Quality of Drinking Water Resources with the Incidence of Stunting in Children Under Five in Kalipakis Village, Sukorejo District, Kendal Regency

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Abstract. In 2020, around 149.2 million or 22% of the world's children under five were stunted, most of which came from Asia. In the same year, stunting data in Kendal Regency according to E-PPBGM was 17.54% of toddlers The incidence of stunting occurred due to chronic malnutrition and repeated infections during 1000 HPK. One of the causes of stunting is associated with water, sanitation and infectious diseases. This study was conducted to determine the relationship between the quality of drinking water sources, the incidence of diarrhea and the incidence of stunting in toddlers in Kalipakis Village. Methods: Quantitative research with case-control study design. Data collection will be carried out from January to April 2023 in Kalipakis Village, Sukorejo District, Kendal Regency. The study sample was mothers of toddlers aged 0-59 months, namely 38 cases and 76 controls. Instrument: Data analysis using Chi-square test. Results: The results of this study show that there is a relationship between the quality of drinking water sources and the incidence of stunting (ρ-value = 0.000), and the results of testing the incidence of diarrhea with stunting (ρ-value = 0.000) means that there is a relationship between the two variables. Conclusions and Suggestions: Indicators of poor drinking water sources are a factor in the high incidence of diarrhea that can increase stunting rates in toddlers. For related agencies such as puskesmas and other village health services to be able to conduct periodic visits or monitor the quality of drinking water sources and history of infectious diseases.

Keywords: Quality of Drinking Water Sources, Diarrhea, Stunting

1 Introduction

An estimated 155 million children less than 5 years of age are stunted, that is, have a length/height-for-age Z-score (LAZ/HAZ) of less than −2. Prevalence of stunting 2020 22%, and 149.2 million toddlers were stunted in 2020. In 2020, the high prevalence areas of stunting included Africa and South Asia. Indonesia is the third country with a high prevalence of stunting in children under 5 years of age in the Southeast Asia region in 2019 at 27.7%. The prevalence of stunting children aged 12-59 months in Indonesia in 2018 was 30.8%[1, 2]. Stunting is divided severely stunted and stunted. Severely stunted has a z-score of < −3 standard deviation (SD), whereas stunted has the z-score

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between −3 to < −2 SD. Typical toddlers have a z score of −2 to 2 SD, and more than 2 SD is considered high[3]. Poor growth in children is currently defined as inadequate height, weight and weight for height, in relation to growth standards, currently those defined by the WHO. Stunting, underweight and wasting describe a height-for-age (HA), weight-for-age (WA) and weight-for-height (WH) ≥2 SD below the median of the relevant standard with severe stunting or wasting at ≥3 SD below the standards[4–6].

Thus, emphasis on the first 1000 as a crucial period for intervention is based not only on the magnitude of faltering but also on its long-term impact on adult human capital. After 24 months of age on the basis of (HA) differences, growth continues to falter in poor environments with no indication of a levelling[7]. Low sanitation and environmental hygiene will trigger digestive disorders. If this condition occurs, the energy that should be used for growth, will be diverted to the body's resistance to infection. This condition will cause disruption to children's nutrition and cause opportunities to experience stunting. This can be due to the fact that unprotected water sources can be contaminated and increase the risk of infections such as diarrhea, One of the microorganisms that cause diarrhea in the water is the bacterium Eschericia coli (E. coli). In Indonesia, regulations on the requirements for drinking water that is suitable and safe for consumption have been set by the government in PERMENKES Number 492 of 2010[8].

Nutrition program data reports that the percentage of Kendal short toddlers is still quite high at 9.5%, this result is higher when compared to Central Java province in 2021 of 8.9. Data from BPS (Central Statistics Agency) in 2020 Kendal Regency is the focus location for integrated interventions to reduce stunting because it is included in the order of 31 districts/cities based on the existence of stunting in Central Java[9]. Stunting data in Kendal Regency in 2020 based on Community-Based Nutrition Recording and Reporting (E-PPBGM) data for stunting toddlers was 17.54%, an increase from the previous year. The number of villages with high stunting cases is 10 villages in Kendal Regency, one of which is quite high, namely the Sukorejo 01 health center work area. The total stunting cases in 2020 were 337 toddlers or around 15.2% in one "work area" from Puskesmas Sukorejo 01, Kendal Regency, while in 2022 it rose to 18.8% or 431 cases of stunting toddlers[9].

The high rate of stunting in the working area of puskesmas 01 sukorejo kab. One of them is Kalipakis village is influenced by several factors that are interrelated with each other, from the results of the data obtained the author is interested in conducting research on the relationship between the quality of drinking water sources and high cases of diarrhea which can cause stunting rates in the area to be higher. The holding of this research is expected to help reduce the prevalence of stunting in the working area of puskesmas 01 sukorejo, Kendal regency.

2 Method

This type of research is an analytical observational study, using survey methods, where researchers observe and take samples from a population using questionnaires, follow the activities of posyandu toddlers, conduct laboratory tests to measure drinking water samples referring to PERMENKES No. 492 of 2010 concerning drinking water quality

requirements, clean water laboratory tests refer to PERMENKES No. 32 of 2017. The study used *case control* or case control using a retrospective approach. The location of the study was conducted in the working area of puskesmas 01 Sukorejo in Kendal Regency, Central Java. Data collection will be carried out from January - April 2023. The study population was 158 toddlers aged 0 – 59 months. Toddlers were stunted as cases and non-stunted as controls. The *simple random* sampling method is used in grouping sampling samples based on the z-score PB / U or TB / U, height measurements are carried out using *microtoise* and *infantometer*.

The sample size is calculated using *the lameshow sample formula*. The number of samples is based on sample calculations with a ratio of 1: 2, to avoid drop out increased by 10% so that the total sampling becomes 114 respondents with a division of 38 case samples and 76 samples for control. The research analysis unit includes checking the quality of drinking water sources, and microbiological clean water using the APHA 2017 method, Article 9222. J. Chemically and physically with SNI method 06.6989.29.2005, Organoleptis, potentiometer, SNI 6989.81.2018, SNI 6989.84.2019, SNI 6989.71.2009, SNI 6989.77.2011, SNI 6989.20.2019, SNI 06.6989.22.2004, SNI 06.6989.12.2004, SNI 06.6989.9.2004, APHA 4500-NO3 B, SNI 6989.84.2019, SNI 06.6989.24.2005, SNI 06.6989.51.2005, SNI 6989.11.2019, SNI 06.6989.23.2005 by the Center for Health Laboratories of the Central Java Provincial Government Health Office and Testing of Medical Devices sourced from Pamsimas, and spring water sources. Each of them was taken 2 samples (1 sample of the case group and 1 control group) at the initial time (water storage area when it has not been consumed).

Then microbiologically tested for contamination of E., coliform bacteria. Physically tested for pH, taste, odor, color, chemically tested for fluoride, turbidity, TDS, arsenic, iron, chrome val 6, cyanide, sulfate, organic substance, dissolved manganese, hardness, NO2, NO3, dissolved cadmium, dissolved zinc, lead, detergent, and temperature. There were 3 total units of analysis studied, namely 2 samples of drinking water sources, both cases and control groups, then 1 clean water sample. The quality test results of drinking water sources and clean water microbiologically, physically, and chemically are used as descriptive supporting data and statistical tests are not carried out. Research instruments in the form of drinking water source quality questionnaires were taken as primary data with interview and observation techniques. The chi-square statistical test uses SPSS, while for research ethics contains informed consent of research respondents' guardians and is guided by the principle of not harming or harming respondents, maintaining the confidentiality of respondent data. This research has met the requirements of the Health Research Ethics Committee of the Faculty of Public Health, Diponegoro University No: 165/EA/KEPK-FKM/2023.

3 Result

3.1 Characteristics of Parents of Toddlers

Based on the results in Table 1, it can be seen that most parents have 2 children at 57 (50.0%), most parents have a junior high school education at 51 (44.7%), and private parents who work the most are 43 (37.7%).

Table 1. Distribution of respondents according to the characteristics of parents of children under five (children to, parents' last education, and parents' occupation)

Variable	n	%
Boys for		
1,00	42	36.8 %
2,00	57	50.0 %
3,00	15	13.2 %
Parents' Last Education		
Sd	31	27.2 %
First High School	51	44.7 %
Upper High School	30	26.3 %
Universitas	2	1.8 %
Parents' Work		
Worker	6	5.3 %
Private	43	37.7 %
Driver	3	2.6 %
Kewirausahaan	7	6.1 %
Farmer	32	28.1 %
Merchant	22	19.3 %
Pegawai Negeri Sipil	1	.9 %

3.2 Characteristics of Children Under Five

The results in Table 2 show that the most toddler ages ranged from 12 – 24 months by 56 (49.3%), the toddler sex was the most male by 68 (59.6%), the toddler weight at birth was at most 3.0 – 3.2 kg by 73 (64.1%), and the length of toddlers at birth was at most 50 – 52 cm times 74 (64.9%).

Table 2. Distribution of respondents according to toddler characteristics (toddler age, toddler sex, toddler weight at birth, and toddler body length at birth)

Variable	n	%
Age (Month)		
12 Months	2	1.8 %
13 Months	1	0.9 %
14 Months	5	4.4 %
15 Months	2	1.8 %
16 Months	9	7.9 %
17 Months	6	5.3 %
18 Months	4	3.5 %
19 Months	10	8.8 %
20 Months	5	4.4 %
21 Months	4	3.5 %
22 Months	4	3.5 %
23 Months	1	.9 %
24 Months	3	2.6 %
25 Months	7	6.1 %
26 Months	1	.9 %
27 Months	2	1.8 %

28 Months	3	2.6 %
29 Months	4	3.5 %
30 Months	3	2.6 %
31 Months	1	.9 %
32 Months	2	1.8 %
34 Months	5	4.4 %
36 Months	3	2.6 %
37 Months	1	.9 %
38 Months	2	1.8 %
39 Months	1	.9 %
40 Months	2	1.8 %
41 Months	6	5.3 %
42 Months	3	2.6 %
43 Months	3	2.6 %
46 Months	2	1.8 %
50 Months	2	1.8 %
51 Months	3	2.6 %
55 Months	1	.9 %
58 Months	1	.9 %
Gender of Toddler		
Man	68	59.6 %
Woman	46	40.4 %
Toddler weight at birth (kg)		
2.3 kg	1	.9 %
2.4 kg	1	.9 %
2.5 kg	4	3.5 %
2.7 kg	1	.9 %
2.8 kg	6	5.3 %
2.9 kg	6	5.3 %
3.0 kg	35	30.7 %
3.1 kg	19	16.7 %
3.2 kg	19	16.7 %
3.3 kg	8	7.0 %
3.4 kg	5	4.4 %
3.5 kg	5	4.4 %
3.6 kg	2	1.8 %
3.7 kg	1	0.9 %
4.0 kg	1	0.9 %
Toddler body length at birth (cm)		
46 cm	3	2.6 %
47 cm	6	5.3 %
48 cm	12	10.5 %
49 cm	14	12.3 %
49 CM	1	.9 %
50 cm	38	33.3 %
51 cm	22	19.3 %
52 cm	14	12.3 %
53 cm	2	1.8 %
57 cm	1	0.9 %
70 cm	1	0.9 %

3.3 Univariate Results of Research Variables

Table 3 shows the nutritional status of the most toddlers in the non-stunting category at 76 (66.7%), the quality of drinking water sources is good at 71 (62.3%), and for the results of diarrhea in the most toddler samples, toddlers are toddlers who are stunted 110 (96.5%).

Table 3. Distribution of Respondents According to the Incidence of Stunting, Water Sources, Quality of Drinking Water Sources and the Incidence of Diarrhea in Children Under Five

Variable	N	%
Nutritional status(Stunting)		
Unhampered	76	66.7 %
Hampered	38	33.3 %
Drinking Water Source		
Pamsimas	70	61.4 %
Spring Source	44	38.6 %
Quality of Drinking Water Source		
Good	71	62.3 %
Bad	43	37.7 %
Incidence of diarrhea		
Already	110	96.5 %
Never	4	3.5 %

3.4 Bivariate Results of Research Variables

According to the results of Table 4 data, the results of statistical tests conducted show that there is a significant relationship between the quality of drinking water sources and the value of stunting events (p- value = 0.000), then the test of diarrhea incidence with stunting events the value obtained is (ρ- value = 0.000) which means there is a relationship.

Table 4. Quality of Distribution of Drinking Water Sources, Incidence of Diarrhea with the Incidence of Stunting in toddlers

Variable	Stunting				Sum		R
	The		No				
	n	%	n	%	N	%	
Quality of Drinking Water Source							
Good	10	8.8 %	61	53.5 %	71	62.3 %	
Bad	28	24.6 %	15	13.2 %	43	37.7 %	0.000
Incidence of diarrhea							
Already	38	33.3 %	72	63.2 %	110	96.5 %	
Never	0	0.0 %	4	3.5 %	4	3.5 %	0.000

4 Discussion

4.1 Bivariate Analysis of Drinking Water Source Quality with Stunting Incidence in Children Under Five

The results of statistical data research stated that there was a significant relationship between the quality of drinking water sources and stunting toddlers (p = 0.000). Another study also revealed that in Ethiopia Drinking water sources are also associated with stunting in children under five. Research results Eka, et. al. 2022 shows the same results, namely the relationship between water quality and the incidence of stunting at the Candipuro Health Center with a p value (0.005). However, there are also the results of some studies that are not in line with this study, such as research conducted by Angki Irawan and Henny Sesanti B.S, (2022) there is no relationship between physical quality of drinking water and stunting[10–12]. Piped water in limited resource settings may be at high risk of faecal contamination due to inadequate or non-existent disinfection. Studies in Ethiopia and Egypt have provided evidence of a higher risk of diarrhea among individuals with intermittent piped water supplies than among those with continuous piped water supplies.

For microbiological parameters such as total E, and total Coliform do not exceed the provisions of quality standards or emphasize that no total coliform content should be found in drinking water. The chemical parameters in question are fluoride, turbidity, TDS, arsenic, iron, chrome val 6, cyanide, sulfate, organic substances, dissolved manganese, hardness, NO2, NO3, dissolved cadmium, dissolved zinc, lead, detergent, and others. The results of Apriluana's research show that toddlers with inadequate or inadequate sanitation have a chance of stunting 1.37 times, while insufficient or unqualified water will have a chance of stunting 1.09 times. The results of the study in Sumatra also stated that toddlers from families with access to unprotected or inadequate drinking water sources will be at 1.35 times the risk of stunting.[8, 13, 14] 2.0 billion people do not have access to a safe place to manage drinking water. Nor do 3.6 billion people have access to safely managed sanitation services[14–16].

Based on prevalence ratios and 95% confidence intervals, boiling drinking water is a risk factor for stunted children under five. WASH or unsafe water and sanitation interventions are estimated to cause more than 1 million deaths from infectious diseases each year [17] Children with raw water consumption were 1.46 times more likely to be stunted than those who drank boiled water[1]. This is consistent with Indian research showing that children who consume raw water are more likely to be stunted than children who consume processed drinking water. Unsafe sanitation management can increase children's risk of developing infectious and parasitic diseases that tend to worsen children's nutritional status.[18, 19] Stunting prevention can be done by increasing access to clean water and sanitation facilities, as well as maintaining the cleanliness of the environment around us. Clean water, as well as good sanitation will be able to prevent the development of diseases that can affect the degree of health nutritional status, especially malnutrition[12].

Statistical data revealed a relationship between the quality of drinking water sources and stunting in Kalipakis village due to observations and laboratory tests that the quality of drinking water sources used did not meet the requirements of microbiological parameters such as E. and Coliform bacteria that exceeded the quality standards set by drinking water source quality related to infectious diseases suffered by toddlers such as diarrheal diseases, If the toddler suffers from diarrhea, it can affect the nutritional condition. The better the quality of water sources for consumption, it can reduce diarrhea and also the incidence of stunting.

4.2 Bivariate Analysis of the Incidence of Diarrhea with the Incidence of Stunting in Toddlers

Statistical analysis shows an interrelated relationship between diarrhea and stunting in toddlers. This study is the same as the research of Angki Irawan and Henny S (2022) which states that there is a relationship with (p – value 0.007) between the incidence of diarrhea and the incidence of stunting[12]. Other studies also state that there is a history of relationships Diarrheal infectious diseases with stunting in children 12 – 59 months, according to the results of research conducted by Novikasari, et al (2021) P value = 0.000 OR 3.236 Conclusions based on research state that children with a history of infection are 3x more at risk of stunting[20]. Unsanitary conditions have been linked to stunting through various mechanisms and pathways such as recurrent diarrhea, infectious pathways, and enteric environmental dysfunction (EED)[19].

Enteric infections will disrupt the absorption function of nutrients in the intestine, causing up to 43% stunted growth. It can affect one-fifth of children worldwide and one-third of children in developing countries. During the first two years, a child has an infectious disease, he or she can experience an average growth decline of 8 cm and a 10-point decrease in IQ when they are 7-9 years old. This suggests that infectious diseases in children can result in stunted growth[21].

Diarrhea itself may not represent a direct cause of wobbly growth, but rather, indicate enteric inflammation and dysfunction. Recent findings of Risk factors and Interactions of Enteric Infection and Malnutrition and Consequences for Child Health and Development reveal that children with enteric pathogens develop enteric inflammation and reduced linear growth[22]. Unqualified latrines or sanitation can cause health and ecological impacts related to microbiological contamination and chemical content of water[23].

Toddlers who have a history of diarrheal diseases with frequent frequency are often at greater risk of stunting, because toddlers who have a history of repeated diarrhea will experience impaired absorption of nutrients so that nutritional needs in the body are not met and will also inhibit the growth and development of the toddler. Long duration of diarrhea (more than four days) and inadequate food interventions cause toddlers to lose nutrients[24]. The mechanism of transmission of diarrhea is generally through oral feces, through food or drink contaminated by enteropathopathogens, or direct contact of hands with patients or items that have been contaminated with feces or indirectly through flies (through 4f = *finger,files,fluid,field*)[19]. Poor sanitation and also unsafe drinking water lead to diarrheal diseases and environmental enteropathy, in the absorption of hibitic nutrients in the small intestine, which can lead to malnutrition and stunting[25].

Between infection and malnutrition there is a close relationship between the two. Infection is the cause of malnutrition due to decreased food intake, decreased absorption of nutrients in the small intestine and increased catabolism of nutrients needed for tissue repair. Conversely, malnutrition can be a factor in the occurrence of infection due to decreased protection of the intestinal mucosal barrier and trigger changes in the patient's immune function, thus increasing the risk of infection, especially enteral infections.[12] Infection becomes a direct obstacle to metabolic processes, including epiphyseal plates of growth which can cause growth disorders in children through malnutrition.[26] Environmental enteropathy and recurrent diarrhea due to fecal, environmental contamination and ingestion by young children are often associated with widespread open defecation practices or improper fecal discharge, theorized to increase the risk of stunting through reduced nutrient absorption and inflammation.

Another study conducted in Central Bengkulu showed different results from this study and several previous studies on the absence of a relationship between diarrheal illness and stunting toddlers with a p value of 0.237. Toddlers who often experience pain, Growth and development will be disrupted if this is left unchecked can lead to malnutrition. Bad water *Hygiene* and sanitary facilities and bad behavior can cause diarrhea, *enteropathy*, or intestinal worm infection. This condition will have an impact on nutritional status caused by loss of appetite, poor digestion (malabsorption of nutrients), and other effects on diseases such as fever that can divert energy and nutrient use[27].

Environmental factors are closely related to infectious diseases. Poor environmental conditions such as children often playing with pets, water reservoirs that are never cleaned, not using footwear or sandals when playing, and also litter or piling up a lot next to or behind the house can cause recurrent diarrhea to occur.

5 Conclusion

Based on the results of data analysis and discussions that have been conducted, it can be concluded that the distribution of stunting toddlers in Kalipakis village, Sukorejo District, Kendal Regency is most commonly found in the age group of 12-24 months with male gender. Most respondents experienced stunting in the control category by 66.7%, the quality of drinking water sources that were not of quality by 37.7%, pamsimas drinking water sources by 61.4%, and the incidence of diarrhea by 96.5%. The results of processing research data with chi-square related to the quality of drinking water sources with stunting cases of toddlers in Kalipakis village, Sukorejo District, Kendal Regency with a value of $\rho = 0.00\%$. Likewise, the interconnection between the incidence of diarrhea and stunting of toddlers in Kalipakis Village, Sukorejo District, Kendal Regency, p-value = 0.00%. Advice for relevant agencies such as puskesmas and other village health offices to conduct periodic visits or monitoring the quality of drinking water sources, as well as a history of infection. In addition, it is expected to increase community participation by providing counseling to the community about maintenance, improving sanitation, providing clean water and drinking water for residents.

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