

## ORIGINAL ARTICLE

## MODELLING OF MITIGATING DIARRHOEA IN THE WETLAND AREA OF BANYUASIN DISTRICT, INDONESIA: A CROSS-SECTIONAL STUDY

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## ABSTRACT

Diarrhoea is one of the causes of high morbidity and mortality rates in developing countries that have poor environmental sanitation, inadequate water supply, high poverty rates and low levels of education. The purpose of this study was to examine diarrhoea control models in toddlers of Banyuasin District wetlands. This study used a cross-sectional study design. The study was conducted in the wetland area of Banyuasin District with a sample of 296 respondents. Data analysis was performed in univariate, bivariate and multivariate. The results showed that there was a correlation between chemical indicators (p-value = 0.035), latrine sanitation (p-value = 0.004), latrine quality (p-value = 0.005), income (p-value = 0.023), and hand washing with soap (p-value = 0.035) with the occurrence of diarrhoea in toddlers of Banyuasin District wetlands area. 51.9% of diarrhoea prevention can be explained by the water factor (19.7%), sanitation factor (15.6%), personal hygiene factor (8.2%), toddler factor (4.8%) and mother factor (3.5%) in this study. Improvements of environmental sanitation related to healthy latrines, rubbish bins, sewerage and clean / drinking water sources, as well as intensive education about personal hygiene and breastfeeding toddlers can contribute in reducing the occurrence of diarrhoea in toddlers.

**Keywords:** Diarrhoea, Water source, Latrine sanitation, Sewerage sanitation

## INTRODUCTION

Diarrhoeal disease is the second leading cause of death in children under five years old, and is responsible for killing around 525 000 children every year. Diarrhoea can last several days, and can leave the body without the water and salts that are necessary for survival (WHO, 2007)

Indonesia is the largest archipelago in the world among countries with wetlands include a large number of rivers, stretches along the coastline, and the distribution of narrow and wide lakes both on large and small islands. It essential needs to preserve wetlands where its area of wetlands reaches up to 40 million ha (Wetlands International, 2009). Wetland areas have characteristics of tidal swamps where the amount of water content is always changing due to the influence of tides. The number of people who live in Banyuasin Districts is also quite a lot with activities such as bathing, washing, defecating and other activities carried out around rivers and swamps. This can make the water source polluted so that when they use it, it can be a source of disease, especially diarrhoea.

During the dry season, the amount of domestic water is not sufficient for daily needs. Diarrhoea is the most waterborne disease in the wetland region. Previous research stated that the

occurrence rate of diarrhoea cases was highest in 2011, which was occupied by people living in the wetland environment. The pattern of distribution of diarrhoea cases according to place in the wetland area fluctuates with the highest case is 1.71%, also the pattern of distribution according shows that female is more affected by diarrhoea than male (Dinas Kesehatan Banyuasin, 2015).

Infectious diseases in Indonesia that spread through water become a priority health problem for the population, where morbidity and mortality rates occur in a short time. Transmission of this disease spreads along with human activities, such as climate change, dam construction, settlement construction, and logging. Based on research conducted by Ekawati (2014), regarding patterns of spread of waterborne diseases and their correlation with environmental sanitation in the wetlands area of Telang, Banyuasin District. It showed that the largest domestic source used by the community in the environment around the wetlands is pool water (37,14%), and rainwater (43.33%).

The major risk factors that have significance in the occurrence of diarrhoeal diseases in wetlands areas included healthy homes (OR:2,75 times), sanitation (OR: 2,76 times) and availability of water (OR: 3,46 times).

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Diarrhoea is one of the causes of high morbidity and mortality rates in developing countries that have poor environmental sanitation, inadequate water supply, high poverty rates and low levels of education. Diarrhoea has become a public health problem especially in unhygienic environments or slums, poor water quality, sanitation and living conditions (Woldemicael, 2001). Clean water drinking water sources that are not sanitary can be a medium for the transmission of diseases called waterborne disease. The distance of drinking water sources with toilets, waste collection points, sewage and other sources of impurities must be considered so that the source of drinking water is sanitary. Water quality can decrease due to household waste, both liquid and solid waste. Clean water quality standards such as odour, total dissolved solids (TDS), color, iron, chloride, manganese, pH and others are regulated in the standard of clean water quality Permenkes RI No.416 / Menkes / Per / IX / 1990 (Peraturan Menteri Kesehatan, 2010).

Acute diarrhoea is more than 90% caused by infectious agents that will be accompanied by fever, vomiting, as well as abdominal pain. The remaining 10% is caused by medication intoxication, ischemia and other conditions. The cause of acute diarrhoea is different from the common causes of chronic diarrhoea caused by non-infectious causes such as allergies or other things. The causes of diarrhoea disease consisted of *Escherichia coli* (20-30%), Rotavirus (40-60%), *Entamoeba histolytic* (<1%) and *Shigella sp.* (1-2%) (Ahlquist and Camilleri, 2005).

It is known that most children with acute diarrhoea due to Blastocystic Hominis infection are in the 1-3 years age group. Rotavirus can be transmitted oro-fecally through contact, water, and air (Mona, Manoppo and Wilar, 2015). Water contained a number of bacteria with a prevalence of diarrhoea states that there is only a slight difference in children who consume water containing *E. coli* (<1/100 ml) and 2 - 100 *E. coli* / 100 ml. However, when compared with children who consume water with an *E. coli* content > 1000/100 ml, the ratio is more significant (9% versus 15%;  $p = 0.002$ ) (Moe, 1991). Lack of management of diarrhoea treatment, unhygienic food, food storage that is not cold enough, food contaminated with flies and contaminated drinking water. The risk factors for diarrhoea sufferers include stomach acid, personal hygiene, age and other obstacles, such as immunity, enteric microflora, intestinal motility and intestinal receptors (Yalew, 2014).

Diarrhoea results in malnutrition and stunted growth if the acute diarrhoea occurs (Mitra, 2002). One of the efforts to minimize the risk of being infected with diarrhoea is by improving hygiene and providing clean water to avoid the contamination of disease-causing agents. The community can make other efforts by boiling drinking water first so that the main agent causing the disease contained in the water dies (Madhi, 2010). Some of the interventions carried out include nutrition education, the use of oral rehydration salt, salt sugar solutions, or liquids available at home (Pahwa, Kumar and Toteja, 2010).

The 2009 Integrated Health Surveillance Data (STP) at the Puskesmas showed that 56.2% of toddlers were sick in South Sumatra due to diarrhoea. South Sumatra is a province whose territory is inseparable from wetlands, one of them is because of the many areas that are passed by rivers flows. Tanjung Lago Village and Gasing Village are wetland areas in Banyuasin Districts, South Sumatra Province. The risk factors in the occurrence of diarrhoea in toddlers in the wetlands area is the base to produce the diarrhoea control model for toddlers in the wetlands. Based on the data it is important to conduct a research about Modelling of Mitigating Diarrhoea in Wetland Area of Banyuasin District, Indonesia

## METHODS

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This research was a quantitative study using cross-sectional studies. The study was conducted in the wetlands of Banyuasin Districts, South Sumatra in April-December 2018. The sample of this study was 296 respondents with a 95% confidence interval by using cluster random sampling. Data were collected using a questionnaire and observation sheet. Physical, chemical and microbiological water indicator variables were carried out through laboratory tests based on the Republic of Indonesia Ministerial Regulation No. 416 / Menkes / Per / IX / 1990. Agent factor data was collected as a case study of 15 toddlers with diarrhoea. Data analysis in this study was carried out by univariate, bivariate and multivariate analysis.

## RESULTS

### *Respondents/Toddlers' Characteristics*

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The following Table 1 shows the characteristics of the respondents or toddlers in this study based on environmental and host factors:

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**Table 1a: Characteristics of the respondents**

Variable	Total	
	Frequency (n)	Percentage (%)
<b>Environmental Factor</b>		
<b>Water Physical Indicator</b>		
Inadequate	0	0
Adequate	296	100
<b>Water Chemical Indicator</b>		
Inadequate	221	74,7
Adequate	75	25,3
<b>Water Microbiological Indicator</b>		
Inadequate	54	18,2
Adequate	242	81,8
<b>Water Source</b>		
Inadequate	264	89,2
Adequate	32	10,8
<b>Drinking Water Source</b>		
Inadequate	106	35,8
Adequate	190	64,2
<b>Quality of clean water facility</b>		
Inadequate	285	96,3
Adequate	11	3,7
<b>Water source condition</b>		
Inadequate	290	98,0
Adequate	6	2,0
<b>Latrine Sanitation</b>		
Inadequate	120	40,5
Adequate	176	59,5
<b>Latrine Quality</b>		
Inadequate	75	25,3
Adequate	221	74,7
<b>Waste Bin Sanitation</b>		
Inadequate	290	98,0
Adequate	6	2,0
<b>Sewage Sanitation</b>		
Inadequate	258	87,2
Adequate	38	12,8
<b>Host Factor</b>		
<b>Income</b>		
Low (Below standard)	172	58,1
High (≥Standard)	124	41,9
<b>Family Members</b>		
Risky (more than 4 people)	125	42,2
Not risky (less than 4 people)	171	57,8
<b>Family Composition</b>		
Risky (more than 1 Head of family)	209	70,6
Not risky (only one head of the family)	87	29,4
<b>Education</b>		
Low (Highschool and lower)	292	98,6
High (University graduate)	4	1,4
<b>Occupation</b>		
Not working	29	9,8
Working	267	90,2
<b>Knowledge</b>		
Low	148	50,0
High	148	50,0
<b>Mother's Personal Hygiene</b>		
Low	67	22,6
High	229	77,4

**Table 1b: Characteristics of the respondents**

<b>Hand Washing with Soap</b>		
Bad	59	19,9
Good	237	80,1
<b>Defecation Habit</b>		
Bad	21	7,1
Good	275	92,9
<b>Toddler's Gender</b>		
Female	138	46,6
Male	158	53,4
<b>Toddler's Age</b>		
<= 2 years old	173	58,4
>2 years old	123	41,6
<b>Breastfeeding while suffering diarrhoea</b>		
Not breastfeeding	9	3,0
Breastfeeding	287	97,0
<b>Breastfeeding History</b>		
< 2 years	85	28,7
Exactly 2 years	189	63,9
>2 years	22	7,4
<b>Toddler's Personal Hygiene</b>		
Low	119	40,2
High	177	59,8
<b>Toddler's utensils sanitation</b>		
Low	165	55,7
High	131	44,3
<b>Toddler's supplementary food</b>		
Yes	269	90,9
No	27	9,1

Based on Table 1 above, some characteristics of the respondents meet the requirements such as physical water indicators (100%) and microbiology of water (more than 81%), at-risk family composition (above 70%), sanitary utensils for toddlers (55%) and mother's education which is around 98% of high school and below, percentage of good and bad knowledge (50% each). Majority of mothers has good personal hygiene, still

breastfeeding when toddlers have diarrhoea . Toddler's personal hygiene was generally good.

*Risk Factors for Diarrhoea in Toddlers*

Table 2 below shows the research correlation analysis variables with the occurrence of diarrhoea in toddlers:

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**Table 2: Risk factors of Occurrence of Diarrhoea in Toddlers**

Variable	Diarrhoea Occurrence				Total N	P- Value	PR CI 95%
	Yes		No				
	N	%	N	%			
<b>Environmental factors</b>							
<b>Physical Indicator</b>							
Inadequate	-	-	-	-	-	-	-
Adequate	63	21,3	233	78,7	296		
<b>Chemical Indicator</b>							
Inadequate	54	24,4	167	75,6	221	0,035	2,036 (1,057 - 3,921)
Adequate	9	12	66	88	75		
<b>Microbiological Indicator</b>							
Inadequate	8	14,8	46	85,2	54	0,271	0,652 (0,330 - 1,287)
Adequate	55	22,7	187	77,3	242		
<b>Water Source</b>							
Inadequate	53	20,1	211	79,9	264	0,219	0,642 (0,364 - 1,133)
Adequate	10	31,3	22	68,8	32		



Table 2b: Risk factors of Occurrence of Diarrhoea in Toddlers

<b>Drinking Water Source</b>							
Inadequate	23	21,7	83	78,3	106	1	1,031
Adequate	40	21,2	150	78,9	190		(0,654 - 1,624)
<b>Quality of Clean Water Facility</b>							
Inadequate	60	21,2	225	78,9	285	0,706*	0,772
Adequate	3	27,3	8	72,7	11		(0,287 - 2,079)
<b>Water Source Condition</b>							
Inadequate	61	21	229	79	290	0,611*	0,631
Adequate	2	33,3	4	66,7	6		(0,199 -2)
<b>Latrine Sanitation</b>							
Inadequate	36	30	84	70	120	0,004	1,956
Adequate	27	15,3	149	84,7	176		(1,257 - 3,042)
<b>Latrine Quality</b>							
Inadequate	25	33,3	50	66,7	75	0,005	1,939
Adequate	38	17,2	183	82,8	221		(1,259 - 2,984)
<b>Waste Sanitation</b>							
Inadequate	63	21,7	227	78,3	290	0,348*	-
Adequate	0	0	6	100	6		
<b>Sewerage Sanitation</b>							
Inadequate	58	22,5	200	77,5	258	0,272*	1,709
Adequate	5	13,2	33	86,8	38		(0,732 - 3,988)
<b>Host factor</b>							
<b>Income</b>							
Below Standard	45	26,2	127	73,8	172	0,023	1,802
Above Standard	18	14,5	106	85,5	124		(1,098 - 2,958)
<b>Family Members</b>							
More than 4 people	22	17,6	103	82,4	125	0,238	0,734
Less than 4 people	41	24	130	76	171		(0,462 - 1,167)
<b>Family Composition</b>							
Risky (>1 head of family)	41	19,6	168	80,4	209	0,352	0,776
Not Risky (1 head of family)	22	25,3	65	74,7	87		(0,493 -1,221)
<b>Education</b>							
Low	63	21,6	229	78,4	292	0,582*	-
High	0	0	4	100	4		
<b>Occupation</b>							
Not working	5	17,2	24	82,8	29	0,748*	0,794
Working	58	21,7	209	78,3	267		(0,346 - 1,819)
<b>Knowledge</b>							
Low	26	17,6	122	82,4	148	0,156	0,703
High	37	25	111	75	148		(0,449 - 1,099)
<b>Mother's Personal Hygiene</b>							
Low	12	17,9	55	82,1	67	0,550	0,804
High	51	22,3	178	77,7	229		(0,456 - 1,418)
<b>Hand washing with soap</b>							
Bad	19	32,2	40	67,8	59	0,035	1,735
Good	44	18,6	193	81,4	237		(1,099 - 2,737)
<b>Defecation Habit</b>							
Bad	7	33,3	14	66,7	21	0,171*	1,637
Good	56	20,4	219	79,6	275		(0,856 - 3,131)
<b>Gender</b>							
Female	29	21	109	79	138	1	0,977
Male	34	21,5	124	78,5	158		(0,629 - 1,516)
<b>Toddler's Age</b>							
≤ 2 years old	38	22	135	78	173	0,845	1,081
>2 years old	25	20,3	98	79,7	123		(0,690 - 1,693)
<b>Breastfeeding Status</b>							
Not breastfeeding while diarrhoea	1	11,1	8	88,9	9	0,690*	0,514
Breastfeeding while diarrhoea	62	21,6	225	78,4	287		(0,080 - 3,307)

**Table 2c: Risk factors of Occurrence of Diarrhoea in Toddlers**

Breastfeeding History							
< 2 years	24	28,2	61	71,8	85	0,343	0,565 (0,173- 1,842)
Exactly 2 years	35	18,5	154	81,5	189	0,969	0,978 (0,311 - 3,069)
>2 years	4	18,2	18	81,8	22		Reference
Toddler's Personal Hygiene							
Low	23	19,3	96	80,7	119	0,597*	0,855 (0,541 - 1,351)
High	40	22,6	137	77,4	177		
Eating Utensils Sanitation							
Low	31	18,8	134	81,2	165	0,301	0,769 (0,497 - 1,191)
High	32	24,4	99	75,6	131		
Toddler's Supplementary Food							
Yes	59	21,9	210	78,1	269	0,539*	1,480 (0,583 - 3,760)
No	4	14,8	23	85,2	27		

\*Alternatives Test: Fisher Exact Test

Based on Table 2 it is found that the variables that have a correlation with the occurrence of diarrhoea are chemical water indicators, latrine sanitation, latrine quality, income and handwashing with soap. Respondents with water chemical indicators that do not meet the requirements are two times more likely to experience diarrhoea than respondents with water chemical indicators that meet the requirements (PR 2.036; 95% CI = 1.057 - 3.921). Respondents with latrine sanitation who did not meet the requirements were twice as likely to have diarrhoea compared to respondents who met toilet sanitation requirements (PR 1.956; 95% CI = 1.257 - 3.042). Respondents with latrine quality who did not meet the requirements were twice as likely to suffer from diarrhoea compared to respondents with qualified toilet quality (PR 1, 939; 95% CI = 1,259 - 2,984). Respondents with income below the minimum wage are 1.8 times more likely to have diarrhoea than respondents with an income above the UMR (PR 1, 802; 95% CI = 1,098 - 2,958). Respondents with bad handwashing habit were 1.7 times more likely to have diarrhoea than respondents with good CTPS (PR 1,735; 95% CI = 1,099 - 2,737)

**Explanatory Factor Analysis**

In the next stage, a factor analysis using an explanatory factor analysis approach is carried out on each latent variable in the diarrhoea

prevention model in the framework of the research concept. The variables are the environment variable and the host variable. Factor analysis aims to analyze the contribution of each factor in the diarrhoea prevention model. The following table 3 shows the contribution of factors in the diarrhoea prevention model in this study.

Based on the results of Table 3, it was found that the indicator with the greatest correlation was toddler's personal hygiene (coefficient 0.850) and the indicator with the lowest correlation was eating utensil's sanitation (coefficient 0.121). The matrix component is obtained to find out the measurement indicators and factor pairs. There are five factors in forming diarrhoea prevention models where 2 factors form environmental variables and three factors form host variables. The total variance of the diarrhoea prevention model that can be explained by the five factors formed is 51.9%. This means that existing factors can explain 51.9% of diarrhoea prevention and the rest is explained by other factors not included in the analysis. 51.9% of the total variance can be explained by five factors: factor 1 (19.7%), factor 2 (15.6%), factor 3 (8.2%), factor 4 (4.8%) and factor 5 (3.5%). In this factor analysis, the diarrhoea prevention model can be seen in the following path diagram that illustrates the correlation between latent variables.

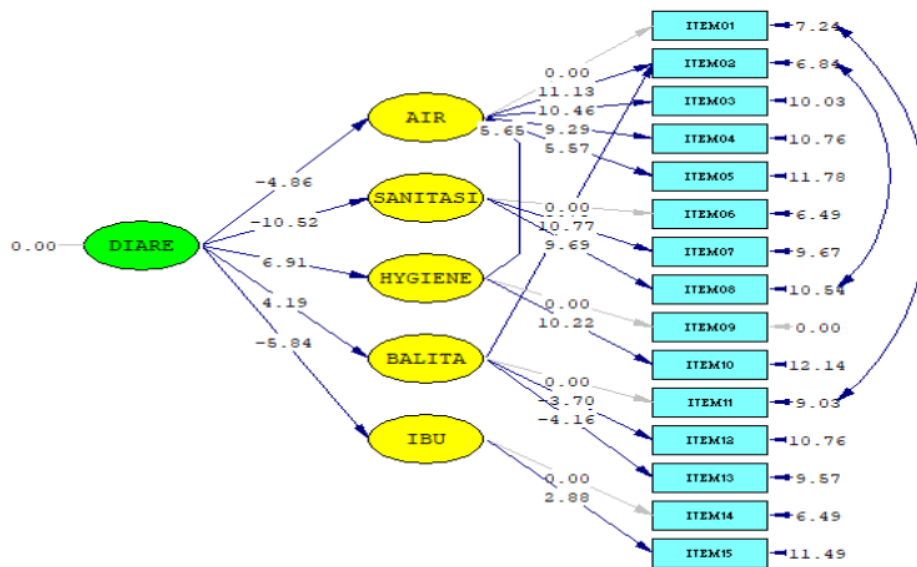
**Table 3a:Contribution of factors in the diarrhoea prevention model**

Code	Measurement Indicators	Factors	Communalities	Matrix Components	Variance Explained	Total Variance Explained
<b>19</b>	<b>Factor 1 (Water):</b>	<b>Environment</b>				
Item 01	1. Clean water source quality		0,687	0,822	19,7%	35,4%
Item 02	2. Clean water source		0,414	0,643		
Item 03	3. Sewerage		0,404	0,618		
Item 04	4. Waste Sanitation		0,332	0,573		
Item 05	5. Water Chemical Indicator		0,136	0,368		

Table 3b: Contribution of factors in the diarrhoea prevention model

Factor 2 (Sanitation):				15,6%	
Item 06	6. Latrine sanitation	0,731	0,882		
Item 07	7. Latrine quality	0,172	0,659		
Item 08	8. Drinking water source	0,426	0,531		
Factor 3 (Personal Hygiene):		Host		8,2%	16,5%
Item 09	9. Mother's personal hygiene	0,329	0,556		
Item 10	10. Toddler's personal hygiene	0,850	0,917		
Factor 4 (Balita):				4,8%	
Item 11	11. Breastfeeding history	0,295	0,514		
Item 12	12. Age	0,189	0,433		
Item 13	13. Supplementary food	0,132	-0,354		
Factor 5 (Ibu):				3,5%	
Item 14	14. Utensils sanitary	0,121	0,332		
Item 15	15. Defecation habit	0,141	0,318		

Table 3. Factor Loadings, Communality dan Total Variance Explained Value



Chi-Square=119.00, df=82, P-value=0.00477, RMSEA=0.039

## Information:

- Item 01 = Clean water source quality
- Item 02 = Clean water source
- Item 03 = Sewerage
- Item 04 = Waste sanitation
- Item 05 = Water chemical indicator
- Item 07 = Latrine quality
- Item 08 = Drinking water source
- Item 09 = Mother's Personal hygiene
- Item 10 = Toddler's Personal hygiene
- Item 11 = Breastfeeding history
- Item 12 = Toddler's age
- Item 13 = Utensil's sanitation
- Item 15 = Defecation habit

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 Based on the results of the analysis above, it is known that all significant coefficients ( $|t \text{ value}| > 1.96$ ) are variable coefficients of the quality of clean water sources, clean water sources, sewerage, garbage sanitation, water chemical indicators, latrine sanitation, latrine quality, drinking water sources, maternal personal hygiene, toddler personal hygiene, breastfeeding history, toddler age, supplement food, utensil's sanitation and defecation behavior. After identification of the initial model, the model of prevention of diarrhoea prevention is carried out based on the results of the correlation in path diagram. The results show that there is a correlation between hygiene factors and water factors, as well as the correlation between clean water sources and toddlers. The results of respecification showed a significant correlation between these factors ( $|t \text{ value}| > 1.96$ ).

*Agent Factor*

Diarrhoea can also occur due to factors such as viruses, bacteria or protozoa that attack the host.

**Table 4. Toddler's Diarrhoea Cases Agent Factor**

Village	AGENT FACTOR								Total
	Diagnosis								
	Cholera		Virus		Salmonella		Bacteria		
	N	%	N	%	n	%	N	%	
Tanjung Lago	1	33,3	2	66,7	0	0	0	0	3
Gasing	0	0	7	58,3	3	25	2	16,7	12
<b>Total</b>	<b>1</b>	<b>6,7</b>	<b>9</b>	<b>60</b>	<b>3</b>	<b>20</b>	<b>2</b>	<b>13,3</b>	<b>15</b>

The existence of these agents can be identified through the results of laboratory examinations of patients' feces or identification of clinical symptoms of diarrhoea in patients. Identification of the presence of agents that cause diarrhoea can be done if the respondent visits the clinic or still shows clinical symptoms of diarrhoea. In this study there were 63 cases of diarrhoea out of a total of 296 respondents or in other words the proportion of toddlers who had diarrhoea was 21.3%. A total of 15 respondents from 63 cases of diarrhoea were diagnosed using a diarrhoea clinical identification questionnaire. The following table illustrates the factor agent of the diarrhoea cases. The diagnosis shows that about 50% of the occurrence of toddler diarrhoea diagnosed in both Tanjung Lago and Gasing villages is caused by a virus. About 60% of diarrhoea in toddlers are caused by virus, 20% by salmonella, 13.3% by bacteria and 6.7% by cholera.

**DISCUSSION**

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 The results of the study reported that the proportion of toddlers with diarrhoea was almost a quarter of the number of respondents, reaching 21.3%. The figure is still relatively high because when compared to the Health Profile of Banyuasin Districts in 2016 the number of cases of diarrhoea at all ages in Banyuasin Districts in 2016 were 23,394 cases or with an Occurrence Rate of 28.4% (for all ages).

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 Indonesia is a developing country in the Southeast Asia region with the highest occurrence of diarrhoea. Based on a report from the Ministry of Health of the Republic of Indonesia in 2011, diarrhoeal disease became an endemic disease and a potential extraordinary event which was the leading cause of death in toddlers in Indonesia. The biggest proportion of diarrhoea sufferers in toddlers is the age group of 6-11 months with 21.65%, the age group of 12-17 months with 14.43%, the age group of 24-29 months with 12.37%, while the smallest proportion in the age group 54 - 59 months with 2.06% (Ministry of Health, 2011).

Laboratory examination results for water sources show that all water sources meet the physical requirements in terms of colour, odour, turbidity, taste, temperature and total dissolved solids. According to Rao and Mamata (2004), fresh water can indicate the presence of various substances that can be harmful to health. Metallic / fishy taste, bitter taste, salty taste, and so on. The effect depends also on the cause of the like. The presence of substances causes changes in water physics and beyond the threshold can be dangerous to health. Laboratory results show that around more than 70% of water sources do not meet chemical requirements because the pH of the water is outside the normal pH range for an ideal water source. Water is an excellent solvent so if it is assisted with a pH that is not neutral it can dissolve various chemical elements in its path (Soemirat, 2009). There is a positive correlation between E. coli content in clean water samples with diarrhoea and dysentery. However, the correlation is weak and the risk of diarrhoea does not increase progressively with an increase in E. coli content in clean water (Brown, Proum and Sobsey, 2008).



Around 40% of respondents in the Banyuasin District wetlands do not yet have sanitary latrines and around 25% of latrine quality does not meet health requirements. This study is in line with research conducted by Godana in Southern Ethiopia, the results show that latrine ownership (not having a latrine or owning an inadequate latrine) is twice as risky for diarrhoea (Godana, 2013). This can affect the occurrence of diarrhoea in toddlers in the Banyuasin Districts wetlands.

Most respondents in the Banyuasin District wetlands area still do not have waste disposals and sanitary sewerage. Research conducted by Eralita (2011) in Palangkaraya showed a correlation between sewer facilities availability and diarrhoea occurrence in toddlers. Muhajirin (2007) in Cilacap Districts and Eralita (2011) in Palangkaraya City, showed a correlation between the availability of solid waste collection and the occurrence of diarrhoea in toddlers.

Based on the data in Table 2, around 41% of respondents still have an income below the minimum wage. Maidartati's research (2017) shows that there is a significant correlation between parental income factors and the occurrence of diarrhoea in toddlers at Babakansari Health Center in Bandung City with a p-value (0.038). Economic factors are factors that indirectly cause the occurrence of diarrhoea in toddlers. Income is one of the determinants of fulfilling the level of food diversity, families with sufficient income will increase purchasing power of food and food diversity will be fulfilled. Besides, the adequate income also affects the ability of families to access health facilities.

The results found that respondents' knowledge related to diarrhoea is still relatively low. Several studies also support that mother's knowledge is one of the factors that influence the occurrence of diarrhoea in toddlers. Based on research conducted by Hartati et al (2018) which states that there is a correlation between the level of knowledge and the occurrence of diarrhoea in toddlers in the Rejosari Public Health Center Pekanbaru area with a p-value = 0,000 <0.05. Mothers who have good knowledge understand about clean and healthy living practices and are able to apply it in a family environment. In addition, mothers who have good knowledge understand diarrhoea transmission in toddlers so they can take early precautions, such as proper handwashing knowledge. According to research conducted by Wijaya, around Sekaran Waste Disposal regarding handwashing habit, not washing hands has a risk of 16 times to contract or cause diarrhoea (Wijaya, 2012).

The lack of sanitary utensils for toddlers in both villages can cause fecal-oral transmission of diarrhoea in toddlers. However, Selviana's research (2013) shows that sanitation of cooking, eating and drinking utensils (p-value = 0.107) is

not related to the occurrence of diarrhoea in toddlers in Desa Sekardangan Sidoarjo. In addition to many other risk factors, factors that need to be considered to be able to carry out effective food sanitation are food factors, human factors and equipment factors (Chandra, 2006). In Decree of the Minister of Health of the Republic of Indonesia No.1098 / Menkes / SK / VII / 2003 regarding Guidelines for Hygiene Requirements for Eatery and Restaurants, there are several aspects governed in food handling, namely food handlers, types of equipment, water, food ingredients, food additives, presentation and handling facilities.

This study reports that water and sanitation factors contribute around 35.4% of diarrhoea occurrences in toddlers, while personal hygiene factors, maternal factors and toddlers contribute for 16.5%. The area which is a wetland area increases the possibility of Banyuasin Districts people, especially Tanjung Lago Village and Gasing Village, to use river water and rain-fed water as a source of drinking water. So the use of refilled gallon water as a source of drinking water is the best choice in efforts to prevent the occurrence of diarrhoea in toddlers. Still, management in the consumption of refilled water, such as boiling water and how long to use bottled water that has been opened must be considered, because of the health quality of said water is not fully guaranteed.

The use of river water as a source of clean water without proper management for the majority of people in the Banyuasin Districts wetland area can be a risk factor for diarrhoea occurrence in toddlers given the high risk of pollution in river water. The possibility of cross contamination from river water as a source of clean water for the human activities such as bathing, washing and defecating in the river can increase the chance of bacterial contamination. According to Chandra (2006) the effective implementation of food sanitation is a food factor, a human factor and equipment factor. Latrine ownership factors and types of latrines that do not meet health requirements can pollute the surrounding environment, especially the sources of clean water and drinking water. Low water quality and sanitation are associated with an increase in diarrhoea, but are not related to episodes of diarrhoea (Curtis and Cairncross, 2003).

The study results showed that several factors contributed to the occurrence of diarrhoea in toddlers; 19.7% water factor, 15.6% sanitation factor, 8.2% personal hygiene factor, 4.8% toddler factor and 3.5% mother factor. The presence of agents also contributes to the occurrence of diarrhoea, the results of this study also reported the diagnosis of some diarrhoea in toddlers caused by a virus. As John Gordon's Balance Model on the Epidemiology Triangle, an integrated diarrhoea control model for wetlands in toddlers in Tanjung Lago and Gasing Village is needed,

covering the aspects of agent, host and environment. Rotavirus vaccine for toddlers who are prone to diarrhoea on agent factors; improvement of environmental sanitation (latrine sanitation, sewerage sanitation and waste disposals), improvement of water sanitation (clean water and drinking water) on environmental factors and intensive education for mothers and toddlers (related to personal hygiene, breastfeeding, supplementary food (PMT), utensils sanitation and defecation behavior) to the host factor can contribute greatly to prevent the occurrence of diarrhoea in toddlers.

## CONCLUSION

Chemical indicator factors, latrine sanitation, latrine quality, income, and handwashing with soap significantly related to the occurrence of diarrhoea in toddlers in the Banyuasin Districts wetland area. The results of the diagnosis in several respondents showed that the virus contributed to the occurrence of diarrhoea. Integrated diarrhoea control models such as rotavirus vaccines, improved water sanitation, environmental sanitation (latrine sanitation, sewerage sanitation, waste disposal sanitation, clean water and drinking water sanitation) and intensive education for mothers and toddlers (related to personal hygiene, breastfeeding, supplementary food, utensils sanitation and defecation behaviour) can greatly contribute in efforts to reduce the prevalence of diarrhoea in the wetlands of Banyuasin District. Further studies are urgently needed to develop this integrated diarrhoea control model based on local context, such as in wetland areas in this Banyuasin District, through mix methods, quantitative and qualitative approaches.

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## Conflict of interest

The authors declare no potential conflict of interest.

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