
ANALYSIS OF THE INFLUENCE OF NUTRITIONAL STATUS VARIABLES AND ENVIRONMENTAL SANITATION ON THE EVENT OF DIARRHOUS TO CHILDREN

Feni Astiti¹, Reni Zuraida², Samsul Bakri³, Khairunnisa Berawi⁴

Environmental Science Study Program, The Graduate Program, Lampung University^{1,2,3,4}

Faculty of Medicine, Lampung University^{2,4}

Department of Forestry, Faculty of Agriculture, Lampung University³

feni_ti2@yahoo.co.id¹, zuraidareni@yahoo.com², samsul.bakri@fp.unila.ac.id³,
nisaberawi0226@gmail.com³

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ABSTRACT

Introduction: Diarrhea in 2019 became the second leading cause of death in children under five. The causes of diarrhoea include infection, malabsorption, and food and are influenced by several factors such as behavioural, nutritional, environmental, and socioeconomic factors. This study aimed to analyze the effect of variables on nutritional status and environmental sanitation on the incidence of diarrhoea in children under five in the South Lampung Regency. **Method:** This study is survey research with a cross-sectional design and uses binary logistic regression analysis. The samples taken were 380 toddlers aged 6-59 months. **Result:** 10 of the 21 predictor variables had a significant effect on the 5% significant level of the incidence of diarrhoea, where there were nine predictor variables, including poor/poor nutritional status, history of exclusive breastfeeding, clean water sources from BOR wells, clean water sources from PDAM, mountain spring drinking water sources, latrine facilities, septic tank facilities, managed waste management, and the floor of a ceramic house can reduce the incidence of diarrhea with odds ratio and $[p=]$ values of 0.06[0.000], 0.33[0.017], 0.01[0.0000], 0.02[0.000], 0.02[0.004], 0.04[0.000], 0.01[0.025], 0.02[0.001], and 0.10[0.000]. Toddlers living in noncoastal areas have a 1.08 times higher chance of experiencing diarrhoea than coastal areas. In contrast, one variable, namely the age of toddlers, can increase the susceptibility to diarrhoea in toddlers with the odds ratio and $[p=]$ values of 1.04 [0.007, respectively. **Conclusion:** This study shows that the influence of nutritional status variables and environmental sanitation has a great possibility to reduce the incidence of diarrhoea in children under five, namely in the group of nutritional status variables, including poor/poor nutritional status, age of toddlers, and history of exclusive breastfeeding.

Keywords: Toddler Diarrhea, Nutritional Status, Environmental Sanitation, Comparative Study.

Corresponding Author: Samsul Bakri

E-mail: samsul.bakri@fp.unila.ac.id



INTRODUCTION

Health problems during childhood can affect the process of child development, mainly if the disorder occurs in the digestive tract, which has an essential role in the absorption of nutrients. One of the disorders in the digestive tract that is prone to occur in children is diarrhoea (Unicef, 2020) ; (Bolon, 2021). Diarrhoea is an abnormal discharge of faeces characterized by an increase in the volume and dilution of faeces and the frequency of defecation (BAB) more than three times a day; in toddlers, it is usually found more than four times a day without mucus. Diarrhoea in toddlers will cause dehydration, and the wasted food substances needed by the body it can interfere with growth (RI, 2018) ; (WHO), 2020).

In 2019 diarrheal disease became the second leading cause of death in children under five years of age and was responsible for the deaths of 370,000 children, which means more than 1,400 children die every day, or about 525,000 child deaths every year with a total cases of diarrhoea in children of 1,7 billion cases annually (WHO), 2020). The most common Source of diarrheal disease is water contaminated with toxins from various pathogenic bacteria. Rotavirus and Escherichia coli bacteria are the two most common diarrhoea-causing agents in developing countries, including Indonesia. Diarrhoea due to water pollution that occurs in environments with poor sanitation, both for drinking, cooking, and washing (especially eating utensils), accounts for nearly 60% of deaths worldwide (UNICEF), 2021).

Diarrhoea in Indonesia is an endemic disease that has the potential to cause Extraordinary Events (KLB) (Ministry of Health, 2014). Based on Indonesia's 2019 health profile, it can be seen that the frequency of outbreaks of diarrheal diseases fluctuated (up and down). However, the case fatality rate (CFR) continued to increase. Outbreak cases in 2015 reached 1,213 people, which occurred in 13 provinces with a mortality rate of 2.47%. Furthermore, in 2016 there were outbreaks in 3 provinces with 198 cases and a CFR mortality rate of 3.03%. In 2018 there were ten diarrheal outbreaks spread across eight provinces in 8 districts/cities, with 756 sufferers and a mortality rate of 4.76% (RI, 2018).

The 2018 Basic Health Research (Riskesdas) reported that the prevalence of diarrhoea in 2018 was 37.88% or around 1,516,438 cases in toddlers. The prevalence increased in 2019 to 40% or around 1,591,944 cases in children under five (Ministry of Health, 2014). In addition, Riskesdas reported that the prevalence of diarrhoea was more prevalent in the under-five group consisting of 11.4% or around 47,764 cases compared to other age groups. Based on the Indonesian Health Profile, Lampung Province contributes to diarrhoea cases. South Lampung is a district in Lampung Province.

Data from the South Lampung District Health Office in 2017 showed that the prevalence of diarrhoea in children under five was 11207, which was 36%. In 2018 there were 10583; the prevalence was 24%; in 2019, the prevalence was 6819, and the prevalence was 19%. In 2020 as many as 4638 with a prevalence of 12%, and 2021, as many as 12205 with a prevalence of 18%; the Number of children under five in South Lampung was as many as 93037 (South Lampung District Health Office, 2021). South Lampung is a district where, administratively, most of the territory lies on the coastline. Based on the Regency Regional Development Plan (RPDK) (2014), South Lampung has a coastline of 247.76 Km², which includes Katibung, Sidomulyo, Kalianda, Ketapang, Bakauheni, Rajabasa, and Sragi sub-districts with an area of 173,347 hectares of seawater. South Lampung Regency has a land area of approximately 210,974 ha.

Factors related to diarrhea in toddlers include infection, malabsorption, and dietary factors. Several factors can also affect diarrhea, including environmental factors, behavioural factors, nutritional factors, demographic factors, and socioeconomic factors (Palancoi, 2014) ; (Wasihun et al., 2018), (Demissie et al., 2021) ; (Anjar et al., 2020) ; (Nemeth V, 2022). Child nutrition problems are the impact of an imbalance between intake and output of nutrients, namely, intake that exceeds output or vice versa. One of the causes of nutritional imbalance in toddlers is diarrhea (Marimbi, 2010).

Research conducted by (Wasihun et al., 2018) on 610 children under five in Ethiopia showed that the problem of diarrhea and malnutrition in children aged 6-59 months had a significant relationship, where around 27.2% of children experienced diarrhea in two months. Weeks before the interview, the prevalence of diarrhea, underweight, wasting, and malnutrition in this study were 36.1%, 37%, 7.9%, and 5.4%, respectively. Access to clean water is a significant problem in the study area. Factors such as the type of drinking water source, mothers not washing their hands, improper disposal of solid waste, and the age of children were predictors of diarrhea.

The environment is one of the determinants of disease occurrence (Blum & Knollmueller, 1975). Factors that directly or indirectly can be a driver of diarrhea include agent, host, and environmental factors. Host factors that cause increased susceptibility to diarrhea include not getting breast milk for two years, malnutrition, measles, and immunodeficiency. The most dominant environmental factors are the means of providing clean water and the disposal of faeces; these two factors will interact together with human behavior. Suppose environmental factors are not healthy because they are contaminated with diarrhea germs and accumulate with unhealthy human behaviour. In that case, diarrhea transmission can quickly occur (RI, 2011).

The results of research conducted by Gali et al. The 2020 study of environmental factors related to the incidence of diarrhea in Mataniko Honiara, Solomon Islands, showed that approximately half (45.9%) of children under five years had suffered at least one episode of diarrhea in the two weeks prior to the survey, of which 73.2% had not. have toilet facilities, 61.0% of households are built in low-lying areas (19 meters above sea level), and 70.6% are located near rivers. The presence of stagnant wastewater, flies, solid waste, and containers filled with water near the house, plus the distance of the house from the river. Previous studies support that hand washing facilities, latrine facilities, drinking water sources, and improper and rural waste disposal have a significant relationship with diarrhea morbidity (Gali et al., 2020) ; (Getachew et al., 2018).

This study aims to analyze the effect of nutritional status variables and environmental sanitation on the incidence of diarrhea in children under five: a comparative study in coastal and noncoastal areas of South Lampung Regency.

METHOD

The research was conducted from May 2022 to September 2022 in the working area of the South Lampung District Health Office. The tools used in this study were microtoise, weight scales, stationery, a camera, and a laptop equipped with Minitab version 16 software.

This research design is an analytic observational survey research method in a population. In this study, researchers analyzed the data collected for the relationship between variables. Researchers use quantitative research with a cross-sectional design to study the correlation between risk factors and their effects (Hidayat, 2015). This correlation includes independent and dependent variables, which are measured simultaneously.

This study's population was all mothers with children under five. They lived in South Lampung Regency in eight sub-districts, consisting of coastal areas including Kalianda, Rajabasa, Bakauheni, and Ketibung Districts. South Lampung has 17 sub-districts. Noncoastal areas include the Districts of Natar, Penengahan, Palas, and Merbau Mataram.

The sample in this study was mothers who had toddlers and were domiciled in South Lampung Regency in these eight sub-districts, according to the research inclusion criteria (mothers who had toddlers aged 6-59 months and registered in these eight sub-districts).

The sampling technique in this study used proportional random sampling. The sample size taken by proportional random sampling is calculated based on the following formula:

$$n = \frac{NZ^2PQ}{(N-1)d^2 + Z^2PQ}$$

Information :

- N = approximate sample size
- N = Population (37043)
- Z = normal standard value (1.96)
- P = estimated proportion of the variables studied (0.5)
- Q = 1-P
- D = level of accuracy used (0.05).

The result is $n=380,0703254$, rounded up to 380 samples. So, the sample in this study was 380 children under five. Furthermore, the determination of the sample size for each sub-district is determined using the following formula:

$$nh = \frac{Nh}{N} \times n$$

Information :

- Nh = Number of samples/district
- Nh = Total population/district
- N = Total population
- N = Number of samples

Sources of data used are primary data obtained from respondents using questionnaires and direct observation of respondents.

The data in this study will be analyzed using Binary Logistics Regression. Binary logistic regression analysis is a statistical method that describes the relationship between one response variable (Y) and several predictor variables (X), with the response variable in the form of dichotomous qualitative data, which is 1 to state the presence of a characteristic and 0 to state the absence of a characteristic. (Hosmer Jr et al., 2013) . Mathematically the postulates of the model to be carried out are as follows.

$$Ln \frac{(p[Diare=1]i)}{(1-p[Diare=1]i)} = 1 - \alpha_0 [NTRL_ST]i + 2 [GEND_BABY]i + \alpha_3 [AGE_INF]i + \alpha_4 [ASI]i + 17 [AREA]i + 18 [D3_MOUNT]i + 19 [D3_RINGS]i + \alpha_{20} [D3_CMNT]i + 21 [D3_BOR]i + 22 [D3_PDAM]i + \alpha_{23} [D4_WTR_MOUNT]i + \alpha_{24} [D4_GLLN]i + 25 [WC]i + \alpha_{26} [SPTICTNK]i + \alpha_{27} [SPAL]i + \alpha_{28} [CMD5]i + 29 [D5_SPAL_PVC]i + 30 [WST_FIRE]i + 31 [WST_MNGED]i + \alpha_{32} [FLR_CMNT]i + 33 [FLR_KRMK]i + \xi_i$$

The dependent and independent variables with a significant relationship with p-value < 0.05 were selected with the help of Minitab 16 software. If the p-value < 0.05, H0 is rejected, meaning there is a significant effect between one independent variable and the dependent variable.

The data that has been obtained will be translated into tabular form and processed using Minitab 16. Through these steps:

- a. Coding to translate the collected data into analysis symbols
- b. Data entry to enter data into the computer
- c. Verification to enter inspection data visually against data that has been entered into the computer
- d. Computer output, printable computer analysis results

The data in this study were analyzed using Binary Logistics Regression. The steps of data analysis carried out in this study are as follows:

1. Data description analysis
2. Binary Logistics Regression Analysis:
 - a. We are forming a predictive model of binary logistic regression using all predictor variables.
 - b. Using the G test, they perform the significance test of all conjecture models with binary logistic regression.
 - c. The G test aims to determine whether there is an effect of the predictor variables used together on the dependent variable.
 - d. The Wald test selected a predictor variable that significantly affects the dependent variable. Wald's test statistic was used to test parameter one partially.
 - e. Determine the best model.
 - f. Look for the odds ratio value for each predictor variable that has a significant effect.
 - g. Interpret binary logistic regression models.
 - h. Performing the suitability test of the binary logistic regression model using the Goodness of Fit. test

The hypothesis to be tested in this study can be expressed as follows:

H0: $1 = 2 = 3 = 4 = \dots = 20 = 0$ (None of the variables has a significant effect on the incidence of diarrhea in the study area)

H1: $1 \neq 2 \neq 3 \neq 4 \neq \dots \neq 20 \neq 0$ (At least one variable significantly affects the incidence of diarrhea in the study area).

The optimization of model parameters was carried out using Minitab 16 software. The significance level used was 5%.

RESULTS AND DISCUSSION

1. Descriptive Analysis

Table 1. Distribution of the Frequency of Diarrhea in Toddlers

Characteristics	N	%
Diarrhea		
No Diarrhea	174	46
Diarrhea	206	54
Total	380	100

Based on the table above, data on the incidence of diarrhea in the South Lampung district occurred in 206 children under five, with 54%. In comparison, only 174 children did not have diarrhea in the Lampung district, with 46% of a total of 380 children under five, with a percentage of 100%.

Variables causing diarrhea based on nutritional status include the nutritional status of toddlers, age of toddlers, gender, and history of exclusive breastfeeding. Based on the results of the study, the frequency distribution of nutritional status was obtained as follows:

2. Frequency Distribution of Nutritional Status of Toddlers

Table 2. Frequency distribution of nutritional status of children under five based on BMI/U. index

Characteristics	N	%
Toddler Nutritional Status		
Good Nutrition Status	232	61
Poor/poor nutritional status	148	39
Total	380	100

Based on the Table of Frequency Distribution of Nutritional Status of toddlers based on body mass index according to age (BMI/U) shows that toddlers in the field are dominated by toddlers who have good nutritional status, as many as 232 people with a percentage of 61%, then obtained as many as 148 toddlers who have poor nutritional status/ poor with a percentage of 39% of the total 380 children under five with a percentage of 100%.

Table 3. Frequency Distribution of Gender

Characteristics	N	%
Toddler gender		
Man	200	53
Woman	180	47
Total	380	100

Based on the Gender Frequency Distribution table based on the gender of the toddlers, the male sex was dominated by 200 toddlers with a percentage of 53%. In comparison, the number number of toddlers with female sex was obtained as many as 180 toddlers with a percentage of 47% of the total 380 toddlers with a percentage of 100%.

Table 4. Frequency Distribution of Exclusive Breastfeeding

Characteristics	N	%
Exclusive breastfeeding history		
Exclusive Breastfeeding	258	68
No Exclusive Breastfeeding	122	32
Total	380	100

Based on the frequency distribution table of the history of exclusive breastfeeding, it was found that toddlers in the field were dominated by toddlers who had a history of exclusive breastfeeding, as many as 258 people with a percentage of 68%, while as many as 122 toddlers who did not have a history of exclusive breastfeeding with a percentage of 32% of a total of 380 toddlers with 100% percentage.

3. Environmental Sanitation Frequency Distribution

Variables causing diarrhea based on environmental sanitation include clean water sources, drinking water sources, latrine facilities, septic tanks, SPAL facilities, SPAL construction facilities, waste processing facilities, and house floors. Based on the results of the study, the frequency of environmental sanitation characteristics was obtained as follows:

Table 5. Distribution of Toddler Household Frequency by Source of Clean Water

Characteristics	N	%
Clean Water Facilities		
Mountain spring	52	14
ring well	73	19
cement well	120	31
Ground well	34	9
Boreholes	56	15
PDA	45	12
Total	380	100

Table of Frequency Distribution of Toddler Households based on Clean Water Sources (SAB) is dominated by under-five households using clean water sources from cement wells as many as 120 children under five with a percentage of 31%. The table also shows that 52 toddlers, with a percentage of 14%, use clean water sources from mountain springs, 73 toddlers, with a percentage of 19%, use clean water sources from Cicnin wells, as many as 34 toddlers, with a percentage of 9% use clean water sources from ground wells, 56 children under five with a percentage of 15% using clean water sources from BOR wells. Meanwhile, 45 children under five, with a percentage of 12%, used clean water sources from PDAM from a total of 380 under-five households, with a percentage of 100%.

Table 6. Frequency Distribution of Drinking Water Facilities

Characteristics	N	%
Drinking Water Facilities		
Mountain spring	54	14
Bottled water/ gallon	142	37
Well water	184	49
Total	380	100

Based on the Table of Frequency Distribution of Drinking Water Facilities, it is dominated by under-five households that use clean water facilities using drinking water sourced from well water 184 with a percentage of 49%. Under-five households that use bottled water/per gallon are 124 under-five households with a percentage of 33%. There are 74 families using source A with a percentage of 37%, while the under-five households using drinking water sourced from mountain springs are 54 with 14% of the total 380 families with a percentage of 14%. 100%.

Table 7. Frequency Distribution of Family Latrine Facilities

Characteristics	N	%
Family Toilet		
There are not any	82	23
There is	294	77
Total	380	100

Based on the Table of Frequency Distribution of Family Latrine Facilities, it is dominated by under-five households that already have latrines, as many as 294 under-fives with a percentage of 77%. Meanwhile, families who do not have latrines, 82 under-five households with 23%, and a total of 380 households under five a percentage of 23%. 100%.

Table 8. Frequency Distribution of Septitenk Sarana Facilities

Characteristics	N	%
Family Toilet		
There are not any	60	30
There is	138	70
Total	380	100

Based on the Table of Frequency Distribution of Septitenk Facilities, it is dominated by under-five households that already have septic, as many as 138 children under five with a percentage of 70%. Meanwhile, the families who do not have septic tanks are 60 under-five households with a percentage of 30%, a total of 380 households under five with a percentage of 30%. 100%.

Table 9. Frequency Distribution of Wastewater Sewerage (SPAL)

Characteristics	N	%
SPAL		
Not up to standard	80	40
according to health standards	118	60
Total	380	100

Based on the Table of Frequency Distribution of Wastewater Drainage Facilities (SPAL), dominated by under-five households with SPAL by health standards, as many as 118 toddlers with 60%. Meanwhile, families who do not have SPAL by health standards are 80 under-five households with 40%, a total of 380 under-five households with a percentage of 40%. 100%.

Table 10. Distribution of SPAL Construction Frequency

Characteristics	N	%
SPAL Construction		
SPAL Land Construction	20	5
SPAL Cement Construction	86	23
SPAL PVC Construction	274	72
Total	380	100

Based on the frequency distribution table for the construction of wastewater drainage facilities (SPAL), it is dominated by under-five households with SPAL for PVC/pipe construction, with as many as 274 children under five, with a percentage of 72%. Meanwhile, in under-five households that have SPAL for cement construction, there are 86 toddlers with a percentage of 23%, and in under-five households that have SPAL for land construction, as many as 20 toddlers with a percentage of 5%, with a total of 380 households under five with a percentage 100%.

Table 11. Frequency Distribution of Waste Management Facilities

Characteristics	N	%
Waste Management Facilities		
Any	32	9
Collected and then burned	165	43
Collected and then transported	183	48
Total	380	100

Based on the frequency distribution table, waste management facilities are dominated by under-five households whose waste management facilities are collected and then transported by garbage collectors, namely 183 toddlers, with 48%. Meanwhile, in under-five

households where waste management facilities were collected and then burned, 165 under-five children with a percentage of 43%, and under-five households whose waste management facilities were only arbitrary were 32 under-fives with a percentage of 9% with a total of 380 under-five households with a percentage of 100%.

Table 12. Frequency Distribution of House Floor Facilities

Characteristics	N	%
Home Floor Facilities		
Ground Floor	116	31
Tile/cement floor	111	29
Ceramic Floor	153	40
Total	380	100

Based on the frequency distribution table for house floor facilities, it is dominated by under-five households whose house floors are made of ceramic, with as many as 153 toddlers at 40%. Meanwhile, in under-five households whose house floors are made of soil, there are 116 toddlers with a percentage of 31%, and under-five households whose floors are made of tiles/cement, as many as 111 toddlers with a percentage of 31% with a total of 380 households with a percentage of 100%.

4. Results of Optimizing Model Parameters the Effect of Nutritional Status Variables on the Incidence of Diarrhea in Toddlers

Table 13. Optimization results of the Influence of the Nutritional Status Variable Model on the Incidence of Diarrhea in Toddlers

Predictor	Symbol	Coef	SE Coef	Z	P	Odds Ratio	95% Lower	CI Upper
Constant		10.1473	2.11979	4.79	0.000			
Toddler Nutritional Status								
Nutritional Status (0=poor/nutrition)	[NTRL_ST]i	1 -2.75307 —	0.650974	- 4.23	0.000	0.06	0.02	0.23
Toddler (Months)	Age [AGE_INF]i	2 0.0418622 —	0.0154063	2.72	0.007	1.04	1.01	1.07
Gender (0=Female)	[GEND]i	3 - 0.101897 —	0.426485	- 0.24	0.811	0.90	0.39	2.08
Breastfeeding (0=Not Exclusive)	[breastfeeding]i	4 -1.11630 —	0.466669	- 2.39	0.017	0.33	0.13	0.82

Based on the optimization of the model parameters in Table 13, it is found that parameter 1 is negative with an Odd Ratio = 0.06 with $p = 0.000$. Suppose other variables remain the same in toddlers with good nutritional status. In that case, the chance of susceptibility to diarrhea will decrease to 0.06 times that of toddlers with poor/poor nutritional status. This decrease was statistically significant, as indicated by $p=0.000$ ($=0.04\% < 1\%$).

Conceptually, diarrhea with nutritional status has a reciprocal relationship. Diarrhea can cause malnutrition, and vice versa; malnutrition is at risk for diarrhea because the body's immune system decreases (Septikasari, 2018). Infectious diseases such as diarrhea can worsen the nutritional state, and poor nutrition can facilitate infection. Children who suffer from

gastrointestinal infections will experience impaired absorption of nutrients that cause malnutrition. A malnourished person will be susceptible to disease, and growth will be disrupted. Patients with malnutrition will experience a decrease in antibody production and atrophy in the intestinal wall, which causes reduced secretion of various enzymes, making it easier for germs to enter the body, especially diarrhea. In malnourished children, diarrhea attacks occur more frequently and last longer. The worse the child's nutritional state, the more frequent and severe diarrhea he suffers. It is suspected that the intestinal mucosa of malnourished children is susceptible to infection. In well-nourished children under normal circumstances, there is a relatively rare microflora due to the cleansing effect of many interrelated factors, including gastrointestinal motility, gastric acid secretion, and secretion of mucosal immunoglobulins. The situation is very different in malnourished children because of bacterial contamination of the upper small intestine. This situation can lead to diarrhea and fluid loss, a factor in children's malnutrition and other causes of impaired absorption of food, fluids, and electrolytes.

Nutritional status in toddlers is one of the benchmarks in assessing the adequacy of daily food intake and the use of nutrients in the body. Nutritional status is also a person's physiological state which can be seen from the relationship between intake and nutritional needs as well as from the ability to digest, absorb, and use nutrients. Suppose the child has poor nutrition that affects growth and development and daily physical and mental function. In that case, the child will be affected by environmental factors and lose the opportunity to develop normally. Hence, they are at risk of retardation in the future (Ishud & Romadona, 2020).

Research conducted by (Maarif & Nafies, 2021) shows a significant relationship between the incidence of diarrhea and the nutritional status of children under five in Tuban Regency with a p-value of 0.000. This study found that diarrhea is common in children with poor nutritional status. Toddlers are an age group prone to malnutrition, so the best indicator to measure the nutritional status of the community is the nutritional status of children under five (Saputri et al., 2015). Another study by (Ganguly et al., 2015) in India proved that malnourished children had a 1.73 times higher risk of experiencing diarrhea than children with normal nutritional status.

The optimization of the model parameters results shows that parameter 2 is positive with an Odd Ratio = 1.04 with $p = 0.007$. If other variables remain the same, toddlers one month older, the susceptibility to diarrhea will increase to 1.04 times the original. Statistically, this increase was very significant at the 5% level as shown by $p=0.007$ ($0.8\% < 5\%$).

Conceptually at a young age, children's body weight contains more water used in the body's metabolism. ((UNICEF), 2021) This is in line with research conducted by Dharmayanti and Tjandrarini (2020) using the 2013 Rikesda data on toddlers on the islands of Java and Bali, showing that children aged 0-5 years are more susceptible to diarrhea than those aged above (Dharmayanti & Tjandrarini, 2020). In addition, children's immune systems are also not perfect, so they are more susceptible to contracting diseases ((UNICEF), 2021).

Based on the results of the optimization of the model parameters, it is found that parameter 3 is negative with Odd Ratio = 0.90 and $p = 0.811$. This finding means that if the other variables are constant, the male toddler has a lower chance of getting diarrhea, which is 0.90 times compared to the female toddler. Statistically, the probability of this decrease was not

significantly different at the 5% significance level, as shown by $p=0.811$ ($81.1\%>5\%$). This means that there is an equal chance of yes or no.

Conceptually, gender differences may influence individuals in activities, so they must be assessed and measured. According to research conducted by (Gultom, 2021), the immune system of girls is lower than that of boys, so girls are more prone to diarrhea than boys.

In line with this, research was conducted (Prawati, 2019). VI, Kelurahan Rangkah Buntu, Surabaya City, stated that 50 people suffered from diarrhea more than women. Women are more at risk of diarrhea because most women usually have more activity in the room, do the less physical activity than men, and more often consume foods with excessive spicy levels and snack indiscriminately. This can make women's immune systems lower than men.

Based on the results of the optimization of the model parameters, it is found that parameter 4 is negative with an Odd Ratio = 0.33 with $p = 0.017$. If the other variables remain the same, in toddlers who receive exclusive breastfeeding, the susceptibility to diarrhea will decrease to 0.33 times. This decrease was very significant at the 5% level, as shown by $p=0.017$ ($1.7\% <5\%$).

Breastfeeding is a natural process that a child needs because a mother's milk is a living fluid that contains protective substances to increase immunity that will protect children from various bacterial, viral, parasitic, and fungal infections so that children who are breastfed by their mothers entirely for six months (Exclusive Breastfeeding Pattern) are healthier and less sick than children who are not exclusively breastfed (Widaryanti, 2019). Conceptually, breast milk is sterile and different from formula milk or other liquids prepared with water or other materials that can be contaminated in unclean bottles. Breastfeeding alone, without liquids or other food and without using bottles, prevents children from the dangers of bacteria and other organisms that will cause diarrheal disease (RI, 2018). The breastfeeding pattern is the habit of breastfeeding mothers based on the Number of mothers breastfeeding their children (Rahmawati, 2019)(Widaryanti, 2019).

Various studies on diarrhea in children under five and its relation to exclusive breastfeeding have been conducted. One of them is a study conducted by (Rahmawati, 2019) with a systematic review that took literature from 1980 to 2009, proving a relationship between the incidence of diarrhea and breastfeeding patterns. The study explains that the risk of diarrhea in children under five increases according to the breastfeeding pattern. This is indicated by the Relative Risk (RR) in the predominantly breastfed group at 1.26, the partial breastfeeding group at 1.68, and the non-breastfeeding group at 2.65. The risk of diarrhea, as seen from the prevalence rate, also increased significantly according to the breastfeeding pattern. The predominant breastfeeding group ($RR=2.15$), the partial breastfeeding group ($RR=4.62$), and the non-breastfeeding group ($RR=4.90$) compared to the exclusive breastfeeding group. Another research on the success of exclusive breastfeeding in the community can be increased by strengthening the role of PKK mothers and puskesmas cadres to minimize the incidence of diarrhea in toddlers (Zuraida et al., 2022).

5. Results of Optimizing Model Parameters of the Effect of Environmental Sanitation Variables on the Incidence of Diarrhea in Toddlers

Table 14. Results of Optimizing Model Parameters the Effect of Environmental Sanitation Variables on the Incidence of Diarrhea in Toddlers

Predictor	Symbol	Coef	SE Coef	Z	P	Odds Ratio	95% Lower	CI Upper
Environmental Sanitation								
Region (0=Coastal area)	[AREA]i	₅ 0.0793534	0.451141	0.18	0.860	1.08	0.45	2.62
Source of clean water (0=Earth Well)								
Mountain Spring Dummy	[D1_MOUNT]i	₆ 0.901511	1.07531	0.84	0.402	5.83	0.30	20.27
Ring Well Dummy	[D1_RINGS]i	₇ -0.682706	0.786499	-0.87	0.385	0.51	0.11	2.36
Cement Well Dummy	[D1_CMNT]i	₈ -0.176658	0.747559	-0.24	0.813	0.84	0.19	3.63
Dummy Well Drill	[D1_BOR]i	₉ -5,11332	1.23891	-4.13	0.000	0.01	0.00	0.07
Dummy PDAM	[D3_PDAM]i	₁₀ -3.79945	0.992462	-3.83	0.000	0.02	0.00	0.16
Source of Drinking Water (0=Well)								
Mountain Spring Dummy	[D2_WTR_MOUNT]i	₁₁ -3.82617	1.32239	-2.89	0.004	0.02	0.00	0.29
Dummy Gallon/ Packaging	[D2_WTR_GLLN]i	₁₂ 0.175129	0.461069	0.38	0.704	1.19	0.48	2.94
WC/ Latrine	[WC]i	₁₃ -3.32966	0.826684	-4.03	0.000	0.04	0.01	0.18
Septitenk (0=Don't have)	[SPTICTNK]i	₁₄ -1.40321	0.546534	-2.57	0.010	0.25	0.08	0.72
SPAL/ Drainage (0=Not up to standard)								
Wastewater Sewer	[SPAL]i	₁₅ -0.906861	0.592321	-1.53	0.126	0.40	0.13	1.29
SPAL/ Drainage Construction (0=Land)								
Dummy SPAL cement	[D3_SPAL_CMNT]i	₁₆ 0.561020	1.19356	0.47	0.638	1.75	0.17	18.18
Dummy SPAL PVC	[D3_SPAL_PVC]i	₁₇ 1.25952	1.20288	1.05	0.295	3.52	0.33	37.23
Waste Processing (0=Any)								
Dummy Garbage	[D4_WASTE_FIRE]i	₁₈ -2.38330	1.25460	-1.90	0.057	0.09	0.01	1.08

Burned									
Dummy Trash Managed	[D4_WASTE_MNGED]i	19	-4.08319	1.25749	-3.25	0.001	0.02	0.00	0.20
House floor (0=Land)									
Dummy Floor Tile/ Cement	[D5_FLOOR_CMNT]i	20	0.337830	0.703013	0.48	0.631	1.40	0.35	5.56
Ceramic Floor Dummy	[D5_FLOOR_KRAMIK]i	21	-2.34233	0.646784	-3.62	0.000	0.10	0.03	0.34

Log-Likelihood = -88,319

Test that all slopes are zero: G = 347,455, DF = 21, P-Value = 0.000

Simultaneous testing of the diarrhea prediction model in South Lampung Regency using the likelihood ratio test with the help of Minitab 16 software, the G test statistic value is 347.455, the World or DF test value is 21, and the p-value = 0.000, which is smaller 0.05, so it can be concluded that the simultaneous testing of the diarrhea incidence model with binary logistic regression with twentyone significant predictive variables at the 95% confidence level or in other words reject Ho. This means that there is at least one significant parameter.

Based on the results of the optimization of the model parameters, it is found that parameter 5 is positive with an Odd Ratio = 1.08 and p = 0.860. This finding means that if other variables remain constant, then children living in noncoastal areas have an increased risk of diarrhea by 1.08 times compared to toddlers living in coastal areas. Statistically, the probability of this decrease was not significantly different at the 5% significance level, as shown by p=0.860 (86.0% > 5%). Conceptually, the humidity level in the lowlands and coastal areas becomes high due to the evaporation of water from lakes, seas, and swamps due to high air temperatures. These conditions can be optimal for the growth of vectors and pathogenic microorganisms that cause infection. Environmental hygiene in higher temperatures must be carried out more often than in areas with lower temperatures. The development of vectors carrying diarrheal germs, such as flies, includes survival. Pre-adult development occurs at an optimum temperature of 28°C so that at temperatures less than 16°C, the development of vectors carrying diarrheal germs, such as flies, will stop (Ihsan, 2016).

The results of the optimization of model parameters for clean water sources show that the parameter 6 is positive, while the parameters 7, 8, 9, 10 are negative with an odd ratio and the value of [p=] is 5.83 [0.402], 0.51 [0.385], 0.84 [0.813], 0.01 [0.000] and 0.02 [0.000]. If the other variables remain the same, toddlers whose families use clean water for daily activities from the mountains will decrease compared to toddlers whose families use clean water from ground wells. In contrast, the susceptibility to diarrhea will decrease when households use clean water sources from ring wells, cement wells, drilled wells, and PDAMs than toddlers whose families use clean water sourced from ground wells. This decrease was significantly different at the 5% level for clean water sourced from drilled wells and PDAMs aimed at p-values of 0.000 and 0.000 (0.1 and 0.2 <5%), respectively.

Conceptually, diarrhea is an environmental-based disease commonly referred to as a water-borne disease. Water sources have a role in the spread of several infectious diseases.

However, in this study, clean water sources were not associated with the incidence of diarrhea. This is in line with the research conducted by (Fatmawati et al., 2017) on 59 children under five in Kenali Asam Bawah Village, which showed no relationship between the use of clean water and the incidence of diarrhea with a p-value = 0.907. The Source of clean water is one of the sanitation facilities that are no less important and related to the incidence of diarrhea. Some infectious germs that cause diarrhea are transmitted through the faecal-oral route. They can be transmitted by putting in the mouth, fingers, liquids, or objects contaminated with faeces and food prepared in pots washed with contaminated water.

Research conducted (Terang & Nur, 2017), which examined the provision of clean water sources in areas close to the sea, found that the poor used brackish water for their MCK needs because fresh and clean water could only be obtained if they drilled to a depth of 100 meters—constrained by very high costs.

Optimizing model parameters for drinking water sources shows that parameter 11 is negative. In contrast, the parameter 12 is positive with an odd ratio, and the [p=] values are 0.02 [0.04], 1.19 [0.704]. If the other variables remain the same, in toddlers whose families use drinking water from mountain springs, the chance of susceptibility to diarrhea will decrease to 0.02 times that of toddlers whose families consume well water. This decrease was significantly different at the 5% level as seen from the p-value = 0.004 < 5%. While the parameter 12 is positive with Odd Ratio = 1.19 and p-value = 0.704. If the other variables remain the same, in toddlers whose families use drinking water sourced from bottles/gallons, the chance of susceptibility to diarrhea will increase to 1.19 times that of toddlers whose families use well water. Statistically, the increase in probability was not significantly different at the 5% significance level, as shown by p=0.704 (70.4% >5%).

Conceptually, drinking water must be safe and meet various health requirements. Good drinking water must meet physical, bacteriological, and chemical requirements. The physical requirements for healthy drinking water are colourless, tasteless, and odourless. The temperature is below the ambient temperature. Bacteriologically, healthy drinking water must be free from all bacteria, especially bacteria that are pathogenic and harmful to the drinker. Healthy drinking water must contain certain substances in specific appropriate amounts. Water that can be said to be clean has acidity or PH 7, and the amount of saturated dissolved oxygen is nine mg/l (RI, 2018).

Based on the optimization of model parameters for latrine ownership, it is found that parameter 13 is negative with Odd Ratio = 0.04 and p-value = 0.000. This means that if other variables remain the same, in toddlers whose families have latrines, the chance of susceptibility to diarrhea will decrease to 0.04 compared to toddlers who do not. The decrease was significantly different at the 5% significance level, as shown by p (0.04% < 5%).

Conceptually, latrine ownership is vital in everyday life. This research was conducted in the South Lampung Regency, where South Lampung Regency has received a certificate as a Regency that has implemented Open Defecation Free (ODF) or Stops Open Defecation by the Ministry of Health of the Republic of Indonesia in 2019. This certificate is conditional because there are still households in some areas. South Lampung District does not yet have a latrine, so it is the

homework of the Lampung Selatan District Government to continue trying to complete its development target so that the certificate is not conditional. South Lampung Regency became the second-best district out of 29 regencies/cities in Indonesia that won the STBM (Community-Based Total Sanitation) Sustainable Award 2020 by the Ministry of Health of the Republic of Indonesia. This is a form of hard work carried out by the South Lampung Regency Government in completing the construction of latrines for households in the South Lampung Regency and is still carrying out construction. There are still households in South Lampung that do not have a latrine. Family latrines are owned by the family and used by all family members to dispose of human faeces or faeces. Stool or faeces is an object that endangers health because it is a source of transmission of various diseases (Fauziah & Tina, 2016).

This study is in line with research conducted by (Anjar et al., 2020); there is a relationship between the availability of family latrines with the incidence of diarrhea in toddlers; latrines are very useful for humans and are part of human life because latrines can prevent the proliferation of diseases caused by indiscriminate human waste can contaminate water, soil, or become a source of infection, for health.

The optimization of the model parameters results shows that parameter 14 is negative with an Odds Ratio of 0.25 with a p-value of 0.010. Suppose other variables remain the same in toddlers whose families have septicemia. In that case, the chance of susceptibility to diarrhea will decrease to 0.25 times that of toddlers whose families do not. The decrease in probability was significantly different at the 5% significance level, as shown by $P=0.010$ ($1.0\% < 5\%$).

The optimization of the model parameters results shows that parameter 15 is negative with an Odds Ratio of 0.40 with a p-value of 0.126. This means that if other variables remain the same, toddlers whose families have drainage (SPAL) will decrease the chance of susceptibility to diarrhea to 0.40 times that of toddlers whose families do not have SPAL according to health standards. Statistically, the decrease in probability was not significantly different at the 5% significance level, as shown by $p=0.126$ ($12.6\% > 5\%$).

Based on the results of the optimization of the model parameters, it is found that the SPAL construction parameters 16 and 17 are positive with odds ratio and $[p=]$ 1.75 [0.638], 3.52 [0.295], respectively. Suppose the other variables remain the same in toddlers with SPAL construction made of cement or PVC. In that case, susceptibility to diarrhea will increase to 1.75 and 3.52 times that of toddlers whose families have SPALs made of soil or grass. The increase in probability was not significantly different at the 5% significance level, as shown by $p=0.638$ and 0.295 (63.8% and $29.5\% > 5\%$).

Conceptually, in principle, handling and safeguarding household liquid waste must be appropriately managed so as not to cause disease breeding grounds; from this, it can be done to handle wastewater with the following criteria: Waste water from bathrooms and kitchens should not be mixed with water from latrines, must not cause odours, must not have puddles of water that cause slippery floors and are prone to accidents, connected to public sewers/sewers or infiltration wells (Sengkey et al., 2020).

Based on the results of the optimization of the model parameters, it was found that parameters 18 and 19 were negative with the odds ratio and $[p=]$ 0.09 [0.057] and 0.02 [0.001],

respectively. This means that if the other variables remain the same, toddlers who have waste management incinerated or transported by garbage janitors, the vulnerability of the chance of getting diarrhea decreases to 0.09 and 0.02 times than toddlers who manage their waste arbitrarily. Statistically, the decrease in probability was significantly different at the 5% significance level, as shown by $p=0.057$ and 0.001 (5.7% and $0.01 > 5\%$).

This study is in line with previous research, which stated that there was a relationship between waste management and the incidence of diarrhea. According to research conducted by (Susanti, 2018) in the Deli river basin, Medan City, it shows that for waste processing variables, from 6 respondents who are not available for waste disposal, having toddlers suffer from diarrhea proportion of 100% and 89 respondents there less waste disposal. Those who suffer from diarrhea have a proportion of 13.5% compared to those who do not suffer from diarrhea, 86.5%. The results of the study were proven by statistical tests with a value of $0.000 < 0.05$, meaning there is a relationship between waste disposal and diarrheal disease. In this study, residents who live in the coastal area of South Lampung Regency, one of which is Rajabasa District, still litter; some throw it in the river or directly into the sea. The garbage truck from the district has not yet reached Rajabasa District, South Lampung Regency. So the choice of residents only burn garbage or throw it carelessly. To process waste into compost or so, the residents of Rajabasa District have never done this.

Based on the optimization of the model parameters, it is found that parameter 20 is positive with an Odd Ratio = 1.40 with $p\text{-value} = 0.631$. If the other variables remain the same, a toddler whose family has a tile/cement floor is more susceptible to diarrhea than 1.40 times that of a toddler whose family has a floor made of earth. The increase in probability was not significantly different at the 5% level as shown by $p = 0.631$ ($63.1\% > 5\%$).

The optimization results of the model parameters are that parameter 21 is negative with Odd Ratio = 0.10 with $p\text{-value} = 0.000$. This means that if the other variables remain the same, a toddler whose family has a floor made of ceramic has a chance of susceptibility to diarrhea to 0.10 times that of a toddler whose family has a floor made of earth. The decrease in probability was significantly different at the 5% level as shown by $p = 0.000$ ($= 0.04\% < 5\%$).

Conceptually, according to (Subarkah & Samino, 2014), the type of floor that fulfils a healthy house's requirements is clean, not dusty, and not flooded in the rainy season. Based on the results of this study, it is known that there are still people who own houses of this type (soil, wood/bamboo). The existence of a community or family that has a ground floor that is not waterproof can allow the floor to cause diarrhea in toddlers. The floor that is not waterproof is the floor of the house that is still made of soil, and the type of floor that is waterproof is the type of floor made of ceramic. Activities carried out by toddlers playing on the floor of the house can cause contact with the toddler's body, and this situation gives rise to various germs that stick to the toddler's body. This can cause diarrhea in toddlers.

6. Goodness Of Fit Test Results

The model suitability test or *Goodness-of-Fit* was conducted to assess the suitability of the binary logistic regression model with the data. The suitability test of the model with the data can be seen in Table 15. As follows:

Table 15. Goodness-of-Fit Tests

Method	Chi-Square	DF	P
Hosmer-Lemeshow	18,229	8	0.020

Based on Table 6, the P value at Hosmer-Lemeshow was 0.020, indicating more than = 0.05. The binary logistic regression model fits/matches the observation data. This assessment means that if there is a toddler/newborn baby, then the chances of the toddler developing diarrhea can be predicted with the following model:

$$Ln \frac{p[Diare = 0-2.40537[NTRL_ST]i+0.0543822}{(1 - p[Diare = [AGE_INF]-0.905724[GEND_BABY]i \\ -2.26223[ASI]i-0.257573[AREA]i+1.76321 \\ [D3_MOUNT]i+0,124611 [D3_RINGS]i \\ +1.07434[D3_CMNT]i-6,21342 [D3_BOR]i-3,56354[D3_PDAM]i-2,56494 \\ [D4_WTR_MOUNT]i+0.917512[D4_GLLN]i \\ -3,31955[WC]i-0,535174[SPTICTNK]i-1,49946[SPAL]i+0,153806 \\ [D5_SPAL_CMNT]i+0.622821[D5_SPAL_PVC]i-2,33641[WST_FIRE]i-4,86838 \\ [WST_MNGED]i+1.85822 [FLR_CMNT]i -2.57936 [FLR_KRMK]i+\xi i}$$

Researchers have made maximum efforts in the data collection to obtain valid and universal results. However, this study still has limitations; namely, the selection of children under five in each region is not done individually but in general. Because it does not measure meters above sea level (mdpl) per location of the toddler's house, the selected MDPL may represent the coastal area the same as the *noncoastal* area. The limitations of this study can be used as a reference for improvement in future research.

CONCLUSION

Based on the results of research and discussion on the Analysis of the Effect of Variables of Nutritional Status and Environmental Sanitation on the Incidence of Toddler Diarrhea, a Comparative Study of Coastal Areas and Noncoastal Areas of South Lampung Regency can be concluded as follows: This study shows that the influence of variables on nutritional status and environmental sanitation has a significant probability Of suppressing the incidence of diarrhea in toddlers, there are variables in the nutritional status group of toddlers, including poor/poor nutritional status, age of toddlers and history of exclusive breastfeeding. The group of environmental sanitation variables includes clean water sources from BOR wells, clean water sources from PDAM, latrine facilities, septic tanks, managed waste management, tile/cement house floors, and ceramic house floors. There is no significant relationship between coastal and noncoastal areas on the incidence of diarrhea in children under five. This study produces a model that can predict the incidence of diarrhea in toddlers to reduce the incidence of diarrhea in toddlers.

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