

The Relationship between the Existence of Bacterial Type from Hand and Feces with Water Piping on Elementary School Students on the Riverbanks of Kuin Banjarmasin

Lia Yulia Budiarti¹, Rahmiati¹, Laily Khariyati², Rudi Fakhriyadi²

¹Department of Microbiology, Medical Faculty of Universitas Lambung Mangkurat Banjarmasin

¹Reset Centre Unit, Medical Faculty of Universitas Lambung Mangkurat Banjarmasin

² Department of Epidemiology and Public Health, Medical Faculty of Universitas Lambung Mangkurat Banjarmasin

Correspondent: lia_arivin@ymail.com

ABSTRACT

Diarrhea is the one of public health problem especially in children who live along the river in Banjarmasin. The increasing incidence of diarrhea and waterborne diarrheal diseases are associated with river water contaminated by coli stool bacteria for domestic use. Hands can be potential source from various types of bacteria, including coli stool bacteria that can cause diarrhea. This study aims to identify and analyze the relationship between the presence of bacterial species from hand swab, stool, and coliform samples in piped water to elementary school students who live around the riverbanks of Kuin Banjarmasin. This research uses analytic survey method. The population or subject of this research are students from Elementary School of Kuin Selatan and Kuin Cerucuk who live around riverbanks of Kuin Banjarmasin. The samples of this study are hand swab, stool swab, and piped water samples that used to wash the hands or stool of the subjects studied. The number of samples studied each group are 30 samples and sampling is done randomly according to the inclusion criteria of this study. The study was held in May-August 2017. The identification conducted through examination of bacterial conventionaly. The variables of this research are level of MPN Coliform of river water, identification of bacterial type from river water sample, hand swab, and feces swab from research subject. The data were analyzed descriptively and using Chi square test at 95% confidence level to assess whether there is any correlation between water coliform variables of piping with bacteria on hand and stool. The results of identification on hand swab sample found 2 isolate bacteria, *S.aureus* (67,7%) and *E.coli* (23,3%). The results of identification on feces samples of elementary school students found 27 isolates *E.coli* (90%) and 3 isolates *S.typhi* (10%). The results of the examination on the piped water samples found 26 posiive sample that contaminated coliform bacteria with Coliform values ranging from 2.0/100ml - 4. 0/100ml water samples and the identifiable coliform species *E.coli*. The conclusion is there is no relation between the bacterial on hand with positive coliform type in piping water samples; there is a relation between bacterial on stool with bacterial coliform (*E.coli*) in piping water samples.

Keywords: air piping, hand bacteria, coliform, elementary students, kuin river

Banjarmasin

INTRODUCTIONS

Sanitation and poor environmental hygiene is the one of the contributing factors to the high incidence of diarrhea among Indonesian students, which is related to clean water facilities (Yeni I, 2011). River is one source of water for human life. The water of the Barito River and the Martapura River that surrounds the city of Banjarmasin has begun to be polluted. According to a report of river analysis data by the Environment Agency of Banjarmasin, the *E. coli* content at the pickup point in the Kuin river which connects the Barito river and the Martapura river in November 2014 reaches 650 mg/water sample (BLH, 2014). One source of contamination is contamination of coliform bacteria and an average *E.coli* content of more than 500-4500MPN/100ml of river water is obtained. High levels of *E.coli* in river water can cause various diseases such as diarrhea (Sujaya N, et al., 2010).

The physical condition of the river and poor hygiene & health behavior of the people along the river can increase the number of diarrheal infections and can result in increasing the number of cases of morbidity and outbreaks and death (Adisasmito, 2007). The results of previous research showed that the water quality of Martapura River in 2007 and Pekapuran River Banjarmasin in 2014 is not feasible for consumption, that is with the value of coliform contamination or MPN Coliform of > 240. The types of bacteria identified in both rivers are *E.coli* as the highest cause of diarrheal bacteria. Other types of

bacteria are *S.typhi*, and *P. aeruginosa sp.*, (Budiarti, LY, 2007; 2014).

The incidence of diarrheal infections in primary school-aged children may increase due to the behavior of having snack at stall that provide food contaminated with bacteria from the soil, dust, or contaminated water. The incidence of diarrhea can also occur due to a diarrhea career that can contaminate the foods which they handle. Hand can be the source of various bacterial from normal flora like *S. epidermidis* and *E.coli* which is a causative agents of diarrhea (Budiarti, 2015). The result of bacterial identification on hand swab of elementary school students in Pekapuran Raya Banjarmasin River at 2014, there are some kinds of bacteria such as *S.aureus*, *S. epidermidis*, and *E.coli*; *E.coli* obtained on the hands as the causative agent of diarrhea (Budiarti, 2014; Budiarti, 2015).

The high cases of bacterial infections by river water due to the many residents of Banjarmasin who using the river water that has been polluted (Anonymous, 2007). Health data shows that more than 150,000 people still use river water for domestic uses such as cooking, washing and latrines, the problems of people living on riverbanks (Kasnodihardjo, et al, 2007).

RESEARCH METODE

This study is an analytic survey, consist of identification stage of bacteriology in the laboratory and data analysis to find the attachment or relationship between the variables studied. This research was conducted from May to August 2017. The research location was at SDN Kuin

Selatan 5 and Kuin Cerucuk 3 Banjarmasin, and Microbiology Laboratory of Medical Faculty of Unlam Banjarbaru.

The population in this study are elementary school students who living around the riverbank of Kuin Banjarmasin. The subjects of this study were water samples used for hand washing and causative bacterial of diarrhea that isolated from swab hands of SDN Kuin Selatan and Kuin Cerucuk Banjarmasin students. The sampling of this research subjects was done randomly against students base on the inclusion criteria in this study. The number of river water studied was 30 samples. Students who has role as research samples will be requested to give the samples of river water samples, hand swab, and stool swab. Total sample of hand swabs and faeces studied were 30 samples. The inclusion criteria of this study were the students of SDN Kuin Selatan and Kuin Cerucuk who lived around the Kuin River and used tap water and river water for the washing hands, students who had suffered from diarrhea at least 3 months before, students who was not suffered diarrhea and not consumption antibiotics when the research was conducted; and want to be the subject of research with informed consent approval.

The identification of research are: (a) Identification of

stool bacteria as bacterial contaminants on water samples that used by SDN students in riverbanks of Kuin Banjarmasin. The bacteriology quality of the sample water are examined based on MPN coliform river water and compare with the standard of MPN coliform based with Permenkes RI No. 416 / Menkes / Per / IX / 1990; (b) Identification of the type of piped water bacterial, the type of bacteria in hand swab and stool samples carried out through macroscopic and microscopic identification and biochemical tests)..

RESULT & DISCUSSION

a. Type of bacteria in hand swab samples of elementary students on the riverbanks of the Kuin Banjarmasin

The results of identification in this study obtained 2 types of bacterial isolates that is as much as 20 isolates or 67.7% *S.aureus* and as many as 10 isolates or 23.3% *E.coli*. The results of this study did not differ much with previous research on the type of bacteria in the hands of the students of SDN Pekapuran Raya and Alalak Selatan Banjarmasin, which obtained *S.aureus* as the most common bacterial isolate (Budiarti, 2016).

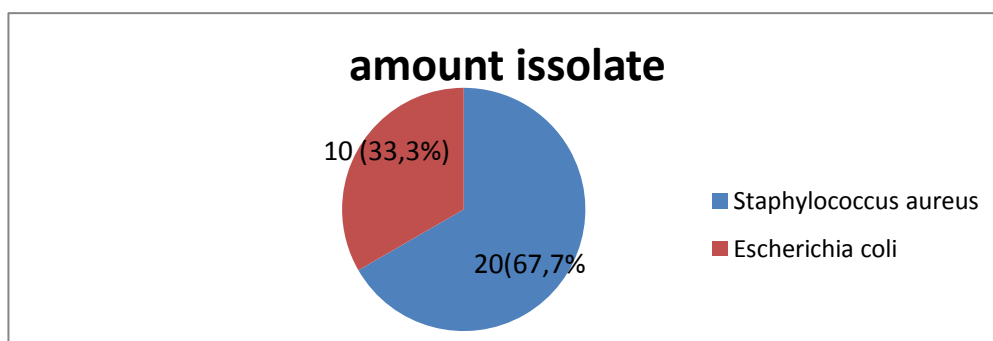


Figure 1. Type of bacterial isolates on the hands of elementary students on the riverbanks of

Kuin Banjarmasin (N = 30)

Staphylococcus aureus is one of the normal flora of the skin, nasal mucosa, and respiratory tract. Transmission can occur either directly or indirectly. Clinical manifestations of these bacteria in humans include pneumonia, endocarditis, scalded skin syndrome, impetigo, meningitis, and sepsis. *E.coli* is a bacteria that is found in the human colon as a normal flora. *E.coli* is associated with a type of intestinal disease in humans (diarrhea), this is associated with enterotoxin released by this bacterium, namely toxin LT (thermolabile) and ST toxin (thermostable). *E.coli* found in the hands due to direct contact of the hands with areas contaminated with these bacteria such as genitals and anus.

In the skin of the palm of the hand is still obtained type of bacteria, because on the skin surface there are many foods that support the growth of bacteria such as fat, nitrogen, and minerals. The existence of bacteria in human skin is affected by age, diet, health hormone, and hygiene. Important factors in reducing / removing microorganisms that do not include normal skin flora are low pH, fatty acids in oil gland secretions, and the presence of lysozyme. Actions to prevent the presence of bacteria in the hands can be done with measures such as maintaining hand hygiene by washing hands with soap / antiseptic and running water in the proper handwashing order. The use of antibacterial or antiseptic substances

can lower the bacterial colonies of the hand. Differences in the nature and characteristics of gram positive and negative can affect in colonization and the effectiveness of the action of antibacterial substances.^{34,35}

The discovery of the types of bacteria in the hands after hand washing can be caused by procedural differences in hand washing in every hospital, hospital environment, and nursing work location. The factors that can affect the type of bacteria in the hands are the colonization of normal flora that is opportunistic and the act of hand washing is not effective or time lapse between washing hands with hand swabs for too long. 4, 9, 10, 30,31

The skin of the palm is not free from microorganisms because on the surface of the skin there are many foods that support the growth of bacteria such as fat, nitrogen, and minerals. Microorganisms in the human skin are affected by age, diet, health hormones, and hygiene. Important factors in removing microorganisms that do not include normal skin flora are low pH, fatty acids in oil gland secretions, and the presence of lysozyme. 31

The part of the hand is one part of the body that most often make direct contact with other objects, then before eating it is advisable to wash hands with soap and running water. A Cochrane study results found that in social movements by agencies and communities to get used to wash hands causes a significant decrease in the incidence rate of diarrhea. A

non-sanitary bowel movement is a source of transmission of waterborne and foodborne diarrheal diseases.

b. Types of bacteria in stool samples of elementary students on the riverbanks of Kuin Banjarmasin

The result of identification of 30 samples of feces / stool of

healthy elementary school students still found *E.coli* 27 isolate (90%) and *S.typhi* 3 isolate (10%). The results of this study can illustrate that there are bacteria *E.coli* and *S. typhi* on stool some of the students of South Kuin Elementary School who live around the riverbanks of Kuin Banjarmasin and can spread diarrhea diseases.

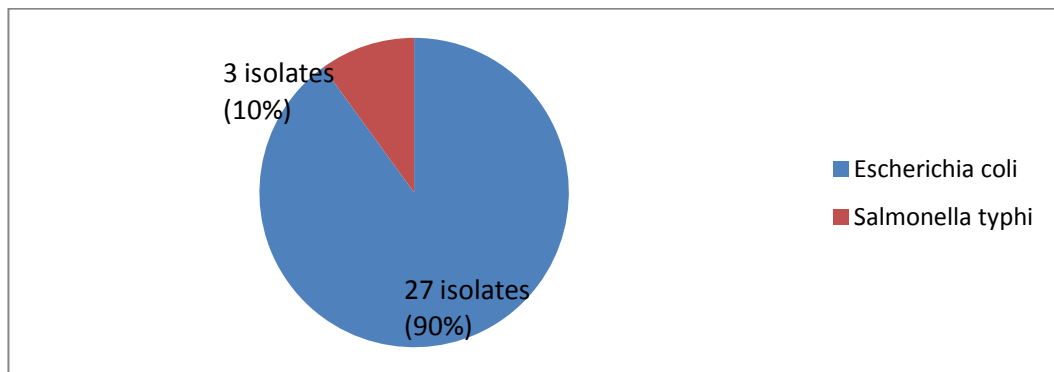


Figure 2 Types of bacterial isolates in stool samples of elementary students on the riverbanks of Kuin Banjarmasin (N = 30)

Diarrhea caused by *E. coli* is caused by the type of ETEC (Enterotoxigenic *E. coli*) causing "Treveller's diarrhea", EPEC (Enteropathogenic *E. coli*), EIEC (Enteroinvasive *E. coli*), EHEC (Enterohemorrhagic *E. coli*), EAaggEC (Enteroadherent aggregative *E. coli*), and EAEC (Enteroadherent *E. coli*) as the cause of "Treveller's diarrhea" (4). The source of transmission of diarrheal diseases is through waterborne diseases and diarrhea-causing agents are often found in contaminated water sources. (4) When contaminated water is used by healthy people it can make people affected by the diarrhea-causing agent (13). Environmental factors related to diarrheal risk are associated with sanitation, including clean water facilities, latrines,

bacteriological quality of water, sewerage, and housing conditions (14,15).

Salmonella typhi is a bacterium that causes typhoid / fever typhoid. There are three bioserotypes: *Salmonella paratyphi* A, B (*S. schottmuelleri*), and C (*S. hirschfeldii*) (4). Typhoid is an endemic disease that is included in health problems in developing countries and in Indonesia typhoid can be found throughout the year with the highest incidence in endemic areas (16,17).

Typhoid is a systemic infectious disease caused by *Salmonella enteritica* bacteria, especially serotype *S.typhi*. There are two sources of *S. typhi* transmission: patients with typhoid and a more frequent carrier. This infection is transmitted by consumption of food or water contaminated with impurities (4). In endemic areas, transmission occurs through

contaminated *S.typhi* water whereas in nonendemic areas due to food contaminated by careers is the most common source of transmission. Poor individual hygiene is the source of the disease although the general environment is good. Generally the disease is more often suffered by students-students-students. Adults often experience with unusual symptoms, then disappear or heal on their own (15,16,17,18).

Diarrheal infections can only spread if the microorganisms that enter the body of water used by the community to meet daily needs. In addition to the hydrosphere, the spread of diarrheal diseases is also influenced by societal or sociosphere behavior. The spread of this disease, such as infectious diseases of the gastrointestinal tract can also be caused by unusual hand washing after a bowel movement, and community communities do not attach importance to the provision of this washing facility. Transmission through water, soil, food, and vector media is also determined by the treatment and ethics of the

community towards the surrounding environment (15,16,17,18).

A non-sanitary bowel movement is a source of transmission of watery and foodborne diarrheal diseases. Habitual bowel movements at the soil surface and times by people in Indonesia are still high, allowing high diarrhea morbidity and the biggest cause of death in Indonesia. Sanitary latrines are a means of functioning to break the chain of transmission of diarrheal diseases, absolutely necessary to be improved in order to combat diarrhea (15,16,17).

c. Coliform Water Piping on the riverbanks of Kuin Banjarmasin

The coliform percentage description of the piped water samples used by students of the Sungai Kuin Banjarmasin Elementary School residing on the riverbanks of the Kuin Banjarmasin is shown in Figure 3 and Table 1.

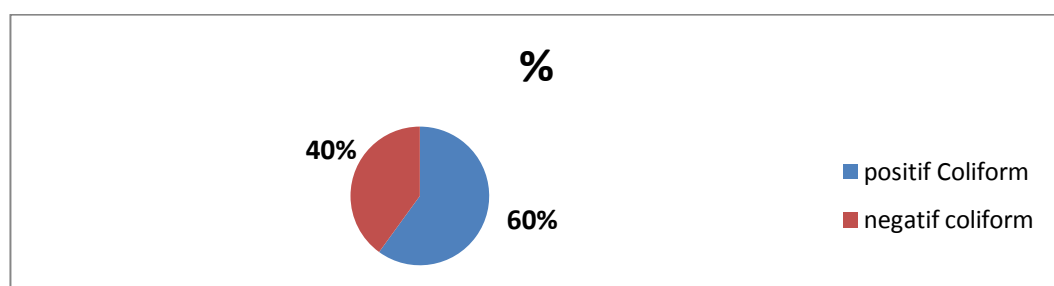


Figure 3 Coliform percentage of the piped water sample used elementary students on the

riverbanks of Kuin Banjarmasin (N = 30)

The results of this study can show that 60% of piped water used for daily activities has been contaminated by stool bacteria

(Coliform). There are about 26 positive water samples containing Coliform bacteria with Coliform values ranging from 2.0 / 100ml to 4, 0 / 100ml water samples. The results

of identification of coliform type found *E.coli* (Table 1). The result of Coliform positive in the table shows the presence of Coliform contamination (60%) in the water sample under study and does not meet the requirements according to Permenkes RI. 492 / Menkes / Per / IV / 2010, which states that piped water for household consumption is zero (MPN Coliform = 0) (MOH,

2010). These results illustrate that approximately 73.3% of the piped water used by elementary students living in the vicinity of the Kuin river has been contaminated by the faecal coliform whether it is the contamination of the river water directly or as a result of leakage in the piped water system used by the living community on the riverbanks.

Table 5.1. The value of Coliform samples of piped water used by student families elementary school students on the riverbanks of Kuin Banjarmasin (N = 30), p.05

Number of samples	Amount of MPN Coliform	Type of Bacteria
1	0	-
2	2.0/100ml	<i>E.coli</i>
3	4.0/100ml	<i>E.coli</i>
4	4.0/100ml	<i>E.coli</i>
5	2.0/100ml	<i>E.coli</i>
6-8	0	-
9	2.0/100ml	<i>E.coli</i>
10	4.0/100ml	<i>E.coli</i>
11	2.0/100ml	<i>E.coli</i>
12	0	-
13	2.0/100ml	<i>E.coli</i>
14	4.0/100ml	<i>E.coli</i>
15	2.0/100ml	<i>E.coli</i>
16-17	0	-
18	2.0/100ml	<i>E.coli</i>
19	0	-
20	2.0/100ml	<i>E.coli</i>
21	4.0/100ml	<i>E.coli</i>
22	0	-
23	2.0/100ml	<i>E.coli</i>
24	0	-
25	4.0/100ml	<i>E.coli</i>
26	4.0/100ml	<i>E.coli</i>
27	4.0/100ml	<i>E.coli</i>
28-29	0	-
30	2.0/100ml	<i>E.coli</i>

WHO : low risk = 1-10 cfu/ml

The result of Coliform positive in the table shows the

presence of Coliform contamination (60%) on the water sample under

study and does not meet the requirements according to Permenkes RI No. 492 / Menkes / Per / IV / 2010, which states that piped water for household consumption is zero (MPN Coliform = 0) (MOH, 2010). These results illustrate that approximately 60% of the piped water used by elementary students living in the riverbanks of Kuin Banjarmasin has been contaminated by the faeces coliform whether it is the contamination of the river water directly or as a result of leaks in the piped water system used by communities living on the riverbanks.

The results of this study can illustrate that there are about 60% of piped water in the population living on the riverbanks of Kuin Banjarmasin can be contaminated by fecal bacteria and have the risk of passing the disease through water. To prevent the risk of diarrheal infections, water can be used for consumption when it has been processed by sterilization, ie by boiling water to kill the contaminant bacteria that cause gastrointestinal infections such as diarrhea or typhoid. The use of contaminated piped water can reduce the public health status of users with the incidence of water borne diseases one of which is diarrheal disease. The use of river water is intended not only for direct use or consumption of water but also on other domestic activities such as washing clothes and tableware. The existence of cases of public health problems living on the banks of the river such as the extraordinary incidence of diarrhea that many occur in the rainy season is an indication that many rivers have been heavily polluted. (Atmosukarto, Kusnindar, 1996) ..

Negative effects that often arise due to the use of water that has been contaminated is the incidence of disease / diarrhea infection. Transmission of diarrhea due to bacterial infection through drinking water (water borne diseases) can be derived from fecal discharges of animals and humans in water bodies. The spread of cases of diarrhea, an inanimate transmission vehicle (vehicle), can also be mediated by unsanitary hands and through food equipment.

d. Relation of the presence of hand bacteria with fecal bacteria on elementary school students of the riverbanks of Kuin Banjarmasin

Based on the assessment of MPN Coliform from the samples of piped water used by elementary school students who live around the riverbanks of Kuin Banjarmasin and the results of identification type of hand swab bacteria after washing hands with liquid soap and piped water, conducted data analyst using Chi-Square test at 95% confidence level obtained result (a) no relation between positive coliform on piped water sample with type of bakteti on hand (b) there is relationship between type of bacteria in stool sample / feces in the presence of species of coliform bacteria (*E.coli*) on water sample piping.

The part of the hand is one part of the body that most often make direct contact with other objects, then before eating it is advisable to wash hands with soap and running water. A Cochrane study results found that in social movements by agencies and communities to get used to wash hands causes a significant decrease in the incidence rate of diarrhea. The

need to note the use of clean and healthy running water when washing hands. The bacteriologically healthy water requirement is the value of MPN coliform zero / ml or the risk of small penularaanya MPN coliform = 1-10 cfu / ml.

The results of this study indicate that there are about 60% of piped water in people living on the banks of the river Kuin Banjarmasin have the risk of transmitting diarrhea diseases through water and piped water used to wash hands contaminated *Eschericia coli*. This means there is a relationship between the quality of bacteriology of piped water with hand swab bacteria cause diarrhea in the students of SDN Sungai Kuin Banjarmasin (chi-square $\alpha.05$).

The results of this study can illustrate the presence of *E.coli* bacteria in some hands and stool students of Sungai Kuin Banjarmasin Elementary School located in the vicinity of the banks of the river Kuin Banjarmasin. *E.coli* in a person can act as a "carrier" and transmit diarrheal infections in others. Diarrheal infections can only spread if the microorganisms that enter the body of water used by the community to meet daily needs. In addition to the hydrosphere, the spread of diarrheal diseases is also influenced by societal or sociosphere behavior. The spread of this disease, such as infectious diseases of the gastrointestinal tract can also be caused by unusual hand washing after a bowel movement, and community communities do not attach importance to the provision of this washing facility. Transmission through water, soil, food, and vector media is also determined by the treatment and ethics of the

community towards the surrounding environment (Sterrit 1988)

According to Atmosukarto (1996), unsanitary disposal is a source of transmission of waterborne and foodborne diarrheal diseases. Habitual bowel movements at the soil surface and times by people in Indonesia are still high, allowing high diarrhea morbidity and the biggest cause of death in Indonesia. Sanitary latrines are a means of functioning to break the chain of transmission of diarrheal diseases, absolutely necessary to be improved in order to combat diarrhea.

For the sake of prevention, some efforts may be made, among others (Wahyudi, 2009) (a) Use of clean and safe drinking water, for example by always cooking water for daily consumption purposes. In addition, efforts can be made to obtain clean and safe drinking water by processing techniques using chlorine, ozone, or ultraviolet radiation; (b) Safe disposal of stools, by behaving only defecating in healthy latrines. The output obtained from the results of this study is (a) Two identifiable bacterial isolates were identified: *S.aureus* and *E.coli*. Isolate *S.aureus* (67.7%) was more commonly obtained as a hand contaminant bacteria, (b) There were two types of bacterial isolates from the normal stool samples identified ie *E.coli* and *S.typhi*. *E.coli* isolates are more commonly found as fecal bacteria, (c) Obtained coliform value of about 60% in water samples piping, and the type of bacteria identified is *E.coli*, and (d) There is a positive relationship between the presence of stool bacteria with the use of piped water by students who live on the banks of the river Kuin Banjarmasin.

CONCLUSION

From the research results can be made the following conclusions:

- a. Types of bacteria in the hands of elementary students on the riverbanks of Kuin Banjarmasin are *S.aureus* (67.7%) and *E.coli* (33.3%); while the bacteria from stool samples are *E.coli* (90%) and *S.typhi* (10%).
- b. The value of MPN Coliform of piped water used by SD Kuin students living on the riverbanks

of Kuin Banjarmasin ranged between 2.0-4.0.

- c. There is a relationship between the presence of bacteria in the hands and stools of elementary school students with the bacteria in the water piping on the riverbanks of Kuin Banjarmasin

Thank-you note.

Our thanks go to FK Unlam for noncompetitive research grant aid in fiscal year 2017.

REFERENCES

- Adisasmito Wiku. Faktor Risiko diare pada bayi dan balita di Indonesia: Systematic review penelitian akademik di bidang kesehatan masyarakat. *Jurnal Makara Kesehatan Universitas Indonesia*: 11(1)2007:1-10.
- Anonim, 2007. *Banjarmasin Terkotor, 420 Meter³ Sampah Telah Terangkat. KCM. Forum Walhi.* <http://www.kompas.com.diakses> 27 September 2007
- Anonim, 2010. *Kota Seribu Sungai Seribu Masalah. Forum Walhi.* <http://info@walhi.or.id.diakses> tanggal 04 oktober 2004.
- Anonim, 2014. Laporan Surveilans Terpadu Penyakit Berbasis Puskesmas tahun 2014. Puskesmas Alalak Utara; Dinas Kesehatan Kota Banjarmasin.
- Budiarti, L.Y., 2010. Daya Hambat Ekstrak Air Lidah Buaya (*Aloe Vera Linn.*) Terhadap Isolat *Staphylococcus Epidermidis* dan *Pseudomonas Aeruginosa* Asal Swab Luka *In Vitro*. Laporan Hibah Penelitian Fakultas Kedokteran Unlam Tahun 2010 (Tersimpan di perpustakaan FK Unlam).
- Budiarti, L.Y., 2011. *Penuntun Praktikum Mikrobiologi Kesehatan.* Laboratorium Mikrobiologi Fakultas Kedokteran UNLAM
- Budiarti, L. Y., 2014. *Model Pembelajaran Strategi Cerdas Agen Sungai Untuk Pencegahan Diare di Daerah Sungai Pekapuran Banjarmasin.* Laporan Hibah Penelitian Fakultas Kedokteran Unlam Tahun 2014 (Tersimpan di perpustakaan FK Unlam).
- Budiarti, L.Y., 2015. Pola Karier Infeksi Diare Pada Siswa Sekolah Dasar di Bantaran Sungai Kuin Banjarmasin Serta Kepekaannya Terhadap Antibiotik. Laporan Hibah Penelitian Fakultas

- Kedokteran Unlam Tahun 2015 (Tersimpan di perpustakaan FK Unlam).
- Dinas Kesehatan, 2008. *Laporan Tahunan Dinas Kesehatan Provinsi Kalimantan Selatan tahun 2008*. Banjarmasin : Dinas Kesehatan Kalimantan Selatan
- Departemen Kesehatan RI. 2010. Peraturan Menteri Kesehatan RI Nomor 492/MENKES/PER/IV/2010. Persyaratan Kualitas Air Minum. Depkes. Jakarta
- Fatmawati, Atik, 2008. *Hubungan Antara Sanitasi Rumah Dengan Kejadian Diare Di Desa Singosari Kecamatan Mojosongo Kabupaten Boyolali Tahun 2008*. Surakarta : Program Studi Kesehatan Masyarakat Fakultas Ilmu Kesehatan Universitas Muhammadiyah Surakarta.
- Harianto, 2004. *Penyuluhan penggunaan oralit untuk menanggulangi diare Di masyarakat*. Departemen Farmasi, Fakultas MIPA Universitas Indonesia Majalah Ilmu Kefarmasian, vol. I, no.127 – 33, Jakarta april 2004.
- Hannif, Nenny SM, Susy K. Faktor risiko diare akut pada balita. Berita Kedokteran Masyarakat 2011; 27(1): 10-17.
- Anonim, 2008. Ikatan Dokter Anak Indonesia. *Buku Ajar Infeksi dan Pediatri Tropis (2nd ed)*, Badan Penerbit IDAI, Jakarta.
- Jawetz, Melnick, Adelberg's. 2014. *Medical Microbiology*. 26 ed. MC Graw Hill Lange. New York .
- Joklik, W. K, Wilett, H. P, Amos, D. B. and Wilfert, C. M. *Zinsser Microbiology Edisi 20*. Appleton and Lange. California, 1992.
- Lukmanul HD. Aksesibilitas air bersih bagi masyarakat di permukiman Linduk Kecamatan Pontang Kabupaten Serang [tesis]. Semarang: Universitas Diponegoro; 2010.
- Misnadiarly, Djajaningrat H. Mikrobiologi untuk klinik dan laboratorium. Jakarta: Rineka Cipta; 2014.
- RISKESDAS. 2007. *Laporan Hasil Riset Kesehatan Dasar Provinsi Kalimantan Selatan*. Depkes. Jakarta
- RISKESDAS. 2008. *Laporan Hasil Riset Kesehatan Dasar Provinsi Kalimantan Selatan*. Depkes. Jakarta
- Sujaya N, Aryantini NPD, Nursini NW, dkk. 2010. Identifikasi penyebab diare di Kabupaten Karangasem Bali. *Jurnal Kesehatan Masyarakat*: 4(4)2010: 186-192.
- Pajeriaty IH, Darmawan S. Analisis faktor-faktor yang berhubungan dengan kejadian diare pada balita di Desa

Mattiro Polangeng Wilayah
Puskesmas Liukang
Tupabbiring Kabupaten
Pangkep. ISSN 2013; 2(2): 1-
10.

Palupi A. Status gizi dan
hubungannya dengan
kejadian diare pada anak
diare akut di ruang rawat inap
RSUP Dr. Sardjito
Yogyakarta [Tesis].
Yogyakarta: Fakultas
Kesehatan Masyarakat
Universitas Gadjah Mada;
2007

Wahyudi, Sedyo; 2009;Diare dan
Upaya Pencegahannya;
Majalah Kasi. Edisi Pertama;
Jakarta.

WHO. 2004. *Guidelines for
Drinking Water Quality (3th
edn)*. WHO. Geneva

WHO. 2011. *Guidelines for
Drinking Water Quality (4th
edn)*. WHO. Geneva

Widoyono. Penyakit Tropis:
Epidemiologi, Penularan,
Pencegahan, dan
Pemberantasannya.
Semarang: Erlangga; 2008.