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WATER SUPPLY AND DIARRHEAL DISEASE IN RURAL AREAS OF INDONESIA

Sumengen Sutomo *

ABSTRAK

Hubungan antara air bersih dan penyakit diare telah dipelajari melalui penelitian di daerah pedesaan di 9 propinsi Indonesia. Sampel 8597 rumah tangga dipilih secara bertahap melalui systematic sampling. Kemudian diadakan wawancara dengan ibu rumah tangga serta observasi untuk menentukan kejadian diare dan sarana air bersih.

Hasil penelitian menunjukkan bahwa penduduk yang menggunakan air bersih memiliki kecenderungan lebih kecil menderita penyakit diare. Sebaliknya penduduk yang tidak menggunakan air bersih memiliki kecenderungan menderita penyakit diare.

INTRODUCTION

Project for water supply in rural areas of Indonesia has many different purposes. One of these is to provide a safe water supply for the rural population. In addition, the project is to reduce morbidity and mortality of diarrheal disease[1].

Safe water supply is defined as treated water or untreated but uncontaminated water such as a piping system and protected springs. Less safe water supply includes springs, deep well pumps, shallow well pumps, dug wells and rain water. Unsafe water supply is other sources of water doubtful quality such as rivers, streams, ponds, and other insanitary facilities[2].

Diarrhea is a condition characterized by an abnormal frequency and liquidity of fecal discharge that weakens the body and leaves it without the fluid and salt needed to survive. It is considered diarrhea when there are more than 3 passages a day of watery, semisolid, liquid or frothy excreta with or without blood or mucus[3,4].

According to the 1980 census, the population of Indonesia was 147, 490, 298. Approximately 77.6 percent of the population lived in rural areas[5]. A study carried out by the National Institute of Health Research and Development, Jakarta reported that 12.2 percent of the rural population had access to safe water supply and the others did not have water supply, and the others had not access to such facilities. They used unprotected sources such as rain waters, rivers, dug wells, and ponds[6]. On the other hand, diarrheal disease is the principal cause of deaths among infants. The total cases was about 60 million with an estimated 40 million cases occuring in children under five years of age with 350,000 to 500.000 deaths[7,8].

Many studies have been reported to demonstrate the relationship between water supply and diarrheal disease. Most of the studies demonstrated the effect of water supply on diarrhea, however doubts are still voiced concerning this effect due to lack of appropriate methodology[9]. Further information on this

* National Institute of Health Research and Development, Jakarta.

issue is still needed by the decision makers and planners in the area of water supply and diarrheal disease control.

This study provides an additional information on the relation between water supply and diarrheal disease. The purpose of the study is to examine the hypothesis, "Populations which have access to safe water supply are more likely to have lower diarrheal disease than those who do not have access to such facilities".

MATERIALS AND METHODS

The study population was people who live in the rural areas of Indonesia. Since most of the population lives in Jawa, all provinces in Jawa were selected. Provinces outside Jawa and Bali were selected using several criteria including the size of population and population density. Limitations of budget, manpower, time, and transportation were considered in selecting the provinces. These provinces were West Jawa, Central Jawa including Yogyakarta, East Jawa, Bali, North Sumatra, West Sumatra, Lampung, West Kalimantan, and South Sulawesi.

The sampling unit was household, and the respondent was housewife. Households were selected through a stratified sampling method proportional to size. At the final step, sample was selected using a systematic sampling method with 5 intervals.

Data on water supply were collected from each household through interviews and observations. The housewives were interviewed to provide data on diarrheal disease using seven days recall period[10]. Questionnaires were used as data collection instruments which consisted of open and close ended questions. The close ended questions consisted of ordinal and nominal classifications, and the open ended questions were developed into ordinal and nominal scales[11, 12]. Cases of diarrheal disease were recorded and identified according to their sexes, ages, and symptoms. These data were used to determine whether each household was classified with or without cases.

Since diarrhea was a dichotomous classification and water supply was nominal scales, the appropriate analysis for examining the relation is using the chi-square test, Bartholomew's test, and calculation of odds ratio[13, 14].

RESULTS

A total of 8597 households was successfully interviewed. Of these households, 369 with cases and 8228 without cases of diarrhea. The classification of households by source of water with respect to diarrheal disease is shown in Table 1. A source of water was classified into spring, well, rain, river, pond, and other facilities. There is a statistically significant association between the source of water and diarrheal disease ($p < 0.05$). The source of water varied from 5.0 to 8.4 percent. The lowest was 8.0 percent for those who had access to protected springs and the highest was 8.4 percent for those who had access to deep well pumps.

Table 1. Households by source of water with respect to diarrheal disease.

Source of water	Household (%)		Total
	Diarrhea	No	
Spring with piping	25 (4.6)	523 (95.4)	548
Protected spring	15 (3.0)	477 (97.0)	492
Spring	45 (4.1)	1043 (95.9)	1088
Deep well pump	9 (8.4)	98 (91.6)	107
Shallow well pump	11 (6.5)	158 (93.5)	169
Dug well	158 (3.9)	3911 (96.1)	4069
Rain water	29 (3.6)	774 (96.4)	803
River, stream	58 (6.4)	850 (93.6)	908
Pond	11 (6.5)	158 (93.5)	169
Other	8 (5.4)	139 (94.6)	147
Total	369 (4.3)	8131 (95.7)	8500

Further classification of households according as to whether they had access to safe, less safe, and unsafe water supply with respect to diarrheal disease is shown in Table 2. There is a statistically significant association between accessibility to source of water and diarrheal disease ($p < 0.05$).

Table 2. Households by categorized source of water and diarrheal disease.

Source of water	Household (%)		Total
	Diarrhea	No	
Safe	40 (3.8)	1000 (96.2)	1040
Less safe	252 (4.0)	5984 (96.0)	6236
Unsafe	77 (6.3)	1147 (93.7)	1224
Total	369 (4.3)	8131 (93.7)	8500

The occurrence of diarrheal disease was 3.8 percent for those who had access to safe water, 4.0 percent for those who had access to less safe water, and 6.3 percent for those who had access to unsafe water. The test of trend indicates that the proportion of diarrheal disease is significantly and correctly arrayed in order. The odds ratio showed that the households which did not have access to safe water had 1.7 times the risk of having diarrheal disease, and those which had access to less safe water had 1.1 times the risk of having diarrheal disease than those which had access to safe water. These data show a trend in the households such which had access to a safe water are more likely to have less diarrheal disease than those which did not have access to such facilities.

DISCUSSION

The occurrence of diarrheal disease in the households varied according to the source of water. The households which had access to safe water had less diarrheal disease than those which had access to less safe water. Those which had access to less safe water had less diarrheal disease than those which had access to unsafe water. In addition, the risk of having diarrheal disease increased for those who had access to less and unsafe water.

One of the reasons that may underline the difference in the occurrence of diarrheal discase was that a safe water was more protected from any possible contamination. In contrast, many safe facilities were easily exposed to contamination. There were many sources of contamination, and the most important source that related to the occurrence of diarrheal disease was from human and animal feces[15]. Human feces are potentially dangerous for the population. A large number of diseases are spread directly through man's contact with human excreta, indirectly via water, food and soil, or via carriers and vectors such as flies, cocroaches and mosquitos[15, 16]. Simple disposal systems like defecation in the gardens, shores, bushes, fields or in open pits is very dangerous especially for densely populated areas. Water contaminated with human feces is a principal means for the transmission of organism causing diarrhea. All the major infectious agents of diarrheal diseases are transmitted via contaminated water.[17]

This finding supports previous studies concerning the relationship between water supply and diarrheal disease. Many studies indicated that the provision of safe water supply would reduce the prevalence or incidence of diarrheal disease such as cholera, dysentery, typhoid, paratyphoid and other intestinal infections. Azurin and Alvero in 1974 reported that the provision of sanitary facilities for human excreta disposal can reduce the cholera by as much as 68 percent, while the provision of a safe water supply can decrease it by 73 percent[18]. Schneider ,et al, reported an evidence that water supplies have reduced on diarrheal disease except for few and very specific situations. There are still many other investigations reported a similar findings[19].

Moreover, all major infectious agents of diarrheal disease are transmitted via contaminated water. For most agent of water borne transmission has been documented. For some evidents that, at least sometimes, water is a major vechicle

of transmission. For example, Salmonella typhi, Vibrio cholerae, and Giardia lamblia [20, 21]. This reason may lead to the households which had access to safe water had less risks of having diarrheal disease than those which did not have access to such facilities. Since the data indicate a trend of diarrheal disease according to the type of water supply, the finding supports the hypothesis that the populations which have access to safe water supply are more likely to have lower diarrheal disease than those which do not have access to such facilities. However, it does not mean that when populations have access to safe water supply there will be no diarrheal disease, because water supply is only one of the determinants of diarrheal disease. Furthermore, it is recommended that the provision of safe water supply for rural population should be increased in order to control diarrheal diseases in the country, particularly in the endemic areas.

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OVALOCYTOSIS AND MALARIA IN NAPU VALLEY, CENTRAL SULAWESI, INDONESIA

Purnomo[1], M. Sudomo[2], Edward M. Lane[1], Eileen D. Franke[1]

ABSTRAK

Pada Penelitian di 3 desa, Tamadue, Maholo dan Winowanga di Lembah Napu, Sulawesi Tengah, didapatkan prevalensi ovalositosis pada penduduk masing-masing sebesar 26%, 25% dan 14%. Dari jumlah penduduk 371 yang diperiksa darahnya dari ketiga desa tersebut 22% menderita ovalositosis dengan 7% di antaranya menderita malaria. Sedangkan dari sisanya 78% penduduk yang mempunyai sel darah merah normal, 20% di antaranya menderita malaria. Perbedaan ini ternyata bermakna, sehingga ada korelasi antara ovalositosis dengan infeksi malaria. Ada kecenderungan golongan anak umur 2-9 tahun yang mempunyai ovalositosis dalam darahnya akan lebih resisten terhadap infeksi malaria dibanding golongan umur yang lain. Selain *P. falciparum*, juga *P. vivax* dan *P. malariae* lebih banyak dijumpai pada penderita yang mempunyai sel darah merah normal daripada penderita yang mempunyai sel darah oval.

INTRODUCTION

Ovalocytosis has a wide distribution in the Indonesian archipelago (Sofro, 1986)[1]. The frequency of ovalocytosis ranged from 0.25% in the Javanese to 23.7% in the Rotinese examined in his study. Bonne and Sandground (1939)[2] reported that half of the population in several villages near Lake Lindu in Central Sulawesi had ovalocytosis. Based on data collected from the Temuan of Malaysia, Baer et al. (1976)[3] hypothesized that individuals with ovalocytosis are resistant to infection with malaria. Serjeantson et al. (1977)[4] showed that in Papua New Guinea ovalocytosis is associated with resistance to severe malaria infections. Furthermore, individuals with ovalocytosis were more resistant to *Plasmodium vivax* and *P. malariae* infections, but not to *P. falciparum*. *In vitro* studies show that ovalocytes are resistant to invasion by *P. falciparum* (Kidson et al., 1981; Hadley et al., 1983)[5,6] and *P. knowlesi* (Hadley et al., 1983)[6]. We examined the frequency of ovalocytosis in three villages located approximately 50 km southeast of Lake Lindu in Napu Valley, Central Sulawesi and the relationship of ovalocytosis to malaria prevalence in this population.

MATERIALS AND METHODS

The study villages, Maholo, Winowanga and Tamadue, are located in Central Sulawesi, Indonesia at 1° 27' south and 120°26' east, at an altitude of 1100 meters above sea level. A more detailed description of the area was reported by Carney et al. (1974)[7]. Thick and thin blood smears from 117 residents of Winowanga, 154 residents of Maholo and 100 residents of Tamadue were prepared in March 1987 at the start of the dry season. Slides were stained with Giemsa and examined for malaria parasites and ovalocytic red blood cells.

1. U.S. Naval Medical Research Unit No. 2, Jakarta, Indonesia.

2 LITBANGKES, Jakarta, Indonesia.