PROCEEDING SRIWIJAYA INTERNATIONAL CONFERENCE OF PUBLIC HEALTH 4th
"Health and Nutrition Innovation for Better Life Style in Digital Era"
September 21st, 2023 | The Zuri Hotel, Palembang

RISK FACTOR DETERMINANTS OF BACTERIOLOGICAL QUALITY OF REFILLDRINKING WATER IN *PALEMBANG* CITY

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ABSTRACT

Various previous studies in various big cities in Indonesia have shown that Refill Drinking Water is less safe and can be detrimental to human health due to contamination by bacteria. One of the studies by Inoy Trisnaini in Ogan Ilir Regency, South Sumatra in 2017 obtained the results of 13 Refill Drinking Water Depots (32.5%) of the water samples positive for coliform bacteria. This study aims to analyze what factors influence the presence of coliform bacteria in refill drinking water from refill drinking water depots. This research is an analytic observational study using a cross sectional method. The sample in this study was 50 Refill Drinking Water Depots in Palembang City. Data were analyzed univariately and bivariately, and laboratory tests were carried out for the content of coliform bacteria in water samples. Test the content of coliform bacteria using the Most Probable Number method with reference to SNI 1-3554-2006. Bivariate data analysis used the chi square statistical test. Results: The bacteriological laboratory test of drinking water samples taken from 50 refill drinking water depots found 6 positive samples of water containing coliform bacteria, so it is not in accordance with the Regulation of the Minister of Health of the Republic of Indonesia number 492/Menkes/IV/2010. Statistical tests showed that the sanitation variable, namely the condition of the garbage collection site, had a relationship with the coliform bacteria content of drinking water from refill drinking water depots in Palembang City. There are still Refill Drinking Water Depots in Palembang City that do not meet health requirements in implementing hygiene sanitation. So as to increase the knowledge and awareness of Refill Drinking Water Depots employees regarding sanitation hygiene and supervision from the health office.

Keywords: hygiene, sanitation, refill drinking water.

Introduction

Previous studies in various major cities in Indonesia have shown that AMIU is unsafe and can be detrimental to human health due to bacterial contamination.[1,2,3,4,5] Research conducted by the Bogor Agricultural Institute (IPB) and the Food and Drug Monitoring Agency (BPOM) states that most drinking water products produced by DAMIUs are considered not to meet the standards of the bottled drinking water industry. The research was conducted in several major cities such as Jakarta, Bandung, Medan and Surabaya. The results of research in these two institutions showed that refill drinking water was

bacteriologically contaminated with Coliform bacteria, *E. Coli*, salmonella, while chemically the water samples were detected to contain heavy metal cadmium.[6] Based on test data from the Environmental Health Engineering Center, Palembang city has 136 depot units with 10 health

centers. However, not all refillable drinking water depots are well managed according to the requirements of Permenkes No. 43 of 2014 related to sanitary hygiene of drinking water depots. And based on the results of laboratory tests, there are 11 DAMIUs that are proven to contain coliform bacteria in their refill water.[7] In addition, research by Inoy Trisnaini in Ogan Ilir District, South Sumatra in 2017 found that 13 DAMIUs (32.5%) tested positive for coliform bacteria. Considering the increasing use and utilization of AMIU for the vital needs of the community and the indications of unsafe AMIU in various big cities in Indonesia, including in Palembang City, it is necessary to supervise or monitor and adequately test the safety of AMIU circulating in Palembang City.[8] People also generally pay less attention and rational consideration regarding the safety and hygiene of AMIU because the main consideration is the affordable price. This is also driven by conditions where the availability of clean and safe drinking water is lacking. This is necessary because people cannot actually see whether the AMIU consumed in Manado city is safe or not. To know whether the AMIU is contaminated or not, research or clinical testing in the laboratory is needed.

Method

The study used a cross sectional design. All variables were measured at the same time to determine the effect of independent variables on the dependent variable. This research was conducted in Palembang city, namely at refill drinking water depots spread across 10 sub-districts in Palembang city, namely Jakabaring sub-district, Sebrang Ulu II sub-district, Alang-Alang Lebar sub-district, Sukarami sub- district, Kemuning sub-district, Kalidoni sub-district, Ilir Timur II sub-district, and Ilir Timur I sub- district.

The population used in this research is all Refillable Drinking Water Depots (DAMIU) in Palembang City. The sample in this study is part of the existing Refillable Drinking Water Depots (DAMIU) in Palembang City, both registered and unregistered. The sample size was obtained through the two-group two-sided Independent Proportional Hypothesis Test formula so that the sample size was 50.[9,10] Sampling was done by *simple random sampling*. Microbiological laboratory tests were conducted to determine the coliform content of water samples. The method of analyzing water samples is Most Probable Number (MPN) with reference to SNI 1-3554-2006, compared based on Permenkes RI No. 429 of 2010 concerning Drinking Water Quality.

Results

Based on the results of the research, a description of several hygiene and sanitation conditions of IlangDrinking Water Depots in Palembang City was obtained, as shown in the following tables:

Table 1. Sanitation of Refillable Drinking Water Depots in Palembang City

Characteristics	Category	Frequency	Percentage (100%)
Presence of Fly Vectors	Yes	48	96
	No	2	4
Total Data		50	100
Handwashing Facilities	Available	31	62
	No	16	38
Total Data		50	100
Availability of hand washingsoap	Available	25	50
	No	25	50
Total Data		200	100
Availability of Flowing Water	Available	27	54
	No	23	46
Total Data		50	100

Table 2. Personal Hygiene of Refillable Drinking Water Depot Managers in Palembang City

Category n %		
No Smoking	49	98
Smoking	1	2
No Eating and Drinking	47	94
Eating and Drinking	3	6
Nails are short and not polished	49	98
Long, painted nails	1	2
Clean and tidy hair	50	100

Inspection of sanitary conditions showed that >90% of depots were free of vector flies and insects. Most depots (62%) have provided hand washing facilities, with 50% of depots providing soap and hand sanitizer labs, and 54% providing running water facilities for hand washing. As for the application of

personal hygiene, the majority of depot managers have implemented it well. The results of laboratory tests on the content of coliform bacteria found that out of 50 samples, 6 water samples from refill drinking water were positive for coliform bacteria, which were then tested for association to see the relationship with the application and condition of sanitation hygiene at the refill drinking water depot.

Based on Table 3, 38 DAMIUs (76%) have operating licenses. In addition, 53% of the DAMIUs included in the analysis started operating between 2010 and 2016. Meanwhile, 47% of the DAMIUs started operating below 2010.

Table 3. Relationship between DAMIU operation license and bacteriological content of refill drinkingwater in Palembang City

Bacteriological Quality Drinking Water Operation License	Not Eligible		Eligible		Total	P Value
	N	%	N	%	N	
License to operate	5	13,2	33	86,8	38	0,654
No Operating License	1	8,3	11	91,7	12	
Total	6	12,0	44	88,0	50	

Table 4 shows that the majority of the 42 DAMIUs (84%) sourced their raw water from wells. Theremaining 8 DAMIUs (16%) sourced their raw water from PDAM.

Table 4. Relationship between DAMIU Raw Water Source and Bacteriological Content of RefillableDrinking Water in Palembang City

Raw Water Source	Bacteriological Quality of Drinking Water				Total	P Value
	Not Eligible		Eligible			
	N	%	N	%	N	
PDAM	1	12,5	7	87,5	8	0,962
Well	5	11,9	37	88,1	42	
Total	6	12,0	44	88,0	50	

Table 4 shows that the majority of the 42 DAMIUs (84%) sourced their raw water from wells. Theremaining 8 DAMIUs (16%) sourced their raw water from PDAM.

Table 5. Relationship between DAMIU hygiene and bacteriological content of refill drinking water in Palembang City

Hygiene	Bacteriological Quality Drinking Water				Total	P Value
	Not Eligible		Eligible			
	N	%	N	%	N	
Clean	5	10,4	43	89,6	48	0,091
Dirty	1	50	1	50	2	
Total	6	12,0	44	88,0	50	

Based on Table 5, the majority of the 48 DAMIUs (96%) studied in Ogan Ilir District showed thatthe depots were clean from dirt and dust.

Table 6: Relationship between DAMIU waste disposal site and bacteriological content of refillabledrinking water in Palembang City.

	Bacteriological Quality Drinking Water					
TPS	Not Eligible		Eligible		Total	PValue
	N	%	N	%	N	
Closed	3	30	7	70	10	0,049
Open	3	7,5	37	92,5	40	
Total	6	12,0	44	88,0	50	

Based on Table 6, 40 DAMIUs (80%) studied in Palembang City had open waste bins. The statistical test results show that there is a significant correlation between the condition of the waste disposal site and the bacteriological quality, namely coliform bacteria content in refill drinking water in Palembang City.

Table 7. Relationship between Periodic Supervision of DAMIU and Bacteriological Content of RefillableDrinking Water in Palembang City.

	Bacteriological Quality Drinking Water					
Surveillance	Not Eligible		Eligible		Total	P Value
	N	%	N	%	N	
Yes	4	11,1	32	88,9	36	0,495
Sometimes	1	33,3	2	66,7	3	
Never	1	9,1	10	90,9	11	
Total	6	12,0	44	88,0	50	

Based on Table 7, out of 50 respondent DAMIU owners/employees, 11 (22%) stated that periodicsupervision of DAMIUs had not been conducted in recent years. Meanwhile, the majority (78%) stated that periodic supervision was conducted.

Discussion

Bacteriological laboratory test results from drinking water samples taken from 50 refill drinking water depots found 6 water samples positive for coliform bacteria. The Indonesian Minister of Health Regulation number 492/Menkes/IV/2010 states that healthy drinking water must meet physical, chemical, and microbiological requirements. Some of these requirements include water must be clear or not cloudy, colorless, tasteless, neutral pH, not contain toxic chemicals, low hardness, and must not contain pathogenic bacteria such as coliform bacteria and Escherichia coli. Based on this regulation, it is clearly stated that one of the requirements that must be met in drinking water quality with the parameter of coliform bacteria content is allowed to be 0/100 ml of water.[11] Coliform bacteria are indicator bacteria for the presence of other pathogenic bacteria. Determination of fecal Coliform as an indicator of pollution because the number of colonies is

positively correlated with the presence of Escherichia coli bacteria if it enters the digestive tract in large quantities can endanger health.[12]

Consumption of drinking water contaminated with coliform bacteria can cause gastrointestinal diseases such as diarrhea. Diarrhea is an endemic disease in Indonesia and is also a potential disease of Extraordinary Events (KLB) which is often accompanied by death.[13] One of the efforts to reduce the incidence of diarrheal disease is to pay attention to the quality of drinking water consumed every day. In today's society, the fulfillment of drinking water is by utilizing refill drinking water. The presence of refill drinking water on the one hand supports efforts to realize a healthy society because in addition to expanding the reach of clean water consumption it can also be an alternative as a source of drinking water that is suitable for drinking at a relatively cheap price, but on the other hand the community pays less

attention to quality indicators of the quality of drinking water it consumes.[14] Several previous studies have reported that drinking water products produced by refillable drinking water depots guarantee low quality and many are contaminated with bacteria.[15,16,17,18,2,19,20] One of the only studies by Trisnaini in 2018, that of all refill drinking water depots in Ogan Ilir Regency, totaling 40 depots, 13 DAMIUs (32.5%) were obtained whose water samples were positive for coliform bacteria. [8]

The majority of the studied DAMIUs, 38 DAMIUs (76%), had operating licenses, with 53% of the DAMIUs starting operations between 2010 and 2016, while the remaining 47% started operations below 2010. Statistical test results showed that there was no significant association between DAMIU operating license and bacteriological quality of refill drinking water in Palembang City. However, this result is in contrast to several other studies that found a significant association between DAMIU operating licenses and the bacteriological quality of refill drinking water. In a study conducted by Haryuni et al (2014), the majority of operating DAMIUs (92.4%) sampled in the study did not have an operating license. The study also found that there was a significant relationship between the presence or absence of a license and the bacteriological content of the water samples. These results indicate that the operating license of a DAMIU is a matter of great concern, as the presence of a license issued by the health office indicates that the DAMIU is registered and is one of the DAMIUs that will be supervised by the relevant office, including supervision of the quality of drinking water produced and the hygiene and sanitation conditions of the depot. [21]

A total of 22 DAMIUs (55%) source their raw water from PDAM. The remaining 18 DAMIUs (45%) sourced their raw water from mountain water. The source of raw water used will determine the quality of the refill drinking water produced. In fact, not only the source, but also the storage of raw water for too long can also affect water quality, which can lead to the growth of microorganisms. Depots that store their raw water for more than 3 days may be another cause of

Coliform bacteria in raw water samples at AMIUdepots.[22] In addition, storing raw water for a long time can affect the quality of drinking water, besides bacteria will grow a lot, it also affects the need for oxygen to oxidize chemicals chemically increasing, as well as decreasing pH, hardness, and chemical Fe ion content.[23] Based on Minister of Industry and Trade Decree No. 651 of 2004, it is stated that refillable drinking water depots are prohibited from taking raw water from PDAM water contained in the distribution network for households. The raw materials used for DAMIU purposes must come from sources whose quality has been guaranteed by Kepmenperindag No. 651 of 2004. In addition, the remoteness of the raw water source poses a risk of pollution, especially when filling raw water into the transport tank car or when transferring raw water from the tank car to the water storage reservoir at the DAMIU.[24]

Statistical test results showed that 40 DAMIUs (80%) studied in Palembang City had open waste disposal bins. Another study also found that the majority of the depots did not have waste disposal bins that meet health requirements.[25] Statistical tests also showed that there was a significant relationship between the condition of the waste containers and the bacteriological quality, namely coliform bacteria content in refill drinking water in Palembang City. Poor sanitation and low hygiene can cause contamination. This problem needs to be overcome by minimizing the possibility of bacterial contamination, one of which is the cleanliness of depots and operators.[26] In addition, the quality of drinking water produced is inseparable from the treatment of depot officers before and after the water is treated, the results of observations when researchers took water samples showed that there were several AMIU depots that did not have hand washing stations and hand soap to wash the hands of depot officers, so that depot officers only washed their hands when washing the outer gallon, and did not use soap.

According to the Indonesian Ministry of Health (2006), operators must implement clean and healthy living behavior (PHBS) practices, not smoking while working, not spitting or sneezing carelessly, holding clean gallons and always getting used to washing hands when serving consumers. Meanwhile, from the observation, there are still depot managers who smoke and have not implemented personal hygiene properly. The low quality of refill drinking water can be caused by the low knowledge of owners or workers regarding sanitary hygiene in refill drinking water depots which has an impact on poor sanitary hygiene practices in maintaining drinking water quality. This is also in line with the lack of socialization and education from the local Health Office and related parties regarding hygiene and sanitation.[27]

Conclusion

Bacteriological laboratory test results from drinking water samples taken from 50 refillable drinking water depots found 6 water samples positive for coliform bacteria, thus not in accordance with the Indonesian Minister of Health Regulation number 492/Menkes/IV/2010. Statistical tests

showed that the sanitation variable, namely the condition of garbage containers, was associated with the microbiological quality (coliform bacteria content) of drinking water from refill drinking water depots in Palembang City.

Acknowledgement

Thank you to all those who have played a role in this research, so that it can be carried out as it should.

Funding

This research was funded by the Institute of Research and Community Service of Sriwijaya University.

Conflict of Interest:

The authors declare that they have no conflict of interest.

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