contains toxic substances that are bad for health, and if the management is not good, it causes insect nests that can cause disease, (such as cockroaches, flies, mosquitoes, and others). Good wastewater disposal must meet several requirements such as not polluting clean water sources, not causing odors, not becoming a nest for mosquitoes and other insects, and at least disposing of waste 11 m from clean water sources.[11,25]

Waste disposal facilities are closely related to human health, this happens because in piles of garbage can be a place of life for various microorganisms that can cause disease, in addition there are vectors that can spread disease. Piles of garbage when stockpiled will be used as a nest for rats and flies, these animals can cause various stomach diseases, such as diarrhea. There are several requirements for a good landfill, namely coming from materials that can be cleaned easily, are not easily damaged, and are watertight, there is a lid that is easy to open, clean and empty its contents and it is highly recommended if the trash can has a lid so that it is easy to open and close without hands coming into direct contact with the trash can, and the trash can is easily carried by one person.[11]

Latrine facilities are closely related to human health because if the disposal of feces is not good, it will lead to the spread of diseases originating from human feces, such as dysentery, diarrhea, cholera, hepatitis A and others that can be caused by the absence of latrine facilities in accordance with health requirements. According to the Indonesian Ministry of Health in 2004, latrines that are said to be healthy have conditions, namely gooseneck type latrines, privately owned latrines, easy to clean and feces cannot be touched by rats or insects.[11]

According to Notoadmojo, the requirements for a healthy house are a house with a type of floor that is

impermeable to water, and is often cleaned because floors that are rarely cleaned will cause the transmission of diseases such as diarrhea to its inhabitants.[11] From the results of observations and questionnaires, it was found that most infants with diarrhea had poor environmental sanitation, including the unavailability of privately owned clean water, the source of water used for daily needs is not sourced from protected water, the water used smells and is colored / cloudy, the unavailability of family latrines, the latrines used have not used goose neck latrines, and are rarely cleaned, the floors of the house are rarely cleaned, the unavailability of landfills, landfills that are rarely cleaned, waste disposal sites that are not closed and close to the house.

Relationship between Handwashing Using Soap with the Diarrhea Occurrence Rate

Based on the results obtained, there is a significant relationship between the habit of washing hands using soap with the occurrence diarrhea Similar research has been conducted in Serdang Bedagai Regency and Puskesmas Sekardangan, Sidoarjo Regency with the results obtained a significant relationship between the habit of washing hands using soap with the incidence of diarrhea.[11,26] Handayani's research explained that some mothers did not apply hand washing using soap properly, such as not rubbing between fingers and nails. This behavior occurs because many mothers do not understand that the use of soap alone is not enough to clean the germs attached to the hands.[11]

Handwashing with clean water and soap is important because the part of the body that most often spreads infection is the hands. When hands touch one's own body parts, other people's body parts, animal bodies and other contaminated objects or surfaces, there can be a dangerous spread of infection. The clean behavior of washing hands with soap is a very effective prevention of the spread of various infectious diseases such as diarrhea and ARI.[11]

From the results obtained, the majority of samples who experienced diarrhea had a habit of not washing their hands with soap before eating, before preparing food, before breastfeeding the baby, after coughing and cleaning the nose, and after the child played on the ground or floor.

Multivariate Analysis

This study found that the habit of washing hands using soap is the most influential risk factor for the occurrence of diarrhea in infants 6-12 months old, because it can increase the occurrence of diarrhea by 11.5 times higher in infants aged 6-12 months. This study is in line with research conducted by Italy in 2016, Italy explained that the habit of washing hands with soap increased the incidence of diarrhea by 5.9 times higher in infants.[27]

REFERENCES

1. Hartono T. Profil mikroba usus pada anak usia 2-12 tahun dengan diare dan non diare di Jakarta Utara. 2014; 1–56.
2. Kemenkes. Morbiditas dan mortalitas diare pada balita di Indonesia tahun 2000-2007. *Bul Jendela Data dan Inf Kesehat* 2011; 2: 26–32.
3. Analinta A. Hubungan antara pemberian ASI Eksklusif dengan kejadian diare pada balita di Kelurahan Ampel, Kecamatan Semampir, Kota Surabaya 2017. 2019; 13–17.
4. Ragil D, Dyah Y. Hubungan antara pengetahuan dan kebiasaan mencuci tangan pengasuh dengan kejadian diare pada balita di Kelurahan Bandarharjo. *J Heal Educ* 2017; 2: 39–46.

5. Bakri Z, Hatta M, Massi MN. Deteksi keberadaan bakteri Escherichia coli O157:H7 pada feses penderita diare dengan metode kultur dan PCR. *JST Kesehat* 2015; 5: 184–192.
6. Sukut S, Arif Y, Qur'aniati N. Faktor kejadian diare pada balita dengan pendekatan teori Nola J. Pender di IGD RSUD Ruteng. *J Pediomaternal* 2015; 3: 230–249.
7. Kusumo PD. Kolonisasi mikrobiota normal dan pengaruhnya pada perkembangan sistem imunitas neonatal. *Widya Kedokt* 2012; 29: 55–63.
8. Hasibuan FEB, Kolondam BJ. Interaksi antara mikrobiota usus dan sistem kekebalan tubuh manusia. *J Ilm Sains* 2017; 17: 35.
9. Francino MP. Birth mode-related differences in gut microbiota colonization and immune system development. 2018; 73: 12–16.
10. Ranuh R, Hegar B. Bifidobakterium dan kesehatan saluran cerna anak. *Sari Pediatr* 2020; 22: 190.
11. Handayani A. Hubungan personal hygiene dan sanitasi lingkungan dengan kejadian diare pada balita di Kabupaten Serdang Bedagai 2021. *Tesis* 2021; 142.
12. Askar NF, Wirakusumah FF, L.T MD, et al. Pengaruh jenis persalinan bedah sesar terhadap kejadian diare dan ISPA pada bayi. *J Kesehat Vokasional* 2020; 5: 224–231.
13. Widodo AD, Juffrie M. Caesarean section and gut microbiota in children. *World Nutr J* 2020; 4: 8.
14. Hegar B. Kesehatan saluran cerna pada awal kehidupan untuk kesehatan pada masa mendatang. *eJournal Kedokt Indones*; 5. Epub ahead of print 2017. DOI: 10.23886/ejki.5.8339.
15. Arista T, Nuzuliana R. Hubungan pemberian ASI Eksklusif dengan kejadian diare pada bayi umur 6-12 bulan di Puskesmas Piyungan. *Universitas Aisyah Yogyakarta*, http://digilib.unisayogya.ac.id/2599/1/tutik arista naskah publikasi.pdf (2017, accessed 5 July 2022).
16. Singh MKG, Lubis M. Relationship between breastfeeding and the incidence of diarrhoea in children aged 6-24 months. *Indones J Med Heal* 2018; 9: 108–114.
17. Rohmah H, Hafsah T, Rakhmilla L. Role of exclusive breastfeeding in preventing diarrhoea. *Althea Med J* 2015; 2: 78–81.
18. Yusrina A, Devy SR. Faktor yang mempengaruhi niat ibu memberikan ASI Eksklusif di Kelurahan Magersari, Sidoarjo. *J Promkes* 2017; 4: 11.
19. Wijayanti W. Hubungan antara pemberian ASI Eksklusif dengan angka kejadian diare pada bayi umur 0-6 bulan di Puskesmas Gilingan Kecamatan Banjarsari Surakarta. *Universitas Sebelas Maret*, https://core.ac.uk/download/pdf/12345193.pdf (2010, accessed 5 July 2022).
20. Umami W, Margawati A. Faktor-faktor yang mempengaruhi pemberian ASI Eksklusif. *J Kedokt Diponegoro* 2018; 7: 1720–1730.
21. Tambuwun F, Ismanto A, Silolonga W. Hubungan sanitasi lingkungan dengan kejadian diare pada anak usia sekolah di wilayah kerja Puskesmas Bahu Manado. *e-Journal Keperawatan (e-Kp)*; 3.
22. Hastia S, Ginting T. Hubungan sanitasi lingkungan dan personal hygiene ibu dengan kejadian diare pada balita di Kelurahan Sidorejo Puskemas Sering Kota Medan. *J Prima Med Sains* 2019; 1: 12–17.
23. Sarudji D. *Kesehatan lingkungan*. Jakarta: Karya Putra Darwati, 2010.
24. Kementerian KI. Peraturan Menteri Kesehatan Nomor 32 Tahun 2017

tentang standar baku mutu kesehatan lingkungan dan persyaratan air untuk keperluan higiene sanitasi, kolam renang, solus per aqua, dan pemandian umum.

25. Kementerian Pekerjaan Umum dan Perumahan Rakyat. Panduan pembangunan perumahan dan permukiman perdesaan:Dasar-dasar rumah sehat.
26. Rohmah N, Syahrul F. Hubungan kebiasaan cuci tangan dan penggunaan jamban sehat dengan kejadian diare balita. *J Berk Epidemiol* 2017; 5: 95–106.